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Dr. R. Hartmeyer

CATALOGUE
OF THE
BRITISH ECHINODERMS

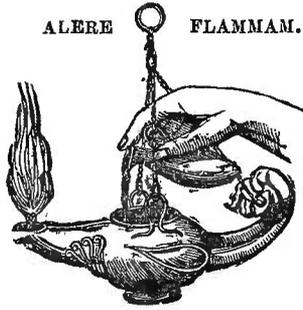
IN THE
BRITISH MUSEUM
(NATURAL HISTORY).

BY
2 F. JEFFREY BELL, M.A.

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ALERE FLAMMAM.



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P R E F A C E.



THE efforts which have been made of recent years to investigate the Fauna of the seas surrounding the British Islands have supplied large and important contributions to the Collection of Echinoderms in the British Museum, which previously was singularly poor in specimens of this part of the indigenous Fauna. Much time and labour has been given to the study and arrangement of these additions; and it seemed to be expedient to prepare, together with the nominal list of the specimens, a complete account of all the species hitherto found in British seas—descriptive so far as to define the limits of a species as understood by the author, and to supply at the same time the means by which the collector could identify his specimens. As no such guide exists, it is expected that much encouragement will be given to the study of Echinoderms by the present volume, and especially that the deficiencies which still exist in the series of specimens in the National Collection will be supplied by those who may use, and profit by, this work.

ALBERT GÜNTHER,

Keeper of the Department of Zoology.

British Museum (N. H.),
16th November, 1892.

INTRODUCTION.

ONE of the objects of the present Catalogue is to supply the students of the British marine fauna with a handbook by means of which, it is hoped, they may be able to recognize such members of the very well-defined group of Echinoderma as they may collect in their expeditions to the sea-shore or in more extended dredging excursions. The study of Starfishes and Sea-Urchins, which may be taken as the English for Echinoderma, has long been a favourite pursuit with British naturalists, owing largely to the peculiar charm of one of the most popular of Mr. Van Voorst's well-known series, Professor Edward Forbes's 'British Starfishes.' So far as that volume is the work of an enthusiastic and experienced field-naturalist, it does and will always hold the chief place in the regard of every lover of Natural History, and what follows here must not be thought of as attempting to oust Forbes's book from its position. Unfortunately, however, the progress of zoological science is still marked by considerable changes in nomenclature, and from this point of view Forbes's work has long been out of date. On the other hand progress is, fortunately, marked by the discovery of new or exotic species in our seas, and by the union of forms which have been incorrectly regarded as specifically distinct. While Forbes enumerated (omitting the Gephyrea, which are not now regarded as Echinoderms) fifty-five species, there are contained in the present Catalogue one hundred and thirty-two; but of the fifty-five, eight are here regarded as synonyms, one (*Arachnoides placenta*) is expelled from the list, and *Psolinus brevis* remains as great a mystery to me as to many others. The great increase in the number of species is due, chiefly, to the dredgings at depths which Forbes believed to be azoic. The inclusion of species known from the Færoe Channel, which

may serve as the northernmost boundary of our area, is responsible for a considerable proportion of the increase ; but, so long as the species belong to groups which are not essentially abyssal forms, it is better to include than exclude them from a work which differs widely from that of Forbes in that it is published at a time when dredging at considerable depths is becoming a pastime as well as a serious business.

In the preparation of the diagnoses I hope I shall not be thought to have erred on the side of brevity ; if I have been brief, I have done my best to avoid being obscure. Where a writer fills page after page with description he will indubitably fail if his object be to make himself intelligible to others. My first object has been to make every point clear, and I have not stinted myself in the use of keys, artificial or otherwise, which would show what I meant. If in the portion of this work which deals with the Asteroidea I have in any way failed to give an accurate account of Mr. Sladen's opinions or diagnoses, I must ask to be accounted innocent. I have devoted many hours to his Report on the Starfishes of the 'Challenger,' but in consequence of the minuteness of his descriptions of species, the frequent absence of any indication of the diagnostic characters of his genera, and the repeated expression of views for which he does not give (I do not say does not possess) adequate reasons, they have not been as fruitful as I could have wished. That the number of species and genera which Mr. Sladen has created will be largely reduced I am convinced, and I feel confident that the majority of naturalists who devote themselves to the study of Starfishes will agree that the species vary greatly. I cannot say how deeply I regret the extreme divergence that exists between Mr. Sladen's views as well as methods and my own. But I cannot assent to or approve of a mode of study which practically results in the description of specimens instead of the diagnosis of species, and I note with satisfaction that the accomplished student of Echinoderms at the Jardin des Plantes ranges himself on the same side as myself.

To me, indeed, and, I believe, to many others, one of the reasons why the study of Echinoderms is so fascinating is that they present so many and such striking variations ; these very variations are, of course, the cause of the difficulty of the study, in which there is a

constant need for caution and reflection. Before the beginner yields to the temptation of describing "new species," which is easy enough, let him first gain the knowledge and experience which will teach him how one form links on to another, and thus avoid the undue multiplication of synonyms.

Till quite recently our collection of Echinoderms was particularly poor in British specimens; that we have now a splendid series illustrative of the fauna of the West coast of Scotland is due to Dr. John Murray, as the repeated citation of his name will abundantly show, and he deserves our sincerest thanks; the Hon. Alfred E. Gathorne-Hardy has from time to time presented us with valuable and well-preserved specimens from Loch Craignish; while from the East of Scotland I have been much aided in forming a collection by Dr. Sutherland of Invergordon, Mr. W. Duncan of Montrose, and Mr. George Sim of Aberdeen. For specimens from the East coast of Ireland we have been aided by the gifts of the Belfast Natural History Society; I owe to the friendly kindness and scientific enthusiasm of Professor A. C. Haddon numerous opportunities of inspecting, and oftentimes keeping for our Collection, the results of dredgings in the Irish Seas, made under the auspices of the Royal Irish Academy or the Royal Dublin Society. The deep-sea expedition of 1889, which Dr. Günther induced the Rev. W. S. Green to undertake in the 'Flying Fox,' resulted in a very valuable and instructive series of Echinoderms. My thanks are also due to Lord Walsingham, F.R.S., Prof. Herdman, F.R.S., Prof. McIntosh, F.R.S., Mr. Howse of Newcastle, to Mr. G. C. Bourne, formerly of the Marine Biological Laboratory at Plymouth, and Dr. Grenfell, for assistance offered and given. Mr. R. L. Spencer has repeatedly sent me objects of interest from the Channel Islands. I have kept to the last, because I desire it to be mentioned by itself, the name of the Rev. Canon Norman, F.R.S., whose interest in the marine British fauna is such that, in the midst of arduous and responsible duties, he has always found time to answer the numerous questions I have asked him, or to lend or give me specimens which would help me in my work.

As many of our species are more familiar to Scandinavian naturalists than ourselves, I have had to ask for, and have received,

assistance from Dr. Danielssen of Bergen, Dr. Sturm of Trondhjemfjord, and Prof. Quennerstedt of Lund. In these inquiries, as in so many of which Echinoderms have been the subject, I owe a special debt of gratitude to my venerable friend Prof. Lovén for advice, assistance, and the gift or loan of numerous specimens.

The names of donors of specimens are in all cases given ; when the column is left blank it is to be understood that the specimens were acquired by purchase.

F. JEFFREY BELL.

British Museum (N. H.),
8th November, 1892.

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CATALOGUE
OF
BRITISH ECHINODERMA.

INTRODUCTORY REMARKS.

The Position of Echinoderms in the Animal Kingdom.—The ECHINODERMA belong to that division of the Animal Kingdom in which the organism consists of more than one cell, and is always, at some period or other of its life-cycle, derived from a single egg-cell which has been fertilized by a sperm-cell. In other words, it is one of the Metazoa. In the course of development from the egg there appears, in addition to the gastric cavity, another space which is known as the body-cavity or cœlom.

Among the Metazoa Cœlomata the Echinoderma occupy a very isolated position, for we know of no link which unites them to any other “phylum” or great division of this series.

The Symmetry of Echinoderms.—It would appear that, at a very early stage in the evolution of the Echinoderma, the adult tended to acquire a marked radial symmetry; but, at first, the number of rays was by no means constantly five; now the symmetry is so generally quinquerradial that wonder is nearly always expressed when the number five is diminished or increased.

The first point, then, which we have to notice is the possession of *rays*; the “rays” and the “body” generally may appear to be conterminous, as in the Holothurian or the Echinus, or the “body” may seem to gradually pass into the “rays,” as in the common Starfish, or may be quite distinct from it, as in the Brittle-star and Sand-star. Where a marked distinction can be made between the body and the rays, the former is often called the disk and the latter the arms.

The radial symmetry which is indicated externally by the rays is to be observed in some at any rate of the internal systems of organs. It is characteristic of Echinoderms to have a special system of tubes, not represented in other types of animal life, some of the

main trunks of which always lie along the line of the rays: these radially-disposed tubes are in connection with one another by means of a circular vessel which lies round the mouth, and is connected with the outer world by means of the tube which is known as the madreporic canal. These tubes contain a clear fluid, and form the "water-vascular system"; the main trunks are ordinarily, though not always, provided with double rows of "suckers" or "pedicels," which sometimes have circular terminal disks, and sometimes end in a point; so that their function is not always ambulatory, but may be, at least, respiratory. Very various names of varying degrees of cumbrousness or inappropriateness have been given to these projecting structures, and I think it is wisest to return to the old and simple expression "podia."

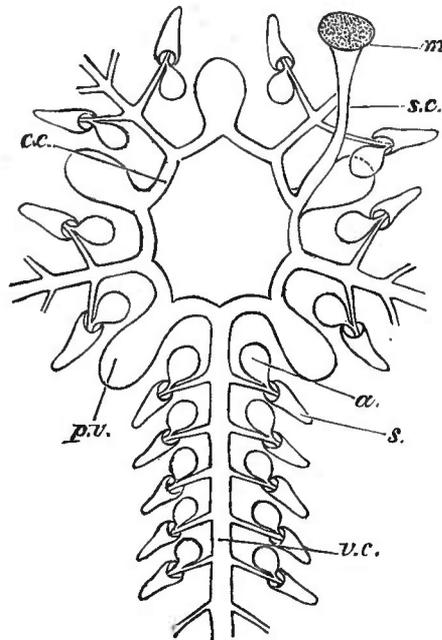


Diagram of Water-vessels.

c.c., circular canal, with *p.v.*, its Polian vesicles; from it a radial canal (*v.c.*) is given off along the lower surface of each arm; this supplies, by side branches, the suckers, *s.*; connected with each sucker is a contractile swelling or ampulla (*a.*). The circular canal is in connection with the exterior by *s.c.*, the madreporic or stone-canal, and opens to it by the madreporite (*m.*).

Similarly, the system of delicate vessels which convey a corpusculated and nutrient fluid (blood) through the body exhibits the influence of the radial symmetry, and the same is true of the nervous system; like the water-vascular system, the trunks of each of these systems in the several rays are combined into a single whole by means of, respectively, a circular vessel and a circular trunk disposed around the mouth.

In most groups of Echinoderms the radial disposition of parts is

exhibited by the generative organs as well as by the systems just mentioned; but in the Holothurians it is not so. In them the reproductive organ (gonad) is either single and on the left side of the oro-anal axis of the body, or double and right and left of it.

I have suggested that this distinction between the Holothurians and all other known Echinoderms should be marked by the use of distinctive terms. Such as have a radial disposition of the gonads may be called ACTINOGONIDIAL, such as have not, ANACTINOGONIDIAL.

Calyx.—This is not the only point in which the Holothurians differ from all other Echinoderms; the forms best known to us, such as the Starfish and the Sea-Urchin, are characterized by the possession of a continuous skeleton, whereas in most Holothurians the skeletal structures are nothing more than scattered spicules, and even where plates are formed the skeleton is not continuous over the whole of the body. Of the parts of which this skeleton is composed there is one set of plates to which great, but probably not undue, attention has been directed. In the middle of the surface of the body opposite to that in which the mouth is placed there is, typically, developed a central plate, around which appear two or more circlets of plates, set radially or interradially*. These combined form what is known as the calyx (cup) or calycinal area. It undergoes very considerable changes, modifications, or reductions, but it seems to have had a very profound influence on the organization of most Echinoderms. No trace of this area or system of plates is to be found in Holothurians, which, therefore, are NON-CALICULATE, as compared with all other Echinoderms, which are CALICULATE.

Divisions of Caliculata.—The caliculate, actinogonidial Echinoderma break up into two divisions: some are capable of continued movement and have organs which may rightly be called locomotor; others are permanently or temporarily fixed by means of a stalk which is developed on the aboral surface of the body. These fixed and free forms may be known respectively as STATOZOA and ELEUTHEROZOA.

The Statozoa were much more abundant in earlier stages of the world's history than they are now, when only one division, that of Crinoids, remains, and is, in our seas, represented by only one genus and but few species.

The great majority of the forms to be described in the succeeding pages are eleutherozoic—that is, are Sea-Urchins, Heart-Urchins, Starfishes, or Brittle-stars.

Habits and Mode of Life of Echinoderms.—Echinoderms are, almost without exception, confined to the sea, being rarely found in brackish water. They are known from all depths, are common

* The nomenclature of these plates has been, apparently, the sport of writers on Echinoderm Morphology; there is no need to burden the memory of the student with them, for the obviously best course is to speak of them quite objectively as first radial circlet, second radial circlet, first interradiial circlet, and so on.

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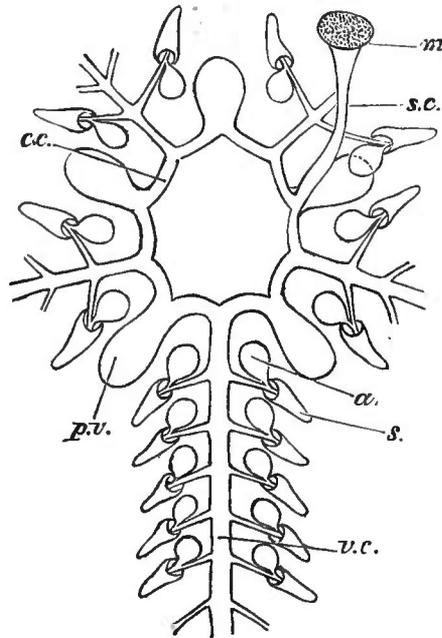


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enough in shallow pools, and may sometimes be seen living for a time completely out of the water, on ridges and ledges of rock. But water is their element, and they can neither breathe nor feed unless they are in it. They move slowly and often remain long in the same position; they are eminently gregarious, and it is quite a common occurrence for the dredger to come upon immense numbers of one species. This gregarious nature is of enormous assistance to the student who is interested in the variation of species, a study far more interesting and fertile than that of new forms, which was almost the sole object of the older school of naturalists. The most casual observer cannot fail to be struck by the wonderful differences in hue and tone exhibited by some, and particularly by the common Brittle-star, *Ophiothrix pentaphyllum*; a little closer examination will show that in the arrangement and numbers of rows of spines, in the pores that perforate some of the plates of the skeleton of an Urchin, and so on, there is a similarly wide range of variation. The difficulty of drawing up diagnoses of Echinoderms comes, therefore, to be considerable, and it must not be imagined by the collector that all those specimens which do not rigidly conform to the diagnoses that follow are examples of new species. The student can make no greater mistake than attempt to draw up long descriptions, which come, of course, to be descriptions of individuals, until he has first concisely and intelligibly presented a diagnosis or *précis* of the specific characters of the form before him*.

Some Echinoderms prefer rocky, others sandy shores; in muddy places they are often rare, if not absent. They are voracious, and though carnivorous, and even cannibal, they do not disdain vegetable food. The Holothurians and the Crinoids are unable to tear up their food: the former have no means of comminuting it, and can only obtain comparatively small objects by means of the tentacles by which the food is brought to the mouth; in Crinoids the food, which is much more delicate and minute, consists only of microscopic organisms which are swept down to the mouth along the grooves on the lower or oral side of the arms; the movement is due to the cilia which are found in abundance in these grooves.

Digestive Organs.—The Starfish and the Sea-Urchin are exceedingly voracious, and shell-fish and crustaceans of some size easily fall victims to their rapacity: the former is provided with a large stomachal sac capable of considerable protrusion and able to envelope a shell, and to draw it and its inmate within the area of the disk; or, dividing its arms into two sets, it will pull aside the valves of an oyster and drag from within the maker of the shell.

* Compare the words of Sir J. G. Dalyell ('Powers of the Creator,' i. p. 92):—"The aspect of individuals often alters very much, either superficially, or in the distribution of the colours. Some undergo a great external change with age. The whole tribe seems to abound in varieties, insomuch that it is difficult to reconcile the observations and descriptions of different naturalists. Perhaps the enumeration of species exceeds the truth of Nature."

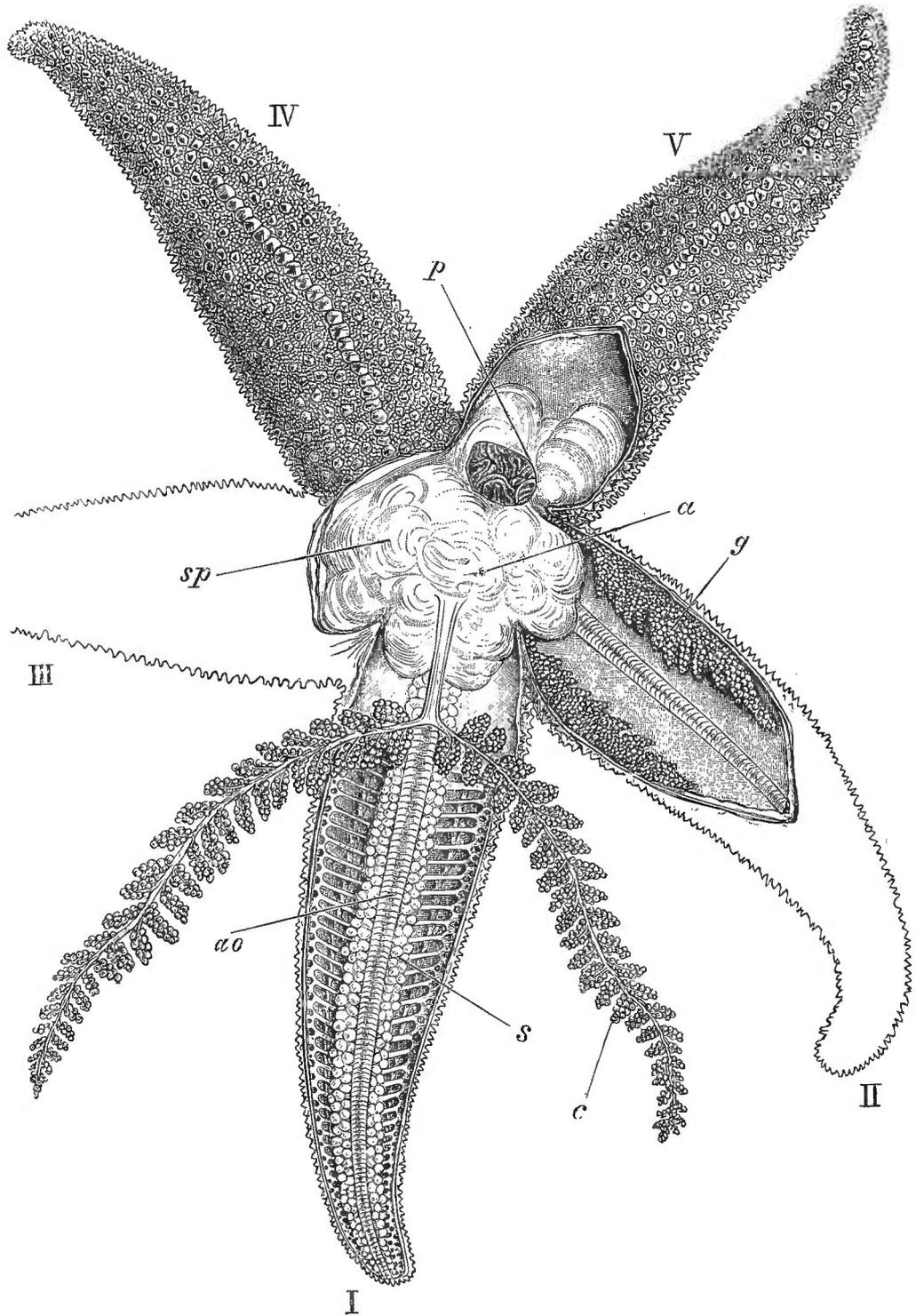


Figure to illustrate the structure of a Starfish (*Asterias rubens*).
 In the ray marked I. the skin has been removed from the upper surface, and the ambulacral ossicles (*ao*) and the suckers (*s*) are seen *in situ*; the blind outgrowths (*c*) from the central stomach (*sp*) have been dissected out. In II. the gonads (*g*) are exposed; and in V. the pouch-like diverticulum (*p*) of the stomach is to be seen (where it joins the central stomach its roof has been removed to show the folded arrangement of its walls). The anus (*a*) is seen to be subcentral in position.

A Sea-Urchin is provided with a most effective comminuting organ in the shape of the pyramidal "Lantern of Aristotle," in which work five strong teeth, ending in a wedge like the teeth of a rat or other rodent. This Lantern is connected with a cirlet of upstanding pieces placed just inside the margin of the mouth (actinostome of Agassiz), and consisting of the five "auricles" as they are called. The dental apparatus may undergo reduction and, finally, in the Heart-Urchins and *Spatangus* it disappears altogether, and the creature is absolutely edentulous; such Urchins have the margin of the mouth produced into a spout, by means of which they bore in the sand in which they live and from which they extract what nutriment they can.

The material which is undigested passes out by an anus in all but a few Starfishes and all Brittle-stars, which are aprocuous. The anus is either exactly opposite the mouth and quite distinct, as in Holothurians and the regular Sea-Urchins; or it shifts towards the margin and even on to the oral surface, as in the irregular Sea-Urchins; or it is on the back, but not quite central and generally small, as in the proctuchous Starfish; or it is on the oral surface, near the mouth, and produced into an anal cone, as in Crinoids.

Respiratory Organs.—The podia are both locomotor and respiratory in function; as they project from the surface of the body, have comparatively delicate walls, and are, from time to time, filled with fluid, they may be supposed to be always respiratory in a general way; but sometimes they are so flattened or pointed that they clearly can have no sucking action, and are purely respiratory. Special organs for respiratory purposes are not always developed, or, if so, are of a purely generalized character, as the soft membranous pouches or saccules which project from among the interstices of the calcareous skeleton of a Starfish. In an ordinary Sea-Urchin there may be seen on the membrane around the mouth (buccal membrane) five pairs of small folded processes, lodged in narrow slits of the margin of the test; these are known as gills and the slits as the gill-slits. In the Piper (*Cidaris*) these gills are wanting, but there are about the Lantern of Aristotle five large membranous sacs which are supposed to have a respiratory function; they are known as the Organs of Stewart, after the name of their discoverer. In the Ophiuroids there is, on each side of the base of every arm, a slit which leads into a pouch or sac; into and out of this sac water passes, and as its walls are thin an exchange of gas is effected between the fluid in the body-cavity and the water which is pumped in and out; these sacs are known as bursal sacs, or bursæ. In Holothurians water may be, as in some species of *Stichopus*, pumped into and out of the intestine, or from the terminal portion of the digestive tract a trunk on either side may give rise to a more or less elaborately branched "respiratory tree" or system of fine and delicate tubes by means of which water carrying fresh oxygen comes into all but contact with the fluid in the body-cavity; lastly, some Holothurians have no special respiratory organs, and have consequently been spoken of as Apneumona.

Locomotor Organs.—The locomotor effect of the podia is due largely to their possession of a circular adhesive disk and a contractile wall, by means of which the animal becomes provided with successive *points d'appui*; the spines may, as in *Echinus*, but still more in *Spatangus*, assist in locomotion. In Ophiuroids both podia and spines are greatly reduced and locomotion is effected by the movements of the arm-ossicles aided by powerful muscles. It has been stated that the common Starfish crawls at the rate of 2 or 3 inches a minute, the Butthorn (*Astropecten*) moves over a foot and more in the same time, while a Brittle-star may writhe and wriggle over 5 or 6 feet in a minute. The pedicellariæ—minute, stalked bodies with, generally, two or three jaws, which are found in abundance on the surface of most Starfishes and Sea-Urchins, though not of Brittle-stars, Holothurians, or Crinoids—may aid in climbing by holding on to the waving fronds of seaweed till the podia come into position.

Skeleton.—No part of the body is more interesting to the collector of specimens than the skeleton; and it is the possession of this skeleton that makes it possible to form a valuable collection of dried examples of Echinoderms with the exception, of course, of most Holothurians. In these last it is either spicular, or when, as in some species of *Psolus*, it forms a set of plates, these are not continuous over the whole of the body. In all the rest the skeleton consists of bars or plates which form a continuous series.

Taking, first, the common Starfish (*Asterias rubens*), we find that the groove along the ventral side of each ray is formed by a pair of rod-like plates so connected together as to form a cavity; in a dried specimen these grooves look something like the walks (ambulacra) of a garden, and the plates are consequently known as *ambulacral ossicles*; on the outer side of each ambulacral ossicle there is an *adambulacral ossicle*; in the region of the mouth the ambulacrals are very large or very small in relation to the adambulacrals, and for this reason it has been proposed to form two divisions of the group of Starfishes (Asteroidea), which have been called Ambulacralia and Adambulacralia respectively. Early in development five of the radially placed plates which appear on the back move towards the ends of the arms, where they form the prominent *terminals*: the extent to which the plates of the calycinal area are apparent after the earliest stages of development varies greatly; in the common Starfish no trace remains. The remaining plates are called the intermediate plates; of these those which border the arms are often very prominent; they form two definite marginal rows, and I have proposed that they should be called superomarginals and inferomarginals. All or any of these ossicles may bear spines.

In the Ophiuroidea the arrangements of the skeleton are somewhat more complicated: in any ordinary Brittle-star (*Ophiothrix*) the central piece of the arm (arm-bone, vertebra) consists of two pieces which become firmly united with one another, and have

their aboral and adoral faces moulded so as to fit into or to receive corresponding depressions or outgrowths on the aboral and adoral surfaces of the vertebræ behind and in front. By these depressions and projections the range of movement of the ossicles on their neighbours is restrained within certain limits. On the upper surface there is a single dorsal plate, on either side a spine-bearing adambulacral, and below a ventral plate; in this way the ambulacral groove is caused to disappear, as it does from all but the most primitive of Ophiuroids. The calycinal plates on the disk are sometimes very distinct, sometimes quite obscure: the most prominent structures are two shields at the bases of the arm, which, in the light of subsequent morphological terminology, are seen to bear unfortunate names; they are called the radial shields. There is often a strong plate at the side of the bursal cleft which is known as the genital plate. On the oral surface of the disk we have the mouth with its five slits; the margin of the mouth is formed by the swinging of the adoral ossicles to right or left and subsequent fusion with half of the neighbouring arm. The spines at the sides of the clefts are called the mouth-papillæ; those at the angle, on the plane of the surface of the mouth, tooth-papillæ, and the larger, stouter, and less numerous spines which form vertical rows within are called teeth. In each ray, distal to these papillæ, there is a small round *mouth-shield*. The podia make their way to the exterior between the arm-ossicles, and one or more small plates lying close to the opening are called tentacle-scales. The Brittlestar has no pedicellariæ.

Some of the Ophiuroids exhibit remarkable differences from *Ophiothrix*; the surfaces of the arm-ossicles form merely bosses and depressions, and the two opposed surfaces move easily on one another in various directions; or the surfaces are distinctly saddle-shaped. In the latter the arms may divide a few times, or many, so as to give rise to that tangled-looking mass which is popularly known as the Gorgon's Head or the Basket-fish (*Astrophyton*).

In the regular Echinoidea the skeleton is very definitely and simply arranged; of the plates of the calycinal area, one set of radial and one of interradial plates persists, but the centrodorsal is absorbed and the digestive tract ends in the space which it filled. In the general description of an Echinus, it is usual to speak of the radial plates as the "oculars," the interradial as the "genitals"; this, because the former has been supposed to bear an eye-like tentacle, and the latter have become connected with the fused and secondarily interradially placed gonads which open to the exterior by a duct which ends in these plates. Except in Cidarids and Echinothurids this area is, however, always small; the greater part of the test is formed by what is known as the corona. In all recent forms this always consists of twenty rows, arranged in ten pairs, five of which are radial and five interradial in position. The radial plates overlie the ambulacral or water-vascular tubes, and the podia here make their way to the exterior through paired pores which

appear at the outer edges of the ambulacral plates. The interambulacral plates, which generally form a wider area, are not perforated. The perforated plates (pore-plates of Agassiz) are primarily single, but, with the exception of the Cidaridæ, they fuse into somewhat larger plates; in a number, hence grouped together as the Triplechinidæ, there are always three pairs of pores on the edge of a well-developed secondary plate; but there may be more, as in *Strongylocentrotus*. Though subject to some variation, the number of pairs of pores in a plate is a character of importance in discriminating species.

In the Cidarids the membrane which bounds the mouth is heavily laden with both radial and interradial scales; in the Echinothurids only the perforate, radial scales are carried on to the buccal membrane, and in the rest of the Echinoidea regularia there are only five pairs of radial ossicles, whence they have been distinguished as *decalepid* from the others, which are *polylepid*.

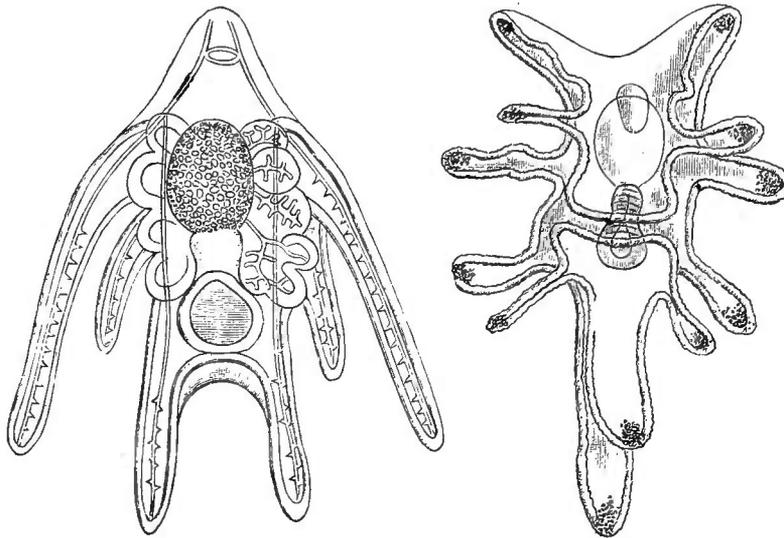
In the Crinoidea the calycinal plates are of functional importance, for they form a cup in which are contained the chief viscera of the body. In an early stage, if not throughout life, this cup is placed at the top of a stem, the basal joint of which is the central plate of the calycinal area; the centre of the cup of the free unstalked adult *Antedon* is formed by a modified plate which is called the centrodorsal; the interradial circlet forms a small "rosette-plate" which is hidden from view, and there are three circlets of radial plates. The centrodorsal carries a number of jointed *cirri* or calcareous grappling-lines by which the creature temporarily fixes itself; if these fall off, their presence is still indicated by the cirrus-sockets on the centrodorsal. After the third radial there is one, or there may be more divisions into arms, the number of which in some foreign species approaches one hundred. There is also another dichotomous division which is alternately incomplete on either side: in this way there is formed on each side a series of minute arms, which hang down by the arm proper; these jointed structures are known as pinnules; they bear the gonads. The arms are made up of joints connected with one another by ligament; sometimes the ligament almost altogether disappears, and two adjoining ossicles are only separated from one another by what looks like a fine dotted line; such apposition of ossicles is called a *syzygy*. The joint next below a division of the arms is known as an *axillary*.

Madreporite.—On the upper surface of a Starfish a grooved scar-like plate will easily be detected among the reticulation of the intermediate plates; if this be examined with a lens, it will be seen to be minutely perforated: if its relations are studied, it will be found to be connected with a tube ("stone-canal") which runs vertically downwards and becomes connected with the water-vascular circle. This plate is known as the *madreporite* (see fig. p. 2). In the regular Echinoidea it always occupies one of the interradials (genital plates), and an Echinoid should always be described with this plate lying forwards and to the north-east. In many irregular Echinoids

the madreporite becomes very extensive, and occupies the centre of what remains of the calycinal area. In Ophiuroids the stone-canal ends on one or several of the mouth-shields. In Crinoids the water-vascular system opens by one or a number of separate pores. In the Holothurians the stone-canal is connected with the wall of the body in the Elaspoda and a few others, to the mesentery in others, and in many hangs freely into the body-cavity; in a number of cases there is more than one canal.

Development.—Although it is possible to understand the diagnosis of an Echinoderm without knowing anything of its life-history, it is not possible to have an intelligent interest in them without desiring to know something of how it comes to be what it is.

Developed, like all other Metazoa, from an egg, there very rarely appears to be that mode of development without the interference of the male element, which is seen in various Arthropoda. The sexes are generally but not always separate. There is often some kind of sexual congress though no copulation. The fertilized ovum undergoes division, and gives rise to a larva which is ciliated all over; these cilia then become arranged in one curving band (as in *Auricularia*, the typical larva of Holothurioids), or in two, as in *Bipinnaria* (the typical larva of Asteroids), or in several circlets as in the larva of *Antedon*. All these larvæ are bilaterally symmetrical. They generally become very remarkable in shape owing to the development of lobes which may unite to form an organ larger than



Developing larvæ.

Pluteus.

Bipinnaria.

the young itself, or several lobes may form processes, or within the lobes rods may be developed and give rise to bodies compared, not inaptly, to a painter's easel (*Pluteus*). These larvæ may, as in the case of *Bipinnaria asterigera*, be more than an inch in size, and sometimes they swarm in the sea in great number.

The ciliated larva appears, in all Echinoderms, to be formed as a hollow sphere (blastosphere) bounded by a single layer of cells; it gives rise to a two-layered sac (Gastrula) by ingrowth at one point or invagination. As it elongates, one end becomes anterior and one posterior; one side ventral and one dorsal.

The central cavity formed by invagination, the archenteron, gives rise to two outgrowths which, as they will form the general coelom or body-cavity, may be called the right and left enterocœles; these increase in size, the left growing larger than the right; later on, part of the wall between them breaks down and a continuous body-cavity is formed, while another part of the wall of each sac unites to make a supporting mesentery. From the surface of the body an ingrowth leads to the formation of a tube which connects the coelom with the exterior; while this is forming, there appears, in various ways in various Echinoderms, a system of water-vessels developed from part of the enterocœle, and having the madreporic tube connected with it.

The history of development may be considerably complicated by the larvæ, which may be of various kinds or degrees of specialized modification.

GENERAL PART.

The chief Divisions of the Echinoderma.

ECHINODERMA.

- Centroniæ, *Pallas, Misc. Zool.* (1766) p. 153 f.n.
 Echinodermes, *Cuv. Tab. Elém.* (1798) p. 643.
 Radiaires echinodermes, *Lamk. Syst. An. s. Vert.* (1801) p. 343.
 Echinoderma, *Latreille, Fam. Anim.* (1825) p. 532; *Pfeffer, Verh. Ver. Hamb.* vi. (1887) p. 107.
 Echinodermata, *Fleming, Brit. An.* (1828) p. 472; *Forbes, Brit. Starf.* (1840) p. xi; *Gray, Syn. Brit. Mus.* (1840) p. 58; *id. Brit. Rad.* 1848, p. 1; *Haeckel, Gen. Morph.* ii. (1866) p. lxii; atque auct. complur.
 Cyclozoa echinoderma (pars), *Eichw. Zool. Spec.* i. (1829) p. 222.
 Echinodermaires, *de Bl. Dict. Sci. Nat.* lx. (1830) p. 169.
 Enteractinozoa, *Bronn, Kl. u. Ordn.* (1860) p. 421.
 Annuloida (pars), *Huxley, Class. Anim.* (1869) p. 127.

The Echinoderma are Metazoa Cœlomata, in which bilateral symmetry is early or altogether lost, but may be secondarily acquired; it is generally replaced by a quinquerradial disposition of nearly all the parts. The integument and some of the internal organs are strengthened by a crystalline deposit of carbonate of lime, mesodermal in origin, plexiform in structure; this may remain microscopic and spicular, or part may form macroscopic rods or plates and give rise to a continuous skeleton. A section of the cœlom becomes modified into a special system of sacs, canals, and tubes, which form the water-vascular system, and have an ambulatory or respiratory function or both. The sexes are generally separate, and development is rarely direct.

They are ordinarily marine in habit, but a few live in brackish water, and they have had representatives in every age in which animals are known to have existed.

Tabular View of the Classes of Echinoderma.*Branch A. *INCALICULATA.*

Stage a. ANACTINOGONIDIATA.

Class 1. HOLOTHURIOIDEA.

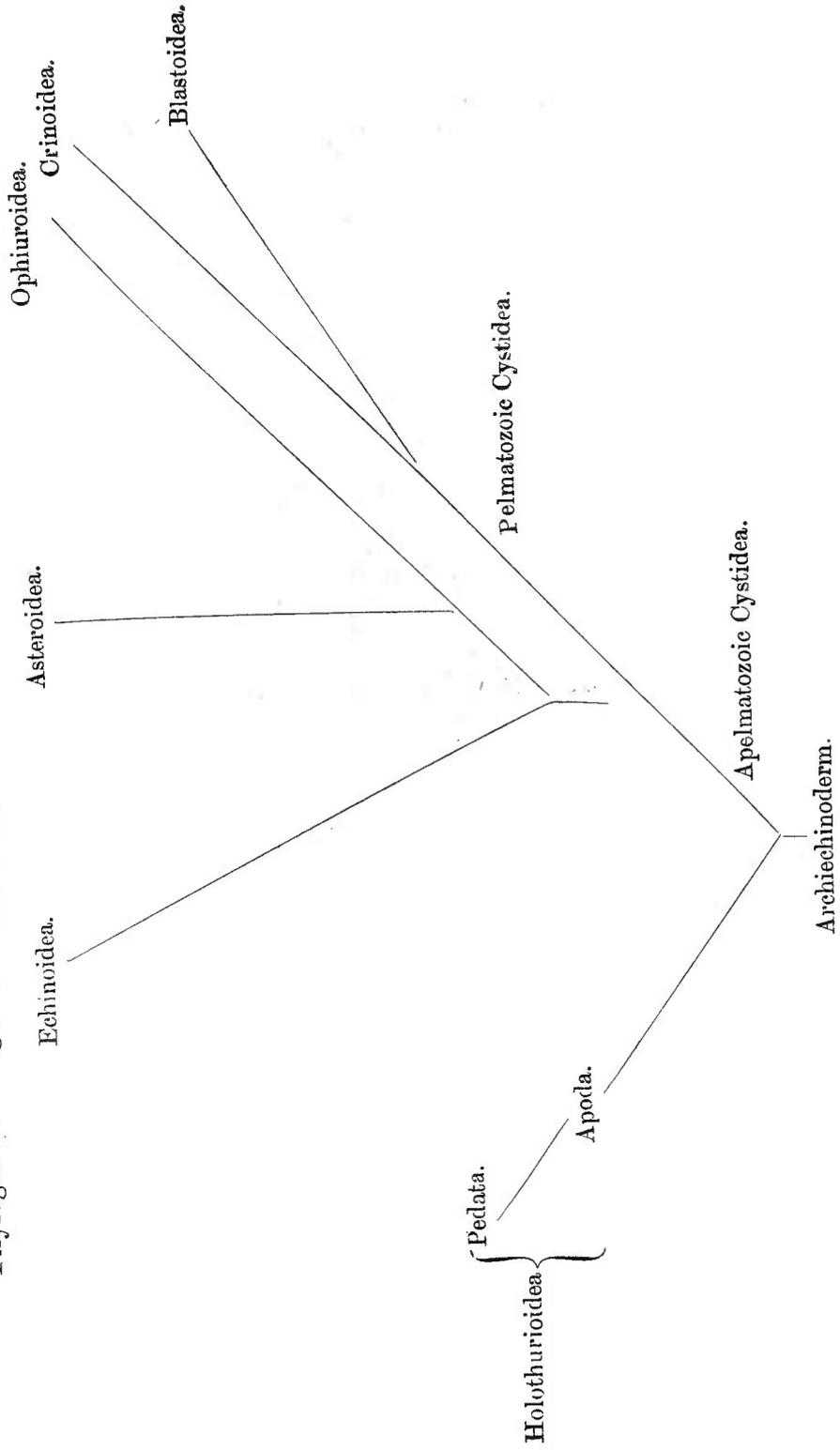
Branch B. *CALICULATA.*

Stage a. ANACTINOGONIDIATA.

Class 2. Some CYSTIDEA (?).

* For the reasons for this arrangement of the classes, cf. *Ann. & Mag. N. H.* 1891, viii. p. 206.

Phylogenetic Diagram of the probable derivation of the Classes of Echinoderms.



Stage β . ACTINOGONIDIATA.

1st Subbranch. STATOZOA.

Substage i. *Apelmatozoic*.

Class 3. ? Some CYSTIDEA.

Class 4. ? Some BLASTOIDEA.

Class 5. ? Some CRINOIDEA.

Sub-stage ii. *Pelmatozoic*.

Class 6. Some CYSTIDEA.

Class 7. BLASTOIDEA (s. s.).

Class 8. CRINOIDEA (s. s.).

2nd Subbranch. ELEUTHEROZOA.

Division i. *Azygopod* (Lissactinic). α . With open ambulacra.

Class 9. ASTEROIDEA.

 β . With (in most) a ventral arm-ossicle

Class 10. OPHIUROIDEA.

Division ii. *Zygopod* (Desmactinic).

Class 11. ECHINOIDEA.

BRANCH A. INCALICULATA.

Incaliculata, *Bell, Ann. & Mag.* viii. (1891) p. 212.

Echinoderma in which no system of plates set alternately along and between the rays is developed in the aboral region.

Stage α . Anactinogonidiata.Anactinogonidiata, *Bell, Ann. & Mag.* viii. (1891) p. 212.

Echinoderma in which the vascular and nervous, but not the digestive or reproductive, systems exhibit quinquerradiate symmetry.

Class I. HOLOTHURIOIDEA.

Holothuria, *Linn. Syst. Nat.* xii. (1767) p. 1089 (pars); *de Bl. Dict. Sci. Nat.* xxi. (1821) p. 310.Les Fistulides, *Lamk. Syst. An. s. Vert.* (1801) p. 351 (pars).Les Holothuries, *Cuv. Règne An.* iv. (1817) p. 20.Fistulida, *Macleay, Hor. Entom.* (1819) p. 316; *Gray, Ann. Phil.* x. (1825) p. 423.Fistulata, *Eichwald, Zool. Spec.* i. (1829) p. 232.Holothurides, *de Bl. Actin.* (1834) p. 188; *Duj. & Hup. Echin.* (1862) p. 609.Holothurina, *Brandt, Prod. descr.* (1835) p. 42.Fistulides ou Holothuries, *Ag. Mém. Soc. Neuch.* i. (1836) p. 180.

- Scytodermata, *Burmeister, Hdbuch. Naturg.* (1837) p. 469 (pars)
Leuckart, Morphol. wirbellos. Thiere, (1848) p. 43.
 Cirrho-Vermigrada or Holothuriadæ, *Forbes, Brit. Starf.* (1840) p. xv.
 Ascidiastella, *Austin, Ann. & Mag.* x. (1842) p. 111.
 Holothuriacea, *Düb. & Kor. Vet. Akad. Hdlg.* 1844 (1846) p. 286.
 Holothurida, *Gray, Brit. Rad.* (1848) p. 7.
 Holothurioidea, *Siebold, Lehrb. vergl. Anat.* (1848) p. 75; *Carus, Prodr. Faun. med.* (1884) p. 104; *Lampert, Seewalzen,* (1885) p. 3; *Théel, Chall. Rep. Hol.* (1886) p. 1; *Ludwig, Klass. u. Ordn.* (1889) p. 1; *Hérourard, Arch. Zool. expér.* vii. (1889) p. 535; *Bell, Ann. & Mag.* viii. (1891) p. 207.
 Holothurina, *Perty, Zoologie,* (1855) p. 534.
 Scytactinota, *Bronn, Klass. u. Ordn.* ii. (1860) p. 368.
 Holothurien, *Selenka, Zeitschr. wiss. Zool.* xvii. (1887) p. 291; *Semper, Hol. Phil.* (1868) p. 1.

The Holothurioidea are non-caliculate, anactinogonidial apelmatozoic Echinoderms, in which the skeletal system is spicular or irregular; the musculature of the body-wall is well developed, and the mouth is surrounded by a circlet of never very numerous tentacles which communicate with the water-vascular system, which is or is not provided with podia. The mouth and anus are at or near the opposite ends of a generally elongated body. A few are hermaphrodite, and a few have been found in brackish water.

Order 1. APNEUMONA.

- Apodes (pars), *Brandt, Prodr. descr.* (1835) p. 58.
 Apoda, *Kor. & Dan. Vet. Akad. Hdlg.* 1844 (1846) p. 322; *Lampert, Seewalzen,* (1885) p. 203; *Théel, Chall. Rep.* (1886) p. 9.
 Apodia (pars), *Bronn, Klass. u. Ordn.* (1860) p. 403.
 1^{re} Tribu, Synaptiens, *Duj. & Hup. Echin.* (1862) p. 614.
 Apneumona Apoda (pars), *Carus, Zoologie,* ii. (1863) p. 494.
 Paractinopoda, *Ludwig, Klass. u. Ordn.* (1891) p. 326.

Holothurioidea without podia or respiratory trees.

Family SYNAPTIDÆ.

- Synaptidæ, *Burmeister, Hdbuch. Naturg.* (1837) p. 472; *Semper, Hol.* (1868) p. 9; *Théel, Chall. Rep.* (1886) p. 18; *Semon, Mitth. zool. Stat. Neap.* vii. (1887) pp. 272 & 401; *Ludwig, Klass. u. Ordn.* (1891) p. 356.
 Apneumones+Chiridota, *Brandt, Prod. descr. Anim.* (1835) pp. 58, 59.
 Chiridoten, *Grube, Actin. etc. Mittelm.* (1840) p. 41.

Apodal Holothurians with pinnate or digitate tentacles, not fewer than ten or more than thirty; cylindrical worm-like bodies; the mesenteries bear ciliated infundibula; the sexes are often united; the tegumentary deposits characterized by the presence of anchors or wheels.

One British genus: *Synapta*.

Order 2. PNEUMONOPHORA.

Pedatae, *Brandt, Prodr. descr.* (1835) p. 42.
 Holothuridea, *Van der Hoeven, Zool.* i. (1850) p. 147.
 Eupodia + Liodermatidæ, *Bronn, Klass. u. Ordn.* (1860) p. 403.
 2^e Tribu, Holothuriens, *Duj. & Hup. Ech.* (1862) p. 616.
 Apneumona Pedata + Pneumonophora, *Carus, Zool.* ii. (1863) p. 494.
 Pedata + Apoda pneumonophora, *Claus, Zool.* (1880) p. 373; *Lampert, Seewalzen*, (1885) pp. 16 & 21; *Théel, Chall. Rep.* (1886) pp. 48 & 57.
 Actinopoda, *Ludwig, Klass. u. Ordn.* (1891) p. 327.

Holothurioidea with respiratory trees, and with (Pedata) or without podia; the latter are not known as British.

Two families.

Family 1. DENDROCHIROTÆ.

Dendrochirotæ, *Brandt, Prodr. descr.* (1835) p. 57; *Grube* (sens. emend.), *Act. etc. Mittelm.* (1840) p. 33; *Selenka, Zeit. wiss. Zool.* xvii. (1867) p. 341; *Semper, Hol.* (1868) p. 47; *Lampert, Seewalz.* (1885) p. 17; *Théel, Chall. Rep.* (1886) p. 99; *Ludwig, Klass. u. Ordn.* (1891) p. 342.

Pedate Holothurians in which the tentacles are dendritic and the pharynx is provided with special retractor muscles.

(a) Decachirote Dendrochirotæ.

Bell, P. Z. S. 1884, p. 254.

Dendrochirotæ in which there are five pairs of tentacles.
 Three genera: *Cucumaria, Thyone, Psolus.*

(b) Polychirote Dendrochirotæ.

Bell, P. Z. S. 1884, p. 254.

Dendrochirotæ, in which there are more than five pairs of tentacles.

One genus: *Phyllophorus.*

Family 2. ASPIDOCHIROTÆ.

Aspidochirotæ, *Brandt, Prodr. descr. An.* (1835) p. 53; *Grube* (sens. emend.), *Act. etc. Mittelm.* (1840) p. 33; *Selenka, Zeitschr. f. wiss. Zool.* xvii. (1867) p. 309; *Semper, Phil. Hol.* (1868) p. 40; *Lampert, Seewalzen*, (1885) p. 16; *Théel, Chall. Rep. Hol.* (1886) p. 188
Ludwig, Klass. u. Ordn. (1891) p. 327.

Pedate Holothurians in which the tentacles are shield-shaped, and no special retractors of the pharynx are developed.

One genus: *Holothuria.*

BRANCH B. CALICULATA.

Caliculata, *Bell, Ann. & Mag.* viii. (1891) p. 213.

Echinoderma in which part at least of the skeleton is formed by a system of plates set alternately along and between the rays in the aboral region, and round a single central plate; it either forms a complete functional calyx, or is more or less reduced.

Stage β . Actinogonidiata.

Actinogonidiata, *Bell, Ann. & Mag.* viii. (1891) p. 213.

Caliculate Echinoderma in which the gonads are radial in position or have undergone fusion and become interradial.

Subbranch I. STATOZOA.

Statozoa, *id. t. c.* p. 214.

Actinogonidiate caliculate Echinoderma in which the body, whose oral surface looks upward, is temporarily or permanently fixed; the podia have a respiratory function only, and the anus opens on the oral surface. They may or may not have or have had a stalk; the former are in the pelmatozoic, the latter in the apelmatozoic grade.

Class VIII. CRINOIDEA.

Crinoidea, *Miller, Nat. Hist. Crin.* (1821) p. 7; *Gray, Syn. B. M.* 42nd ed. (1840) p. 63; *id. Brit. Rad.* (1842) p. 27; *Norman, Ann. & Mag.* xv. (1865) p. 100; *Carpenter, Chall. Rep. Crin.* 1884, p. 187; *Bell, Ann. & Mag.* viii. (1891) p. 215.

Stilasteritæ, *Goldfuss, Pet. Germ.* i. (1829) p. 161.

Asterencrinea, *de Bl. Dict. Sci. Nat.* lx. (1830) p. 228.

Asterencrinidea, *id. Act.* (1834) p. 247.

Crinoïdes (pars), *Ag. Mém. Soc. Neuchât.* i. (1836) p. 193; *id. Ann. Sci. Nat.* vii. (1837) p. 288; *Duj. & Hup. Ech.* (1862) p. 35.

Crinoideæ, *Forbes, Mem. Wern. Soc.* viii. (1839) p. 128; *id. Brit. Starf.* (1840) p. xiv.

Pinnigrada, *id. Brit. Starf.* (1840) p. xiv.

Pinnastella Crinoidea, *Austin, Ann. & Mag.* x. (1842) p. 108.

Actinoidea, *F. Roemer, Leth. Geog.* (1852-4) i. 2. p. 224.

Crinoidea brachiata, *Burmeister, Zoonom. Brief.* i. (1856) p. 243.

Brachiata, *Haeckel, Gen. Morph.* (1866) p. lxxviii.

Eucrinoidea, *Zittel, Hdbuch. Pal.* (1879) p. 325.

Caliculate, actinogonidial, statozoic Echinodermata, provided with branching articulated arms. In a number of forms the stalked condition is larval only or it is altogether lost: the power of locomotion is often re-acquired. A highly specialized aboral nervous system. Gonads developed in the arms. Five or more water-pores establish a communication between the cœlom and the exterior.

Family ANTEDONIDÆ.

- Les Astérencrieniens libres, *de Bl. Dict. Sci. Nat.* lx. (1830) p. 229.
 Pentacrinitidæ, *Gray, Synop. B. M.* (1842) p. 119; *id. Brit. Rad.* (1848) p. 28.
 Comatulidæ, *d'Orbigny, Cours Elém.* ii. (1852) p. 138; *Bronn, Klass. u. Ordn.* ii. (1860) p. 233; *Carpenter (sens. emend.), Chall. Rep. Comat.* (1888) p. 63.
 Comatuliens, *Duj. & Hup. Echin.* (1862) p. 191.
 Antedonidæ, *Norman, Ann. & Mag.* xv. (1865) p. 101.

Crinoids free when adult, with the top joint of the larval stem persistent and cirriferous; the basal plates of the calyx complete and external or vestigial and internal. Rays five or ten, simple or divided once or more. Mouth central, except in *Actinometra*.

One genus: *Antedon*.

Subbranch II. ELEUTHEROZOA.

Eleutherozoa, *Bell, Ann. & Mag.* viii. (1891) p. 214.

The Eleutherozoa are actinogonidiate calciculate Echinoderms in which the oral surface of the body looks downwards, the power of locomotion is retained, and the podia are often locomotor in function; the anus, if present, varies in position.

Division I. AZYGOPODA.

Azygopoda, *id. t. c.*

The Azygopoda are Eleutherozoa in which the podia are all or nearly all on the oral surface of the body only, and are separated by terminal plates from any contact with the calycinal area.

Class IX. ASTEROIDEA.

- Asterias (pars), *Linn. Syst. Nat.* x. (1758) p. 661; *id. op. cit.* xii. p. 1098.
 Asterias, *Lamk. An. s. Vert.* ii. (1816) p. 547.
 Asteridea, *de Bl. Dict. Sci. Nat.* lx. (1830) p. 216; *Actinol.* (1834) p. 235.
 Astéries, *Agass. Mém. Soc. Neuch.* (1836) p. 190; *id. Ann. Sci. Nat.* vii. (1837) p. 284.
 Asteriæ, *Forbes, Mem. Wern. Soc.* viii. (1839) p. 118; *Düb. & Kor. Vet. Akad. Hdlg.* 1844 (1846) p. 238.
 Asteriadæ, *id. Brit. Starf.* (1840) pp. xiv & 71.
 Cirrhigrada, *id. ibid.*
 Asteroidea, *Gray, Syn. Brit. Mus.* 42nd ed. (1840) p. 61; *id. Ann. & Mag.* vi. (1840) p. 178.
 Asterida, *M. Tr. Syst. Ast.* (1842) p. 1.
 Lobistella, *Austin, Ann. & Mag.* x. (1842) p. 111.
 Asteriadæ, *Bronn, Klass. u. Ordn.* ii. (1860) p. 286.
 Asteridæ, *Sars, Norg. Ech.* (1861) p. 25.

- Asteroidea (pars), *Burmeister, Hdbh. Naturg.* (1837) p. 467.
 Asteroidea, *Wright, Mon. Brit. Foss. Echin. Oolit.* ii. (1863) p. 1; *Norman, Ann. & Mag.* xv. (1865) p. 115; *Perr. Arch. Zool. expér.* iv. (1875) p. 281; *Fewkes, Proc. Bost. Soc. N. H.* xxiv. (1889) p. 96; *Sladen, Chall. Rep. Ast.* (1889) p. xxviii; *Bell, Ann. & Mag.* viii. (1891) p. 214; [*non Zittel, in Hdbuch. Pal.* (1879)].
 Stelleridæ, *Zittel, Hdbuch. Pal.* (1879) p. 447.
 Tocastra+Colastra+Brisingastra, *Haeckel, Gen. Morph.* ii. (1866) pp. lxx & lxxvi.

On the movements of Asteroidea, see *Preyer, MT. zool. Stat. Neap.* vii. (1886 & 87) pp. 33 & 77; on their anatomy see *Cuénot, Arch. Zool. expér.* v. Suppl. art. 2 (1887-90).

The Asteroidea are calciculate, actinogonidial, eleutherozoic, azygopodous Echinoderms, in which there is an open ambulacral groove. The stellate form of the body is often well marked and the rays prolonged into "arms," which vary in their proportional length to the diameter of the disk; the digestive system, which is rarely aprocuous, and the generative share in the stellate disposition of the organism. Pentameric repetition is more often exceeded in this than in any other class; and asexual reproduction from a part of the body is by no means uncommon; respiration diffuse.

Order 1. PHANEROZONIA.

Phanerozonia, *Sladen, Chall. Rep. Ast.* (1889) p. xxviii.

Asteroidea with well developed marginal plates in two distinct rows; the superior and inferior touch, and usually have their axes in parallel planes. Papulæ confined within the area bounded at the sides by the superomarginals. Ambulacral plates not crowded nor narrow. Adambulacral plates take a prominent share in the formation of the oral plates. Pedicellariæ valvate, foraminate or excavate.

Family 1. ARCHASTERIDÆ.

Archasteridæ, *Viguiér, Arch. Zool. expér.* vii. (1878) p. 235; sens. emend. *Sladen, Chall. Rep. Ast.* (1889) p. xxviii.

Phanerozonia in which the calycinal plates are inconspicuous in the adult, the abactinal plates spiniform or paxilliform, and the integument spiny; there is an anus, no superambulacrals, large adambulacrals, and, usually, pedicellariæ.

Two subfamilies.

Subfamily 1. PARARCHASTERINÆ.

Pararchasterinæ, *Sladen, Chall. Rep. Ast.* (1889) p. xxviii.

Archasteridæ with papulæ in a limited area only at the base of

the ray. Marginal plates more or less alternate. Actinal intermediate plates absent or scarce.

One genus: *Pontaster*.

Subfamily 2. PLUTONASTERINÆ.

Plutonasterinæ, *Sladen, Chall. Rep. Ast.* (1889) p. xxviii.

Archasteridæ with papulæ distributed over the whole abactinal area. Marginal plates opposite one another. Actinal intermediate plates well developed.

One genus: *Plutonaster*.

Family 2. PORCELLANASTERIDÆ.

Porcellanasteridæ, *Sladen, J. Linn. Soc.* xvii. (1883) p. 214; *id.* (sens. emend.) *Chall. Rep. Ast.* (1889) p. xxix.

Phanerozonia in which the calycinal plates are inconspicuous in the adult, the abactinal plates spiniferous or paxilliform, and the integument spiny; the marginal plates are thin and lamelliform, without spines.

One subfamily.

Subfamily CTENODISCINÆ.

Ctenodiscinæ, *Sladen, Chall. Rep. Ast.* (1889) p. xxx.

Porcellanasteridæ with a simplified cribriform organ on the margins of each pair of marginal plates. Actinal interradial areae traversed by fimbriated channels, continuous with those between the marginal plates.

One genus: *Ctenodiscus*.

Family 3. ASTROPECTINIDÆ.

Astropectinidæ, *Gray, Ann. & Mag.* vi. (1840) p. 180; *Norman, Ann. & Mag.* xv. (1865) p. 115; *Viguiier, Arch. Zool.* vii. (1878) p. 225; *Sladen* (sens. emend.), *Chall. Rep. Ast.* 1889, p. xxx.

"Dritte Familie," *M. Tr. Syst. Ast.* (1842) p. 13 (pars).

"Troisième Section," *Duj. & Hup. Echin.* (1862) p. 413 (pars).

Phanerozonia in which the calycinal plates are inconspicuous in the adult, the abactinal plates paxilliform, and the integument spiny; there is no anus, there are superambulacrals, short, more or less compressed adambulacrals, and rarely pedicellariæ.

Two subfamilies.

Subfamily 1. ASTROPECTININÆ.

Astropectininæ, *Sladen, Chall. Rep. Ast.* (1889) p. xxx.

Astropectinidæ in which the adambulacral touch the inferomar-

ginal plates along the ray; the marginals and adambulacrals do not correspond in number or length.

Four genera: *Leptoptychaster*, *Astropecten*, *Psilaster*, *Bathyiaster*.

Subfamily 2. LUIDIINÆ.

Luidiinæ, *Sladen, Chall. Rep. Ast.* (1889) p. xxxi.

Astropectinidæ in which the inferomarginal are separated from the adambulacral plates by a small intermediate plate throughout the ray. Marginals and ambulacrals corresponding in number and length.

One genus: *Luidia*.

Family 4. PENTAGONASTERIDÆ.

Pentagonasteridæ, *Perrier, Arch. Mus.* vi. (1884) p. 231; *Sladen, Chall. Rep. Ast.* (1889) p. xxxi.

Phanerozonia in which the marginal plates are very large and the diameter of the disk long in proportion to the arms. The skeletal, as well as the marginal, plates may be naked or covered with granules, are set close, and are rounded, polygonal, or stellate in form.

Two subfamilies.

Subfamily 1. PENTAGONASTERINÆ.

Pentagonasterinæ, *Sladen, Chall. Rep. Ast.* (1889) p. xxxi.

Pentagonasteridæ in which the abactinal area is covered with rounded, polygonal, or paxilliform plates.

Two (or three) genera: *Pentagonaster*, *Nymphaster*, ? *Hippasterias*.

Subfamily 2. MIMASTERINÆ.

Mimasterinæ, *Sladen, Chall. Rep. Ast.* (1889) pp. xxxii & 264.

“Abactinal area with small stellate plates bearing true paxillæ. Actinal intermediate areas with imbricating plates in transverse series, bearing paxilliform groups of spines.” (*Sladen.*)

One genus: *Mimaster*.

Family 5. GYMNASTERIIDÆ.

Gymnasteriadæ, *Perrier, Nouv. Arch. Mus.* vi. (1884) p. 229.
Gymnasteriidæ, *Sladen, Chall. Rep.* (1889) p. xxxiii.

Phanerozonia in which the marginal plates are not all equally developed.

Four genera: *Porania*, *Cheilaster*, *Rhegaster*, and *Lasiaster*.

Family 6. ASTERINIDÆ.

Asterinidæ, *Gray, Syn. B. M.* 42nd ed. (1840) p. 62; *id. Ann. & Mag.* vi. (1840) p. 288; *id. Brit. Rad.* (1848) p. 21; *Perrier* (sens. emend.), *Arch. Zool. expér.* iv. (1875) p. 301; *Viguier* (sens. emend.), *Arch. Zool. expér.* vii. (1878) p. 205; *Perrier, Nouv. Arch.* vi. (1884) p. 219; *Sladen, Chall. Rep. Ast.* (1889) p. xxxiii.

The Asterinidæ are phanerozonte Asteroidea with small marginal plates in which the abactinal skeletal plates are imbricated and carry spines on their free edge, or are irregularly rounded and bear tufts of spinelets.

Two genera: *Asterina* and *Palmipes*.

Order 2. CRYPTOZONIA.

Cryptozonia, *Sladen, Chall. Rep. Ast.* (1889) p. xxxiv.

Asteroidea with reduced or obsolete marginal plates; when present the upper and lower rows do not touch, and their axes are not in parallel planes. Papulæ not confined to the area bounded by the superomarginals. Ambulacral plates more or less crowded and narrow. Adambulacral plates may or may not take a prominent share in the formation of the mouth-plates. Pedicellariæ foraminiate in Linckiidæ only.

Family 1. STICHAsterIDÆ.

Stichasteridæ, *Perr. Ann. Sci. Nat.* xix. (1885) art. 8, p. 15.

Cryptozonte Asteroids with major or minor pedicellariæ or both; ambulacral tubes quadriserial at base of arms at least; skeleton of arms well developed, the ossicles arranged in regular longitudinal rows and imbricating.

Three genera: *Stichaster*, *Neomorphaster*, and *Zoroaster*.

Family 2. SOLASTERIDÆ.

Solasteridæ, *Perrier, Nouv. Arch. Mus.* (2) vi. (1884) p. 210; *Sladen, Chall. Rep. Ast.* (1889) p. xxxvi.

The marginal plates more or less obscured, the abactinal skeleton more or less loosely reticulate, with the spines on its plates arranged in paxilliform groups.

One genus: *Solaster*.

Family 3. CORETHRASTERIDÆ*.

Korethrasteridæ, *Dan. & Kor. Norsk. Nordh. Exp., Aster.* (1884) p. 99.

Allied to the Asterinidæ, but distinguished by the complete absence of interbrachial spaces, and by the possession of a continuous calcareous plating, and the formation of the paxillæ.

One genus : *Corethraster*.

Family 4. PTERASTERIDÆ.

Pterasteridæ, *Perrier, Arch. Zool.* iv. (1875) p. 302; *Viguier, op. cit.* vii. (1878) p. 224; *Perrier, Nouv. Arch. Mus.* vi. (1884) p. 216; *Sladen, Chall. Rep. Ast.* (1889) p. xxxvii.
Velatæ, *Perrier, Miss. Cap Horn,* vi. (1891) p. k 72.

Cryptozoonate Asteroidea in which the dorsal ossicles carry a spine crowned by long diverging spines which support a more or less well-developed membrane; this forms a marsupial recess for the young. No actinal intermediate plates, interbrachial septa, or pedicellariæ.

Two genera : *Pteraster* and *Hymenaster*.

Family 5. ECHINASTERIDÆ.

Echinasteridæ, *Verrill* (no diagnosis), *Trans. Conn. Acad.* i. (1867[71]) p. 343; *Perrier, Arch. Zool.* iv. (1875) p. 299; *Viguier, op. cit.* vii. (1878) p. 121; *Perrier, Nouv. Arch. Mus.* vi. (1884) p. 206; *Sladen, Chall. Rep. Ast.* (1889) pp. xxxviii & 535.

One subfamily.

Subfamily ECHINASTERINÆ.

Echinasterinæ, *Viguier, Arch. Zool. expér.* vii. (1878) p. 123; *Sladen, Chall. Rep. Ast.* (1889) p. xxxviii.

Echinasteridæ with rather small disk and five or six rays; spines small, simple, solitary or grouped. No pedicellariæ.

One genus : *Henricia*.

Family 6. ASTERIIDÆ.

Asteriadæ, *Gray, Ann. & Mag.* vi. (1840) p. 178; *Norman, Ann. & Mag.* xv. (1865) p. 125; *Perrier, Arch. Zool.* iv. (1875) p. 299; *Viguier* (s. em.), *op. cit.* vii. (1878) p. 93; *Perrier, Nouv. Arch. Mus.* vi. (1884) p. 199.

Urasteriæ, *Forbes, Brit. Starf.* (1840) p. 77.

Erste Familie, *M. Tr. Syst. Ast.* (1842) p. 11.

* The only specimen available to me is the type of Wyville Thomson, which has been investigated by Mr. Sladen.

1^{re} Tribu, *Duj. & Hup. Echin.* (1862) p. 329.
 Typical Startfishes, *Gray, Syn. B. M.* 42nd ed. (1840) p. 61.
 Asteroiidae (s. em.), *Sladen, Chall. Rep. Ast.* (1889) p. xxxix.

The Asteroiidae are cryptozionate Asteroids, with the reticular abactinal skeleton made up of small unequal plates carrying one or more small spines. The podia appear to be arranged in four rows. Major and minor pedicellariae, as a rule, both present.

One genus: *Asterias*.

Family 7 BRISINGIDÆ.

Brisingidae, *Sars, Remarkable Forms*, ii. (1875) p. 101; *Perrier, Nouv. Arch. Mus.* vi. (1884) p. 188; *Sladen, Chall. Rep. Ast.* (1889) p. xl.

Cryptozionate Euasteroidea, in which the reduction of the marginal plates is altogether or almost complete; and the dorsal skeletal plates, if present, found only on the disk and the proximal portion of the arms; no intermediate ventral plates or any interbrachial septa.

Two genera: *Brisinga* and *Odinia*.

Class X. OPHIUROIDEA.

Ophiura, *Lamk. Syst.* (1801) p. 350.
 Asterophidea, *de Bl. Dict. Sci. Nat.* lx. (1830) p. 223; *id. Actinol.* (1834) p. 242.
 Ophiures, *Agass. Mém. Soc. Neuch.* i. (1836) p. 192; *id. Ann. Sci. Nat.* vii. (1837) p. 287.
 Ophiurida, *Gray, Syn. B. M.* 42nd ed. (1840) p. 63; *id. Brit. Rad.* (1848) p. 23.
 Ophiuridae, *Forbes, Brit. Starf.* (1840) pp. xiv, 19; *M. Tr. Syst. Ast.* (1842) pp. 79, 81; *Bronn, Klass. u. Ordn.* (1860) p. 283.
 Ophiuræ, *Forbes, Mem. Wern. Soc.* viii. (1839) p. 124; *Düb. & Kor. Vet. Akad. Hdlg.* 1844 (1846) p. 233.
 Ophiurides, *Duj. & Hup. Ech.* (1862) p. 219.
 Ophiuroidea, *Norman, Ann. & Mag.* xv. (1865) p. 104; *Ljungman, Efv. Vet. Akad. Förhlg.* 1866 (1867), p. 303; *Cuénot, Arch. Zool. expér.* vi. (1888) p. 33; *Bell, Ann. & Mag.* viii. (1891) p. 215.

The Ophiuroidea are calciculate, actinogonidial, eleutherozoic, liss-actinic Echinoderms in which there is no distinct ambulacral groove. The "arms" are sharply marked off from the disk, are very rarely more than five in number, and are sometimes elaborately branched. The digestive system, which is aprocuous, and the generative are confined to the area of the disk, as is also the specialized respiratory apparatus which, typically, takes the form of deep clefts.

Order 1. ZYGOPHIURÆ.

- Ophiuræ (pars), *Forbes, Brit. Starf.* (1840) p. 21; *M. Tr. Syst. Ast.* (1842) p. 83.
 Ophiurinae (pars), *Bronn, Klass. u. Ordn.* (1860) p. 284.
 Ophiuridées (pars), *Duj. & Hup. Ech.* (1862) p. 228.
 Ophiuridæ (pars), *Lyman, Ill. Cat. M. C. Z.* (1865) p. 5; *Norman, Ann. & Mag.* xv. (1865) p. 106.
 Ophiastra (pars), *Haeckel, Gen. Morphol.* ii. (1866) p. lxvi.
 Zygophiuræ, *Bell, P. Z. S.* 1892, p. 180.

Ophiuroids with the faces of the arm-ossicles more or less distinctly provided with articulating knobs and pits, which prevent the ossicles from being coiled, or rolled towards the mouth. In nearly all the central ossicles are surrounded by an upper or lower and two lateral plates; the last bear few or several spines of varying length and strength. The arms are never branched. The clefts at the base of the arms always open into bursæ. Mouth, tooth-papillæ, and true teeth may all be found, and are never all wanting. Mouth-shields and side mouth-shields present. A single madreporite. No pedicellariæ. The tentacular pores very often covered by one or two scales.

I. Without tooth-papillæ.

A. Arm-incisions on the disk.

Family 1. OPHIOLEPIDIDÆ.

Ophiolepididæ, *Ljungman, Æfv. Vet. Akad. Förhlg.* 1866 (1867), no. 9, p. 306.

Oral papillæ three to six; radial shields naked; spines smooth; mouth-shields moderate or large, often produced into the inter-brachial spaces.

Two genera: *Ophiura* and *Ophiocten*.

Incertæ sedis: *Ophiochiton*.

B. Arms inserted on ventral surface of disk.

Family 2. AMPHIURIDÆ.

Amphiuridæ, *id. t. c.* p. 309.

Oral papillæ one to five; radial shields naked: spines smooth, or more or less rough; mouth-shields small, not produced into inter-brachial spaces.

Seven genera: *Ophiomusium*, *Ophiocnida*, *Amphiura*, *Ophiactis*, *Ophiopus*, *Ophiopholis*, and *Ophiacantha*.

II. With dental papillæ.

A. With oral papillæ.

Family 3. OPHIOCOMIDÆ.

Ophiocomidæ, *id. t. c.* p. 328.

Spines smooth or covered with skin, disk granulated.

Two genera: *Ophiocoma* and *Ophiopsila*.

B. Without oral papillæ.

Family 4. OPHIOTHRICIDÆ.

Ophiothricidæ, *id. t. c.* p. 330.

Spines roughened or serrated, disk generally with spines or spiniform rods.

One genus: *Ophiothrix*.

Order 2. STREPTOPHIURÆ.

Streptophiuræ, *Bell, P. Z. S.* 1892, p. 179.

Ophiuræ (*auct.*), pars.

Ophiuroids in which the faces of the arm-ossicles have no pits or processes sufficient to prevent the ossicles being so twisted on their neighbours that the arms may be coiled or rolled towards the mouth. Of the covering-plates, tentacle-scales, teeth, teeth-papillæ, mouth-papillæ, several may be absent. A single madreporite. No pedicellariæ. Arms never branch.

Three genera: *Ophioscolex*, *Ophiobyrsa*, and *Ophiomyxa*.

Order 3. CLADOPHIURÆ.

Euryalidæ, *Gray, Syn. B. M.* 42nd ed. (1840) p. 63.

Euryalæ, *M. Tr. Syst. Ast.* (1842) p. 85.

Asterophydées, *Duj. & Hup. Echin.* (1862) p. 295.

Astrophytonidæ, *Norman, Ann. & Mag.* xv. (1865) p. 104.

Asterophyidiæ, *Wright, Brit. Foss. Echin. Oolit.* ii. (1866) p. 138.

Phytastra, *Haeckel, Gen. Morph.* ii. (1866) p. lxxvii.

Astrophytidæ, *Lyman*, Chall. Rep.* (1882) p. 250.

Cladophiuræ, *Bell, P. Z. S.* 1892, p. 180.

Ophiuroidea with more or less saddle-shaped faces to the arm-

* *Astrophytidæ* is to be found *passim* in the works of Mr. Lyman, but does not seem to have been defined by him till 1882.

ossicles, so that the arms can be twisted round foreign objects or rolled towards the mouth; the ossicles not invested by definite plates, but the covering-skin more or less granular. Arms simple or branched, arm-spines represented by papillæ. Bursal clefts may open directly into cœlom, when true bursæ are wanting. No true teeth; mouth-shields and oral spines present or absent. Madreporite present or absent, and when present as many as five may be found. Pedicellaria-like processes sometimes present. Some at least can swim.

Two subfamilies.

Subfamily 1. ASTRONYCINÆ.

Astronycinæ, *Ljungman, Öfv. Vet.-Ak. Förhlg.* 1866 (1867) p. 334.

The clefts at the sides of the arms open into bursæ. The arms undivided. Oral spines or papillæ present, but no oral shields. Madreporite single.

One genus: *Astronyx*.

Subfamily 2. GORGONOCEPHALINÆ.

Gorgonocephalinæ, *Ljungman, Öfv. Vet.-Ak. Förhlg.* 1866 (1867) p. 335.

The clefts at the sides of the arms open directly into the cœlom. The arms branch, often very considerably. Oral spines or papillæ present, but no oral shields. Madreporite single or multiple.

One genus: *Gorgonocephalus*.

Division II. ZYGPODA.

Zygopoda, *Bell, Ann. & Mag.* viii. (1891) p. 214.

The Zygopoda are Eleutherozoa in which the podia extend more or less uninterruptedly from the calycinal to the oral region.

Class XI. ECHINOIDEA.

Echinus, *Linn. Syst. Nat.* x. (1758) p. 663.

Echinides, *Lamk. Syst.* (1801) p. 345; *de Bl. Dict. Sci. Nat.* lx. (1830) p. 178; *id. Actinol.* (1834) p. 197; *Desmoulins, Act. Soc. Linn. Bordeaux*, vii. (1835) p. 167.

Oursins, *Cuvier, Tab. Elém.* (1798) p. 647.

Echinoïdes (*Echinoida*), *Latreille, Fam. Nat.* (1825) p. 532.

Echinida, *Macleay, Hor. Entomol.* 1819, p. 316; *Gray, Ann. Phil.* x. (1825) p. 423; *id. Brit. Rad.* (1848) p. 2.

Echinidæ, *Flem. Brit. An.* (1828) pp. 473, 474.

- Echini, *Eichwald, Zool. Spec.* (1829) i. p. 228.
 Cirri-Spinigrada, *Forbes, Brit. Starf.* (1841) p. xv.
 Adelostella (pars), *Austin, Ann. & Mag.* x. (1842) p. 111.
 Echinodea, *Düb. & Kor. Vet. Ak. Hdlg.* 1844 (1846) p. 255.
 Echinoidea, *Bronn, Klass. u. Ordn.* ii. (1860) p. 295; *Duncan, J. Linn. Soc.* xxiii. (1889) p. 4.

The Echinoidea are caliculate, actinogonidial, eleutherozoic, desm-actinic Echinoderms in which the calycinal area may be very extensively reduced or greatly metamorphosed; the gonads are unpaired and interradial; the body is perfectly rounded, more or less flattened or bilaterally symmetrical, and is more or less covered by spines which may be long, stout, and strong, or present every stage of reduction to such as are fine and silky. The calcareous deposit in the peristome takes the form of polygonal plates which are arranged in regular rows and perforated in the radial area for the passage of the podia. They are all proctuchous, but the anus is not always opposite the mouth. Respiration partly by gills and partly by podia, which may be specially modified.

Order 1. *EUECHINOIDEA.*

- Euechinoidea, *Bronn, Klass. u. Ordn.* ii. *Actinozoa* (1861), p. 350;
Zittel, Hdbuch. Paläont. (1879) p. 487; *Duncan, J. Linn. Soc.*
 xxiii. (1889) p. 4.
 Autechinida, *Haeckel, Gen. Morph.* (1866) p. lxxii.

The Euechinoidea are Echinoidea in which the number of rows of coronal plates is always twenty, or, in other words, in which there are always five pairs of ambulacral (radial) and five of interambulacral plates.

Suborder 1. *REGULARIA.*

- Regularia, *Latreille, Fam. Nat.* (1825) p. 532.
 Les Cidarites, *Ag. Mém. Soc. Neuch.* i. (1836) p. 188.
 Echinides normaux ou réguliers, *Gras, Ours. foss. de l'Isère*, (1848)
 p. 20.
 Cidarides, *Desor, Syn. Ech. foss.* (1858) p. 5.
 Endocyclica, *Wright, Brit. Foss. Echin. Oolit.* i. (1857) p. 17.
 Desmosticha, *Haeckel, Gen. Morph.* (1866) p. lxxii.
 Regulares, *Zittel, Hdbuch. Paläont.* (1879) p. 487.

Euechinoidea in which the anus is at the opposite pole of the more or less globular body to the mouth, and is surrounded by a regular series of five radial and five interradial plates. Lantern of Aristotle well developed.

A. ENDOBRANCHIATA.

Entobranchiata, *Bell, P. Z. S.* 1881, p. 417.

Abranchiata, *Ludwig, Zeitschr. f. wiss. Zool.* xxxiv. (1880) p. 82.

The Endobranchiata are regular Euechinoidea in which there are no external gills or peristomial slits; the oral membrane is covered with several sets of both radial and interradial plates; the perignathic arches are interradial and incomplete.

Family 1. CIDARIDÆ.

Cidaridæ, *Gray, Ann. Phil.* xxvi. (1825) p. 426; *Wyv. Thoms. Phil. Tr.* vol. 164 (1874) p. 721; *Zittel, Hdb. Paläont.* i. (1879) p. 493; *Duncan, J. Linn. Soc.* xxiii. (1889) p. 26; *Döderlein, Japan. Seeigel.* (1887) p. 3.

Cidaridées au[n]gustistellées, *Gras, Ours. foss. de l'Isère*, (1848) p. 20.

Angustistellées, *Desor, Syn. Ech. foss.* (1858) p. 2 [2 bis].

Gonicidarida, *Haeckel, Gen. Morph.* (1866) p. lxxiii.

The Cidaridæ are endobranchiate Euechinoidea in which there are no spheridia; the calycinal area is extensive; organs of Stewart appear to be always developed; the plates of the ambulacral area remain separate from one another and are all primary. The spines are strong and often long, and are frequently of bizarre shapes; in structure they are acanthodictyote and acanthostracous throughout their whole extent from the ring upwards; the central axial portion exhibits a simple fenestrated structure; the spicules in the walls of the ovary are triangular or triradiate in form.

One genus: *Cidaris*.

B. ECTOBRANCHIATA.

Ectobranchiata, *Bell, P. Z. S.* 1881, p. 417.

Branchiata, *Ludwig, Zeitschr. f. wiss. Zool.* xxxiv. (1880) p. 82.

The Ectobranchiata are regular Euechinoidea in which external gills are always developed and the edges of the peristome indented by five pairs of notches; the oral membrane is covered with radial plates only, and these may be numerous or reduced to five pairs; the perignathic arches are radial and complete.

Family 2. ECHINOTHURIIDÆ.

Echinothuridæ, *Wyv. Thoms. Depths of the Sea* (1873) p. 164; *id. Phil. Trans.* 164. (1874) p. 730; *A. Ag. Chall. Rep.* (1881) p. 71; *Ludwig, Zeitschr. f. w. Zool.* xxxiv. (1880) p. 82; *Sarasin, Ergebn. Ceylon*, i. 3 (1888) p. 129.

Diadematoïda Streptosomata, *Duncan, J. Linn. Soc.* xxiii. (1889) p. 40.

The Echinothuriidæ are regular ectobranchiate Euechinoidea, in which the organs of Stewart are more or less retained; they may

or may not have spheridia. The calycinal area is extensive, but its constituents are much reduced in size; the ambulacral plates consist of a primary plate only, or have half-plates united with them, or of isolated half-plates, and they imbricate and are continued on in several rows on to the peristomial membrane; the interambulacral plates also imbricate. Perignathic arches radial and complete.

Two genera: *Asthenosoma* and *Phormosoma*.

Family 3. ECHINIDÆ.

Echinidæ, *Bell, P. Z. S.* 1881, p. 417.

The Echinidæ are regular ectobranchiate Euechinoidea, in which the organs of Stewart are vestigial: they are provided with spheridia. The calycinal area is never very extensive, and is often much concentrated; the ambulacral plates always formed of at least three plates, so that there are three pairs of pores at least in each, and only one pair from each radius is found on the peristomial membrane. Perignathic arches radial and complete. Podia homoiopodous. Spines acanthodictyote, acanthosphenote, polycyclic; C-shaped spicules always among the calcareous deposits.

Subfamily ECHININÆ.

Echininæ, *Bell, P. Z. S.* 1881, p. 418.

Echinidæ with circular body.

Three genera: *Echinus*, *Strongylocentrotus*, and *Sphærechinus*.

Suborder 2. I R R E G U L A R I A.

Irregularia, *Latreille, Fam. Nat.* (1825) p. 533; *Gray, Cat. Echin. B. M. i.* (1855) p. 1.

Echinides paranormaux ou irreguliers, *Gras, Ours. foss. de l'Isère*, (1848) p. 39; *Desor, Ech. foss.* (1858) p. xxv.

Irregulares, *Zittel, Hdbuch. d. Paläont.* (1879) p. 510.

Exocyclica, *Wright, Brit. Foss. Echin. Oolitic*, i. (1857) p. 17.

Euechinoidea in which the anus is in the posterior interradius beyond the calycinal areas. Lantern of Aristotle and auricles reduced or lost.

Grade A. GNATHOSTOMATA.

Les Clypeâstres, *Ag. Mém. Soc. Neuchâtel*, i. (1836) p. 185.

Clypeastrides, *Lovén, K. Svenska Vet.-Ak. Hdlg.* xi. no. 7. (1874) p. 32.

Clypeastroida, *Duncan, J. Linn. Soc.* xxiii. (1889) p. 142.

Echinodermes exocycliques gnathostomes, *de Loriol, Echinol. helvét. in Pal. Suisse (Pictet)*, 1873, p. 172.

Irregular Euechinoidea in which the central mouth is provided with teeth and jaws. Ambulacra simple or petaloid, all similar.

Family 1. CLYPEASTRIDÆ.

Clypeastrida, *Haeckel, Gen. Morph.* ii. (1866) p. lxxxv.

Irregular gnathostomatous Euechinoidea with a depressed and more or less oval test. The ambulacra petaloid or subpetaloid. Apical area almost entirely occupied by the madreporite, and the genital pores sometimes external to it. Anus ordinarily marginal or inframarginal.

One genus: *Echinocyamus*.

Grade B. NODOSTOMATA.

Spatangidæ, *Gray, Ann. Phil.* x. (1825) p. 430; *id. Cat. Ech. B. M.* (1855) p. 38.

Echinides exocycliques atélostomes, de *Loriol, Echinol. helvét.* 2^e partie, in *Pal. Suisse (Pictet)*, 1873, p. 198.

Atelostomata, *Zittel, Hdbuch. Pal.* i. (1879) p. 523.

Spatangoida, *Duncan, J. Linn. Soc.* xxiii. (1889) p. 25.

Irregular Euechinoidea in which the mouth is central, and more often pushed forwards, and is devoid of teeth and auricles. The anterior odd ambulacrum often divides the test into two well-marked bilaterally symmetrical halves.

Only one family.

Family 2. SPATANGIDÆ.

Subfamily 1. CASSIDULINA.

Peristome nearly central.

One genus: *Neolampas*.

Subfamily 2. SPATANGINA.

Peristome excentric, with a hinder lip (labrum).

Group i. PRYMNADETES.

Prymnadetes, *Lovén, K. Svenska Vet.-Akad. Hdlg.* xi. 7. (1874) p. 16.

Spatangina without a subanal fasciole.

One genus: *Schizaster*.

Group ii. PRYMNODESMIA.

Prymnodesmia, *Lovén, K. Svenska Vet.-Akad. Hdlg.* xi. 7. (1874) p. 15.

Prymnodesmia, *Duncan, J. Linn. Soc.* xxiii. (1889) p. 239.

Spatangina with a subanal fasciole.

Three genera: *Spatangus*, *Echinocardium*, *Brissopsis*.

II. SPECIAL PART.

Descriptions of the Genera and Species of British Echinoderma, with an account of their synonymy and geographical distribution, together with some notes on their habits.

HOLOTHURIOIDEA (see p. 14).

Key to the Genera of Holothurioidea.

- | | |
|---|-----------------------|
| A. Without podia | 1. SYNAPTA, p. 32. |
| B. With podia. | |
| I. Tentacles arborescent. | |
| A. Tentacles ten. | |
| 1. The podia in rows along the ambulacra, even if scattered on the interambulacra also. | 2. CUCUMARIA, p. 35. |
| 2. The podia scattered | 3. THYONE, p. 41. |
| 3. The podia confined to the trivium, which forms a flat sole | 4. PSOLUS, p. 44. |
| B. Tentacles more than ten. | [p. 46.] |
| Tentacles fifteen | 5. PHYLLOPHORUS, |
| II. Tentacles shield-shaped. | |
| 1. No C-shaped spicules. | 6. HOLOTHURIA, p. 48. |
| 2. With C-shaped spicules. | 7. STICHOPUS, p. 51. |

1. SYNAPTA.

Synapta, *Eschscholtz, Zool. Atlas*, (1829) ii. p. 12; *Düb. & Kor. Vet. Akad. Hdlg.* 1844 (1846) p. 322; *Duj. & Hup. Ech.* (1862) p. 614; *Selenka, Zeit. f. wiss. Zool.* xvii. (1867) p. 360; *Semper, Phil. Hol.* (1868) p. 9; *Lampert, Seewalzen*, (1885) p. 22; *Théel, Chall. Rep. Hol.* (1886) p. 18; *Ludwig, Klass. u. Ordn.* (1891) p. 357.

Fistularia, *Forskål, Descr. Anim.* (1775) p. 121 (pars).

Mulleria, *Fleming, Brit. An.* (1828) p. 484.

Tiedemannia, *Leuckart, Isis*, xxiii. (1830) col. 685 f.n.

Oncinolabes, *Brandt, Prodr. descr.* (1835) p. 48; *Ludwig, Zeits. f. wiss. Zool.* xxxv. (1881) p. 576.

Dactylota, *Brandt, op. cit.* p. 45.

Chirodota, *Forbes, Brit. Starf.* (1841) p. 239.

Leptosynapta, *Verrill, Trans. Connect. Acad.* i. (1867[71]) p. 325 f.n.

Heterosynapta, *id. op. cit.* p. 346 f.n.

Tentacles ten to twenty-five; deposits anchors, anchor-plates, and fine granules; hermaphrodite.

Key to the Species *.

- Tentacles with more than five digits ... 1. *S. inhærens*.
 Tentacles with five digits or less.
 Tentacles eleven 2. *S. buski*.
 Tentacles twelve 3. *S. digitata*.

1. *Synapta inhærens*. (Plate I. fig. 1.)

- Holothuria inhærens*, O. F. Müll. *Prod. Zool. Dan.* (1776) p. 232;
id. Zool. Dan. i. (1779) p. 35, pl. xxxi. figs. 1-7; *de Bl. Dict. Sci.*
Nat. xxi. (1821) p. 319.
Pentacta inhærens, Jäger, *De Hol.* (1833) p. 13.
Cucumaria inhærens, *de Bl. Actin.* (1834) p. 195; *Kimahan, Nat.*
Hist. Rev. vi. (1859) p. 369.
Dactylota inhærens, Brandt, *Prodr. Descr. Anim.* (1835) p. 45.
Chirodota pinnata, Grube, *Actin. etc. Mittelm.* (1840) p. 41.
Synapta duvernœa, Quatrefages, *Ann. Sci. Nat.* xvii. (1842) p. 19,
 pls. 2-5 [anatomy]; *Held, Vierteljahrschr. naturf. Ges. in Zürich,*
 ii. (1857) p. 250, pl. ii. fig. 1; *Frédol [Moquin-Tandon], Monde de*
la Mer, (1866) p. 238, pl. xiv.
Holothuria (Synapta) inhærens, Rathke, *Nov. Act. Leop.* xx. (1843)
 p. 136.
Synapta inhærens, Düben & Koren, *Vet.-Ak. Handlg.* 1844 (1846),
 p. 322, pl. v. figs. 56-62; *J. Müller, Arch. f. Anat. u. Physiol.*
 1850, p. 136; *Woodward & Barrett, P. Z. S.* 1858, p. 363, pl. xiv.
 figs. 18-22; *Sars, Norg. Ech.* (1861) p. 124; *Selenka, Z. f. wiss.*
Zool. xvii. (1867) p. 364; *Lankester, Q. J. Micr. Sci.* viii. (1868)
 p. 53; *Semper, Hol. Phil.* (1868); *Norman, Rep. Brit. Assoc.*
 1868 (1869), p. 318; *Jarzynsky, Trans. Petersb. Soc. Nat.* i.
 (1870) p. 319; *Leslie & Herdman, Proc. R. Phys. Soc.* vi. (1881)
 p. 95; *Graeffe, Arb. Inst. Wien*, iii. (1881) p. 342; *Dan. & Kor.*
Norske Nordhavs Holoth. 1882, p. 80; *Barrois, Cat. Crust.* (1882)
 p. 55; *Carus, Prod. Faun. Med.* (1884) p. 111; *Lampert, Seewalzen,*
 (1885) p. 217; *Théel, Chall. Rep. Hol.* (1886) p. 24; *Bell, Proc.*
R. Irish Ac. iv. (1886) p. 621.
Synapta inherens, Gray, *Brit. Rad.* (1848) p. 12.
Synapta henslowana, *id. ibid.*
Synapta girardii, *Pourt. Proc. Amer. Assoc.* 1851, p. 14.
Synapta pellucida, *Stimpson & Kürtz*, apud *Ayres, Proc. Bost. Soc.*
N. H. iv. (1852) p. 214.
Synapta tenuis (not *Quoy & Gaimard*), *Ayres, Proc. Bost. Soc. N.*
H. iv. (1854) pp. 11, 67, 148; *Agas. Sea-side Studies*, (1865) p. 95,
 fig. 124; *Verr. Proc. Bost. Soc. N. H.* x. (1864) pp. 342, 354.
Cucumaria inhærens, *Thompson, Nat. Hist. Irel.* iv. (1856) p. 443.
Synapta galliennii vel saruiensis, *Herapath, Q. J. M. S.* v. (1865)
 p. 5, pl. i. figs. 4-7.
Synapta ayresii, *Selenka, Z. f. wiss. Zool.* xvii. (1867) p. 362.
Synapta sarniensis, *Lankester, Q. J. M. S.* viii. (1868) p. 53.
Leptosynapta inhærens, *Verr. Trans. Connect. Acad.* i. "1867"
 (1871), p. 325.
Leptosynapta tenuis, *id. ibid.*

* This and the following keys refer to British species only, and are there-
 fore generally based on characters arbitrarily selected.

Leptosynapta girardii, *Verr. Rep. Comm. Fish. U. S.* 1871 & 1872 (1873), part i. p. 716.

Leptosynapta roseola, *id. ibid.*; *Théel, Chall. Rep. Hol.* (1886) p. 25.

Twelve tentacles, each with six or seven digitate processes on either side; a single madreporic canal; one to three Polian vesicles; edge of fluke of anchor serrated; several of the anchor-plates with serrated holes; miliary granules not largely developed.

From 40 to 50 mm. long in spirit, but always greatly disfigured by preservation in alcohol.

Distribution. Both sides of North Atlantic; White Sea and Mediterranean. 0-96 fms.

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| <i>a-c.</i> 49° 7' N., 10° 57' W., 96 fms. | 'Porcupine' Exp. 1869 (St. 35). |
| <i>d.</i> Cumbrae, 25 fms. | J. Murray, Esq. |
| <i>e.</i> West coast of Scotland. | J. Murray, Esq. |
| <i>f.</i> Aberystwyth. | Mus. Leach. |
| <i>g-h.</i> Polperro, "gravel bottom." | |
| <i>i.</i> S. Devon. | Mus. Leach. |

2. *Synapta buski*. (Plate I. fig. 2.)

Synapta buskii, *McIntosh, Proc. Roy. Soc. Ed.* v. (1866) p. 611, fig. 6.

Synapta tenera, *Norman* [n. n.], *Rep. Brit. Assoc.* 1863 (1864), p. 106; *Brady & Robertson, P. Z. S.* 1871, p. 690, pl. lxxi. figs. 1-3; *Dan. & Kor. Norske Nordhavs Hol.* (1882) p. 80; *Lampert, Seewalzen*, (1885) p. 216; *Théel, Chall. Rep. Hol.* (1886) p. 30.

Eleven tentacles, with three true digits and two or three transverse ridges which look like digits; a single madreporic canal; one Polian vesicle. Anchor-plates (see Pl. I. fig. 2) with seven dentate holes and long narrow handle.

25 to 35 mm. long; body transparent and faintly rosy when fresh.

Distribution. Apparently rare in British seas, but very common on west coast of Sweden. 15-30 fms.

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| <i>a-d.</i> Sound of Harris. | Prof. McIntosh. |
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3. *Synapta digitata*. (Plate I. fig. 3 & Plate VII. figs. 1 & 2.)

Holothuria digitata, *Montagu, Trans. Linn. Soc.* xi. (1815) p. 22, pl. iv. fig. 6; *Grube, Arch. f. Anat.* 1850, p. 115.

Fistularia digitata, *Lamk. An. s. Vert.* iii. (1816) p. 76.

Holothuria inhærens, *Delle Chiaje, Mem. An. s. Vert.* iii. (1828) p. 69.

Mülleria digitata, *Fleming, Hist. Brit. An.* (1828) p. 484.

Thyone digitata, *de Bl. Actinol.* (1834) p. 194.

Chirodota chiajii, *Grube, Actin. etc. Mittelm.* (1840) p. 41; *Delle Chiaje, Invert. Sic. Cit.* iv. (1841) p. 4.

Chirodota digitata, *Forbes, Brit. Starf.* (1841) p. 239; *Thompson,*

- Nat. Hist. Irel.* iv. (1856) p. 443; *Kinahan, Nat. Hist. Rev.* vi. (1859) p. 369.
- Synapta digitata*, *J. Müller, Arch. f. Anat.* 1850, p. 136; *id. Ueber Synapta digitata, &c.* 1852; *id. Arch. f. Anat.* 1852, p. 1; *Leydig, t. c.* p. 507, pl. xiii. figs. 4-11; *W. Berlin, op. cit.* 1853, p. 442; *Held, Vierteljahrschr. naturf. Ges. in Zürich*, ii. (1857) p. 258, pl. ii. fig. 2; *Woodward & Barrett, P. Z. S.* 1858, p. 361, pl. xiv.; *Sars, Midd. Litt. Fauna*, 1857, p. 88; *Baur, Nov. Act. A. C. L.* xxxi. (1864) i. & ii. pls. i.-v.; *Selenka, Zeitschr. f. wiss. Zool.* xvii. (1867) p. 364; *Semper, Hol. Phil.* (1868) p. 264; *Norman, Rep. Brit. Assoc.* 1868 (1869), p. 318; *Fischer, Act. Soc. Linn. Bordeaux*, xxvii. (1869) p. 374; *Graeffe, Arb. Inst. Wien*, iii. (1881) p. 342; *Carus, Prodr. Faun. Med.* (1884) p. 111; *Lampert, Seewalzen*, (1885) p. 224; *Théel, Chall. Rep. Hol.* (1886) p. 29; *Semon, Jen. Zeitschr.* xxii. (1888) p. 175 (development).

Twelve tentacles, each with four or five digitate processes on either side; a single madreporic canal and Polian vesicle. Fluke of anchor smooth or slightly serrated; the holes of the anchor-plates smooth or with fainter serrations than in *S. inhærens*; miliary granules numerous and in places crowded.

From 30 to 40 mm. in spirit, which always injures these animals.

Distribution. British, French, Spanish coasts and Mediterranean; east coast of North America. 10-20 fms.

a-e. Polperro.

f, g. South Devon and Cornwall.

Mus. Leach.

2. CUCUMARIA.

- Cucumaria*, *de Bl. Dict. Sci. Nat.* lx. (1830) p. 173; *id. Actin.* (1834) pp. 191 & 195 (pars); *Forbes, Brit. Starf.* (1841) p. 209; *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 293; *Duj. & Hup. Echin.* (1862) p. 621; *Selenka, Zeitschr. wiss. Zool.* xvii. (1867) p. 346; *Semper, Hol. Phil.* (1867) p. 47; *Verrill, Trans. Conn. Acad.* i. (1867[71]) p. 321; *Carus, Prodr. Faun. Med.* (1884) p. 107; *Lampert, Seewalzen*, (1885) p. 17; *Théel, Chall. Rep. Hol.* (1886) p. 99; *Bell, Ann. & Mag.* viii. (1891) p. 406; *Ludwig, Klass. u. Ordn.* (1891) p. 344.
- Pentacta*, *Jäger, De Hol.* (1833) p. 11 (*non Goldfuss*) (pars); *Verrill, Trans. Connect. Acad.* i. (1867[71]) p. 321.
- Cladodactyla*, *Brandt, Prodr. descr.* (1835) p. 43.
- ? *Psolinus*, *Forbes, Brit. Starf.* (1841) p. 207.
- Ocnus*, *Forbes & Goodsir, op. cit.* p. 229; *Semper, Hol.* (1867) p. 54; *Carus, Prodr. Faun. Med.* (1884) p. 109; *Lampert, Seewalz.* (1885) p. 17; *Théel, Chall. Rep. Hol.* (1886) p. 117.
- Botryodactyla*, *Ayres, Proc. Bost. Soc. Nat. Hist.* iv. (1854) p. 52.
- Echinocucumis*, *Sars, Forh. Vid. Selsk. Christiania*, 1858 (1859), p. 176; *id. Norg. Ech.* (1861) p. 102.
- Pentactella*, *Verrill, Bull. U.S. Nat. Mus.* no. 3 (1876), p. 68.
- Semperia*, *Lampert, Seewalz.* (1885) p. 150.

A dendrochirotous form with ten tentacles, of which two are ordinarily smaller than the rest, in which the podia are set in rows

along the ambulacra, and may also be found sporadically on the interambulacra.

Key to the Species.

- A. Podia confined to ambulacra (stichopod).
 I. Podia non-retractile.
 Skin smooth 1. *C. hyndmani*.
 Skin very stiff ... 4. *C. lactea*.
 II. Podia retractile.
 a. Skin smooth.
 Attenuated at either end 3. *C. pentactes*.
 Body sac-like or elongated 2. *C. planci*.
 β. Skin rough 5. *C. hispida*.
 B. Podia scattered (sporadipod) 6. *C. frondosa*.

1. *Cucumaria hyndmani*. (Plate II. fig. 1.)

- Holothuria hyndmani*, *Thompson, Ann. & Mag.* v. (1840) p. 100.
Cucumaria hyndmanni, *Forbes, Brit. Starf.* (1841) p. 225; *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 299, pl. xi. fig. 56, pl. iv. figs. 8-14; *Sars, Norg. Ech.* (1861) p. 101; *Norman, Rep. Brit. Assoc.* 1868 (1869), p. 317; *Lampert, Seewalzen*, (1885) p. 147; *Théel, Chall. Rep. Hol.* (1886) p. 108; *Chadwick, Rep. Liverpool Biol. Soc.* iii. (1889) p. 180; *Hoyle, J. Linn. Soc.* xx. (1890) p. 458; *Sladen, Proc. R. Irish Ac.* i. (1891) p. 702.
Cucumaria hyndmani, *Thompson, Nat. Hist. Irel.* iv. (1856) p. 443; *Marenzeller, Verh. zool.-bot. Ges. Wien*, xxiv. (1874) p. 309.
Cucumaria pentactes, *Brady & Robertson, P. Z. S.* 1871, p. 690.

Body tapering a little or hardly at all posteriorly; skin whitened and rough, with large stout scales of considerable thickness; podia only slightly retractile, pretty regularly set in two close rows along each ambulacrum.

Deposits as shown in Pl. II. fig. 1; only scales and rods present. Not more than four inches long, often less.

The podia are of a dark colour, and the tentacles are pale.

Distribution. British and Norwegian coasts; Mediterranean. To 420 fms.

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| <i>a-c.</i> 56° 13' N., 14° 18' W., 420 fms. | 'Porcupine' Exp. |
| <i>d-f.</i> 56° 7' W., 14° 19' W., 630 fms. | 'Porcupine' Exp. |
| <i>g.</i> Loch Craignish. | Hon. A. E. Gathorne Hardy. |
| <i>h.</i> West coast of Scotland. | John Murray, Esq. |
| <i>i-k.</i> 51° 57' N., 13° 39' W., 251 fms. | 'Porcupine' Exp. |
| <i>l, m.</i> Firth of Lorn, 70-80 fms. | John Murray, Esq. |
| <i>n.</i> Firth of Lorn, 20 fms. | John Murray, Esq. |
| <i>o-y.</i> Firth of Lorn, 50-70 fms. | John Murray, Esq. |
| <i>z.</i> Cornwall. | |
| <i>a', b'.</i> Off Liverpool. | |

2. *Cucumaria planci*. (Plate II. fig. 2 & Plate VIII. fig. 1.)

Holothuria pentacta, L., *Gmelin, Syst. Nat.* xiii. (1788) p. 3139 (partim).

Holothuria doliolum, Lamk. *An. s. Vert.* iii. (1816) p. 74 (partim); *de Bl. Dict. Sci. Nat.* xxi. (1821) p. 317 (partim).

Cucumaria planci, Marenzeller, *Verh. zool.-bot. Ges. Wien*, xxiv. (1874) p. 300; Ludwig, *Mitth. zool. Stat. Neap.* i. (1879) p. 565; Carus, *Faun. Medit.* (1885) p. 107; Lampert, *Seewalzen*, (1885) p. 140; Théel, *Chall. Rep. Hol.* (1886) p. 101; Chadwick, *Proc. Liverpool Biol. Soc.* iii. (1889) p. 180; *id. op. cit.* v. (1891) p. 81 (spontaneous fission).

Body more or less cylindrical; skin slightly wrinkled, not very rough with very numerous, rather small scales; podia retractile, and sometimes appearing as mere knobs, arranged in two not very regular rows in each ambulacrum.

Deposits in the form of spherical scales, with few perforations and many knobs and delicate hemispherical framework (Pl. II. fig. 2).

One to four inches long.

Skin brownish or with brown patches, podia of a much lighter colour.

Distribution. Eastern side of North Atlantic, from Portuguese to British coasts; Mediterranean; Mauritius (?). 9–30 fms.

a-b. Off Kerrera.

J. Murray, Esq.

c-e. Off Liverpool.

f-k. Coast of Cornwall.

l. Coast of Cornwall.

m. Falmouth.

W. P. Cocks, Esq.

n-q. S. Devon.

Mus. Leach.

(" *Holothuria communis*.")

3. *Cucumaria pentactes*. (Plate III. fig. 1 & Plate VIII. fig. 2.)

? *Hydra corolliflora*, Gaertner, *Phil. Trans.* lii. (1762) p. 80, pl. i. b. fig. 3.

Holothuria pentactes, (?) *Linn. Syst. Nat.* xii. (1767) p. 1091; (?) O. F. Müller, *Prodr. Zool. Dan.* (1776) p. 232; (?) Pennant, *Brit. Zool.* iv. (1777) p. 42, fig. 41; (?) O. F. Müller, *Zool. Dan.* i. (1788) p. 36, pl. xxxi. fig. 8; Fleming, *Brit. An.* (1828) p. 482; Thompson, *Ann. & Mag.* v. (1840) p. 247.

Le fleurilardé, *Dicquemare, Observ. sur la physique*, xii. (1778) p. 283; Bell, *Ann. & Mag.* viii. (1891) p. 406.

Holothuria pentactes, var., Montagu, *Linn. Trans.* ix. (1808) p. 112, pl. vii. fig. 4.

Holothuria pentacta, Gmelin, *Syst. Nat.* (1789) p. 3139 (partim); ? Lamk. *An. s. Vert.* iii. (1816) p. 73.

Holothuria dicquemarii, de Bl. *Dict. Sci. Nat.* xxi. (1821) p. 317.

Holothuria gaertneri, *id. op. cit.* p. 318.

Holothuria montaguui, Fleming, *Brit. An.* (1823) p. 483.

Cucumaria pentactes, Forbes, *Brit. Starf.* 1841, p. 213; Maitland, *Faun. Belg.* (1851) p. 95; Thompson, *Nat. Hist. Irel.* iv. (1856) p. 442; Lampert, *Seewalzen*, (1885) p. 145; Carus, *Faun. Med.* (1885) p. 107; Bell, *Proc. R. Irish Ac.* iv. (1886) p. 620; Topsent, *Bull. Soc. Linn. Norm.* ii. (1889) p. 112.

- Cucumaria elongata*, *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 301, pl. iv. fig. 14, & pl. xi. fig. 56; *Sars, Nyt Mag.* x. (1859) p. 76, pl. ii. figs. 44-48; *Marenzeller, Verh. zool.-bot. Ges. Wien*, xxiv. (1874) p. 306; *Théel, Chall. Rep. Hol.* (1886) p. 106.
Holothuria fusiformis, *Forbes & Goodsir, Athenæum*, 1839, no. 618, p. 647; *Forbes, Brit. Starf.* (1841) p. 219; *Norman, Rep. Brit. Assoc.* 1868 (1869), p. 316.

Body elongated, sometimes very narrow, and rather frequently a good deal narrower posteriorly than anteriorly. Podia not in regular double rows at ends of body, varying somewhat in the extent to which they may be retracted after death.

Deposits irregular in form, but often of large size and sufficiently numerous to make the body-wall stiff.

Of all sizes, up to six inches, as *C. montagui* is probably only a variety.

Distribution. Eastern side of North Atlantic, from Spanish coast to within Arctic circle; White Sea (?); Mediterranean. 10 to 50 fms.

a-e. Plymouth.

f. Weymouth.

W. Thompson, Esq.

4. *Cucumaria lactea*. (Plate III. fig. 2.)

Holothuria lactea, *Forbes & Goodsir, Athenæum*, no. 618, 1839, p. 647.

Holothuria brunnea, *Thompson, Ann. & Mag.* v. (1840) p. 100.

Ocnus lacteus, *Forbes, Brit. Starf.* (1841) p. 231; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 443; *Lampert, Seewalzen*, (1885) p. 131.

Ocnus brunneus, *Forbes, op. cit.* p. 229; *Thompson, op. cit.* p. 443.

Cucumaria lactea, *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 297, pl. iv. figs. 3-7, pl. xi. fig. 55; *Sars, Norg. Ech.* (1861) p. 101; *Barrois, Cat. Crust.* (1882) p. 51; *Théel, Chall. Rep. Hol.* (1886) p. 101.

Cucumaria brunnea, *Hérouard, Arch. Zool. expér.* vii. (1889) p. 682.

Holothuria badotriæ, *Dalyell, Powers*, i. (1851) p. 72, pls. xiii. & xiv.

In many points resembling *C. planci*.

Body pretty regularly cylindrical; skin rather stiff and rough, white or brown in colour. Podia in a single zigzag row in each ambulacrum, feebly retractile.

Deposits not unlike those of *C. planci*, but the holes of the disks larger and the knobs less numerous.

Not much more than an inch long and frequently smaller.

Distribution. British seas, and West Norway. 0-50 fms.

a-d. Plymouth.

5. *Cucumaria hispida*. (Plate IV fig. 1.)

Eupyrgus hispidus, *Barrett, Ann. & Mag.* xx. (1857) p. 46, pl. iv. fig. 1.

Echinocucumis typica, *Sars, Forh. Vid. Selsk. Christ.* 1858 (1859), p. 174; *id. Norg. Ech.* (1861) p. 102, pl. x. figs. 11-20; *Semper*,

Hol. Phil. (1868) p. 271; *Pourt. Bull. Mus. C. Z.* i. (1869) p. 359; *Möb. & Bütsch. JB. Comm. Kiel*, ii. & iii. (1875) p. 151; *Norman, Ann. & Mag. N. H.* vi. (1880) p. 435; *Hoffm. Nederl. Arch. f. Zool.*, Suppl. Bd. i. (1881) *Ech.* p. 17; *Théel, Proc. Roy. Soc. Edinb.* xi. (1882) p. 694; *Lampert, Seewalzen*, (1885) p. 166; *Théel, Chall. Rep. Hol.* (1886) p. 118.

Cucumaria typica, *Ludwig, Klass. u. Ordn.* (1891) p. 344.

Body very small, bowed on itself, the terminal seventh or eighth part very much narrower than the rest. Body-wall firm, owing to the presence of large, flat, calcareous scales (Pl. IV. fig. 1), which are perforated with a number of small holes and many of which have a projecting spine; these spines give a very characteristic hedgehog-like appearance. The podia completely developed in the three ventral rows, where they are set in a zigzag.

Colour whitish.

Size about half an inch.

Distribution. Both sides of North Atlantic, extending from the Arctic Sea to the Bay of Biscay, and from 40–555 fms.

a. 54° 1' N., 12° 14' W., 422 fms.

'Porcupine' Exp.

6. *Cucumaria frondosa*. (Plate IV. fig. 2.)

Holothuria frondosa, *Gummerus, Vet.-Akad. Hdlg.* xxviii. (1767) p. 115, pl. iv. figs. 1 & 2; *Linn. Syst. Nat.* xii. (1767) p. 1089; *O. F. Müller, Prod. Zool. Dan.* (1776) p. 231; *Fabricius, Faun. Grœnl.* (1780) p. 353; *Lamk. An. s. Vert.* iii. (1816) p. 73.

Holothuria pentactes, *O. F. Müller, Prod. Zool. Dan.* (1776) p. 232; *Fabr. Faun. Grœnl.* (1780) p. 352; *O. F. Müller, Zool. Dan.* i. (1788) p. 36, pl. xxxi. fig. 8; *Abilgaard, Zool. Dan.* iii. (1789) p. 45, pl. cviii. figs. 1–4; *Vahl, in Rathke, Zool. Dan.* iv. (1806) p. 3, pls. cxxiii.–vii.

Pentacta frondosa, *Jäger, De Hol.* (1833) p. 12; *Maitland, Faun. Belg.* (1851) p. 95; *Stimpson, Inv. Grand Manan* (1853) p. 16; *Ayres, Proc. Cal. Acad. Nat. Sci.* i. (1855) p. 68; *Verrill, Proc. Bost. Soc. N. H.* x. (1866) pp. 352 & 357; *Rathbun, Fisheries U.S.* (1884) p. 838.

Cuvieria (?) *frondosa*, *de Bl. Dict. Sci. Nat.* lx. (1830) p. 173.

Holothuria grandis, *Forbes & Goodsir, Athenæum*, 1839, no. 618, p. 647.

Holothuria fucicola, *id. ibid.*

Cucumaria frondosa, *Forbes, Brit. Starf.* (1841) p. 209; *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 293, pl. iv. fig. 1; *Lütken, Vid. Medd.* 1857, p. 2; *McAndrew & Barrett, Ann. & Mag.* xx. (1857) p. 43; *Sars, Norg. Ech.* (1861) p. 100; *Selenka, Zeit. wiss. Zool.* xvii. (1867) p. 347, pl. xix. fig. 102; *Semper, Hol. Phil.* (1868) pp. 234 & 268; *Norman, Rep. Brit. Assoc.* 1868 (1869), p. 316; *Pourtales, Bull. Mus. C. Z.* i. (1869) p. 359; *Duncan & Sladen, Arctic Echin.* (1883) p. 2, pl. i. figs. 1 & 2; *Ludwig, Notes Leyden Mus.* iv. (1882) p. 129; *Jensen, Arch. Biol.* iv. (1883) p. 74; *Lampert, Seewalzen*, (1885) p. 135; *Théel, Chall. Rep. Hol.* (1886) p. 110.

Botryodactyla grandis, *Ayres, Proc. Bost. Soc. N. H.* iv. (1852) p. 52.

Botryodactyla affinis [n. n.], *id. tom. cit.* p. 145.

Attains a large size. Podia not confined to ambulacra. Body a more or less swollen sac; podia retractile, sometimes in four rows in ambulacra near middle of body; not many interambulacra podia; the arrangement of the podia varies a good deal with age. Skin soft and smooth.

Deposits very variable both in form and in the extent to which they are developed; often almost or quite absent in large examples.

Colour ordinarily purplish or dark slate, the podia lighter, as is sometimes the ventral surface. Occasionally the whole creature is of a much lighter hue.

May be as much as a foot long, and four or five inches wide, capable of extension to twice this length or more.

Distribution. Circumpolar, extending southwards to Britain, Florida Reef, and California. 3–220 fms.

- | | |
|--------------------------------|-------------------|
| a. Off Faeroe Islands, 70 fms. | R. K. Burt, Esq. |
| b. Orkneys. | |
| c–k. West coast of Scotland. | John Murray, Esq. |
| l–m. Montrose. | W. Duncan, Esq. |
| n. Plymouth. | |

7. *Cucumaria fucicola*.

Holothuria fucicola, Forbes & Goodsir, *Athenæum*, no. 618 (1839), p. 647; Norman, *Rep. Brit. Assoc.* 1868 (1869), p. 316; Ljungman, *Öfv. Vet.-Ak. Förh.* 1879, no. 9, p. 127.

I have not seen this species, which most authors have united with *C. frondosa*. Mr. Norman, however, noted the following points of difference. He says:—

“*Cucumaria fucicola* (Forbes & Goodsir).

“The type-specimens were found not uncommonly ‘in Bressay Sound, Shetland, in 7 fathoms water, adhering to the stems of *Laminariæ*,’ and thus in the same locality with *C. frondosa*. Von Düben and Koren (*Öfversigt af Skandinav. Echinod.* p. 294) referred this species to the young of *C. frondosa*, and their synonymy has been copied by all subsequent writers without inquiry. But the young of *C. frondosa* is like the adult, in that ‘corpus, collum et pedum latera teguntur *granulis* calcareis, irregularibus, difformibus, *nunquam perforatis*,’ which is not the case with *C. fucicola*.

“Specimens of this species, procured by myself in the typical locality, have the skin supplied with calcareous plates, which are very irregular in form and size, but when fully developed are nearly round, rather longer, however, than broad, and perforated with as many as 30–40 holes. The sides of the feet are likewise furnished with the irregular-shaped, elongated, perforated plates common in this position in the different species of the genus; but these *feet-spicules* I have also observed sparingly present in the young of *C. frondosa*, though in the passage above quoted Düben and Koren deny their existence.”

8. *Cucumaria andrewsii*.

Pentactes andrewsii, Farran, *Proc. Nat. Hist. Soc. Dublin*, i. (1860)* p. 155.

Thyone andrewsii, Kinahan, *Nat. Hist. Rev.* vi. (1859) p. 368; *Lampert, Seewalzen*, (1885) p. 164; *Théel, Chall. Rep. Hol.* (1886) p. 141.

Nothing can be said about this species except that it is certainly a *Cucumaria*; a leading ground for regarding it as new was the canary colour of the tentacles.

It was taken at Clonea, co. Waterford, and was found intertwined among the roots of *Laminaria digitata*.

Species incertæ vel inquirendæ.

1. *Hol. decollata*, Leach, is a MSS. name, *apud* Gray, *Brit. Rad.* (1848) p. 11, a synonym of *Cucumaria montagui*, Fleming, and wrongly cited by Théel, *Chall. Rep.* 1886, p. 116.

2. *Cucumaria neillii*, Fleming, *Brit. An.* (1828) p. 483.

3. *Cucumaria dissimilis*, *id. loc. cit.*

4. *Cucumaria saxicola*, Brady & Robertson, *Proc. Zool. Soc.* 1871, p. 690.

3. THYONE.

Thyone, Oken, *Lehrb. Naturg.* iii. (1815) p. 351; *Düb. & Kor. Vet.-Ak. Hdlg.* 1844 (1846), p. 308; *Semper* (sens. emend.), *Hol. Phil.* (1867) p. 64; *Théel, Chall. Rep. Hol.* (1885) p. 132; *Ludwig, Klass. u. Ordn.* (1891) p. 346.

Mulleria, Fleming, *Brit. An.* (1827) p. 484.

Anaperus, Trosch. *Arch. f. Nat.* xii. (1846) p. 60.

Sclerodactyla, Ayres, *Proc. Bost. Soc. Nat. Hist.* iv. (1854) p. 6.

Stereoderma, *id. tom. cit.* p. 46.

Pentamera, *id. t. c.* p. 207.

Stolus, Selenka, *Zeits. f. w. Zool.* xvii. (1867) p. 355.

Uroxia, Costa, *Ann. Mus. Zool. Nap.* v. (1869) p. 57.

Thyonella, Verrill, *Amer. Journ. Sci.* iii. (1872) p. 437.

Trachythyone, Studer, *M.B. Ak. Berl.* 1876, p. 453.

A dendrochirotus form with ten tentacles, of which the two ventral are smaller than the other eight, the podia numerous and scattered, rarely exhibiting any arrangement in rows; the anus is often armed with five calcareous teeth.

Key to the Species.

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|---------------------------------------|-------------------------|
| 1. Body not curved on itself | 1. <i>T. fusus</i> . |
| 2. Body curved on itself | 2. <i>T. raphanus</i> . |

Spec. inquire.

- | | |
|------------|------------------------|
| 3. | 3. <i>T. flexus</i> . |
| 4. | 4. <i>T. elegans</i> . |

* The communication of Farran bears date Nov. 21st, 1852, and a notice was published in some newspaper—not, however, as Kinahan states, ‘in Saunders’s Newsletter’ for February 1852; I have vainly searched journals about that date.

1. *Thyone fusus*. (Plate V. fig. 1 & Plate VII. fig. 3.)

- Holothuria fusus*, *O. F. Müll. Zool. Dan.* i. (1788) p. 11, pl. x. figs. 5 & 6; *Gmel. Syst. Nat.* xiii. (1780) p. 3141; *Lamk. An. s. Vert.* iii. (1816) p. 74; *Rathke, Nov. Act.* xx. (1843) p. 140, pl. vi. figs. 24 & 25.
- Holothuria penicillus*, *O. F. Müll. Zool. Dan.* i. (1788) p. 10, pl. x. fig. 4.
- Holothuria papillosa*, *Gmel. Syst. Nat.* xiii. (1788) p. 3140; *O. F. Müll. Zool. Dan.* iii. (1789) p. 47, pl. cviii. fig. 5.
- Mülleria papillosa*, *Johnston, Loudon's Mag. Nat. Hist.* vii. (1834) p. 584, fig. 66.
- Thyone fusus*, *Ag. Mem. Soc. Neuchât.* i. (1835) p. 181; *Koren, Nyt Mag.* iv. (1845) p. 203, pl. i.; *Düben & Koren, Vet.-Akad. Hdlg.* 1844 (1846), p. 308, pl. v. figs. 42-48, & pl. xi. fig. 52; *Gray, Brit. Rad.* (1848) p. 7; *Sars, Nyt Mag.* x. (1859) p. 79, pl. ii. figs. 49-51; *id. Norg. Ech.* (1861) p. 111; *Semper, Hol. Phil.* (1868) p. 273; *Norman, Rep. Brit. Assoc.* 1868 (1869), p. 317; *Hodgs. Trans. Northumb. & Durham*, iv. (1872) p. 146, pl. ii. figs. 19-40; *Marenz. Abh. z.-b. Ges. Wien*, xxiv. (1874) p. 312; *Ludw. Mitth. zool. Stat. Neap.* i. (1879) p. 567; *Graeffe, Arb. Inst. Wien*, iii. (1881) p. 343; *Barrois, Cat. Crust.* (1882) p. 53; *Lampert, Seewalz.* (1885) p. 161; *Théel, Chall. Rep. Hol.* (1886) p. 134; *Bell, Proc. R. Irish Ac.* iv. (1886) p. 620; *Hérouard, Arch. Zool.* vii. (1889) p. 689.
- Thyone papillosa*, *Forbes, Brit. Starf.* (1841) p. 233; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 444.
- Anaperus fusus*, *Troschel, Arch. f. Nat.* 1846, p. 62.
- Thyone floccosa* [n. n.], *Norman, Rep. Brit. Assoc.* 1863 (1864), *Trans.* p. 106 (teste *N.*).
- Thyonidium pellucidum*, *Barrois, Cat. Crust.* (1882) p. 49.
- Semperia barroisi*, *Lampert, Seewalzen*, (1885) p. 153; *Théel, Chall. Rep. Hol.* (1886) p. 268.
- ? *Thyone subvillosa*, *Hérouard, Arch. Zool.* vii. (1889) p. 687.

Body irregularly fusiform, not curved, and with no tail-like end. Richly covered with podia.

Deposits ordinarily with four holes, occasionally also with smaller outer holes, irregularly oval in form; spire ends in small spines.

Whitish in colour; about a couple of inches long, and one wide.

Distribution. Eastern side of North Atlantic to Lofoten; Mediterranean. 10 to 80 fms.

- a. Loch Etive, 15-20 fms. J. Murray, Esq.
 b-d. Between Canna and Rum, 80-100 fms. J. Murray, Esq.
 e. Weymouth.

2. *Thyone raphanus*. (Plate V. fig. 2 & Plate VIII. fig. 3.)

- Thyone raphanus*, *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), pp. 219 & 311, pl. v. figs. 49-55, pl. xi. figs. 58 & 59; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 444; *Kimahan, Nat. Hist. Rev.* (1859) p. 369; *Sars, Norg. Ech.* (1861) p. 112; *Norman, Rep. Brit. Assoc.* 1868 (1869), p. 317; *Semper, Hol. Phil.* (1868) p. 273; non *Marenz. Verh. z.-b. Ges. Wien*, xxvii. (1877) p. 118 (teste *Marion, Ann. Sci. Nat.* viii. (1879) p. 40); *Hodge, Tr. Nat. Hist. Soc. North.* iv.

(1872) p. 146, pl. iii. figs. 22-30; *Lampert, Seewalzen*, (1885) p. 156; *Théel, Chall. Rep. Hol.* (1886) p. 135; *Bell, Proc. R. Irish Ac.* iv. (1886) p. 620.

Body curved on itself, much narrower in posterior half or third, which looks more like a tail to the rest of the body, which is more or less irregularly semiovate.

Deposits rather small, overlapping plates with a varying number of holes.

Half an inch to an inch or an inch and a half in size. More or less yellow or brown in colour.

Distribution. British and Norwegian seas; Mediterranean. To 155 fms.

a-c. 60° 32' N., 0° 29' W., 64-75 fms.

d-f. Faeroe Channel, 570 fms.

g-h. The Minch.

i-k. Dingle Bay, 40 fms.

l. Shetland.

'Porcupine' Exp.

'Triton' Exp.

'Porcupine' Exp.

Royal Dublin Society.

R. McAndrew, Esq.

3. *Thyone flexus*.

Thyone flexus, *Hodge, Trans. Northumb. & Durh. Nat. Hist. Soc.* i. (1867) p. 44.

"Body-spicules (or plates) of varying forms and dimensions; perforations round or slightly oval; on their first formation four such perforations are arranged round two nodules, which, when viewed sideways, are seen to be two stalks, meeting at the top, and terminating in several minute points; in some cases, that of large plates, three of these 'nodules' are present. The prevailing shape of the plates nearly square, with eight perforations. This form is, however, soon lost in the further growth of the plate, which seldom again presents any regular outline. Feet-spicules much curved, the convex or upper part being produced into two stalks meeting at the tips, and having a triangular opening between them. Each foot furnished with a plate at the extremity, irregular in outline, with numerous irregular perforations, the larger being concentrically arranged."

I have not seen this species, of which, so far as I know, only one specimen has ever been obtained.

4. *Thyone elegans*.

Thyone elegans, *Norman, Rep. Brit. Assoc.* 1868 (1869), p. 317.

"Length 1-2 inches. Body smooth; skin thin, very delicate, totally devoid of all calcareous imbedded spicula: feet numerous but not crowded, scattered all over the body, their sides without spicula, but a large round spiculum at the extremity. This spiculum has round perforations in the centre, exterior to these a circle of large radiating wedge-shaped openings, the spaces between them very narrow; and exterior to these again, and close within the

edge, a few small perforations, the length of which is in the opposite direction to that of the radiating openings, each of them forming a minute segment of a semicircle.

“Tentacula 10 (8 long and 2 very short), completely clothed in a scaly investiture of irregular-shaped cribriform calcareous plates.

“Found in St. Magnus Bay, and also on the Balta Haddock-ground.”

I have not seen this species.

4. PSOLUS.

- Psolus*, *Oken, Lehrb. Naturg.* iii. (1815) p. 352; *Selenka, Zeit. wiss. Zool.* xvii. (1867) p. 342; *Lampert, Seewalzen*, (1885) p. 17; *Théel, Chall. Rep. Hol.* (1886) p. 126; *Ludwig, Klass. u. Ordn.* (1891) p. 350.
Cuviéries, Peron, sec. Cuvier, Règne An. iv. (1817) p. 22 f.n.
Cuvieria, Jäger, De Hol. (1833) p. 20; *de Bl. Actinol.* (1834) p. 191; *Brandt, Prodr. descr.* (1835) p. 47; *Verrill, Proc. Bost. Soc. N. H.* x. (1866) p. 353.
Lepidopsolus, Bronn, Klass. u. Ordn. ii. (1860) p. 404.
Lophothuria, Verrill, Proc. Bost. Soc. N. H. x. (1866) p. 353.
Lissothuria, id. Trans. Connect. Acad. i. (1867[71]) p. 322.

A dendrochirotus form with ten tentacles, in which the trivial surface is flattened to a sole and alone carries podia.

Key to the Species.

- Podia in three complete rows 1. *P. phantapus*.
 Podia of median row few or none 2. *P. fabricii*.

1. *Psolus phantapus*. (Plate VI. fig. 1 & Plate VIII. fig. 4.)

- Holothuria phantapus, Strussenfeldt, Vet.-Ak. Hdlg.* xxvi. (1765) p. 263, pl. 10; *Linnaeus, Syst. Nat.* xii. (1767) p. 1089; *O. F. Müller, Zool. Dan.* iii. (1788) p. 54, pls. cxii. & cxiii.; *Dalyell, Powers of the Creator*, (1851) p. 79, pl. xv.
Ascidia rustica?, *Pennant, Brit. Zool.* iv. (1777) p. 40, pl. xxiii. fig. 35.
Ascidia eboracensis, id. Brit. Zool. (1812) p. 99, pl. xxv. fig. 3.
Cuvieria phantapus, Fleming, Brit. An. (1828) p. 483; *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846) p. 313.
Cuviera phantapus, Johnston, Loudon's Mag. ix. (1836) p. 472, fig. 68.
L'Holothurie phantope, de Bl. Dict. Sci. Nat. lx. (1830) p. 173.
Psolus phantapus, Jäger, de Hol. (1833) p. 21; *Forbes, Brit. Starf.* (1841) p. 203; *Gray, Brit. Rad.* (1848) p. 9; *Maitland, Faun. Belg.* (1851) p. 96; *Stimpson, Inv. Grand Manan*, (1853) p. 16; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 442; *Lütken, Vid. Medd.* 1857, pp. 12 & 68; *Sars, Norg. Ech.* (1861) p. 112; *Selenka, Zeit. wiss. Zool.* xvii. (1867) p. 342, pl. xix. figs. 94 & 95; *Semper, Hol.* (1868) p. 272; *Norman, Rep. Brit. Assoc.* 1868 (1869), p. 316; *Duncan & Sladen, Echinod. Arctic Sea*, (1881) p. 10; *Bell, P. Z. S.* 1882, p. 646; *Lampert, Seewalzen*, (1885) p. 116; *Théel, Chall. Rep. Hol.* (1886) p. 127.

Body moderately curved, hinder portion often greatly constricted

so as to form a little tail; mouth and anus terminal or subterminal; the scales, though often rather large, not prominent, but immersed in the skin; the integument much more flexible than in *P. fabricii*. No special oral plates; circumanal plates small. Podia arranged in three irregularly triple rows on the trivium, which is itself a regular oblong, but does not extend as far forwards or backwards as the rest of the body.

To about four and a half inches long, and less than one and a half broad. Colour light, or more or less dark brown.

The young are much more like *P. fabricii* than the adult, the mouth and anus being dorsal in position, and the plates far less deeply immersed in the skin.

Distribution. Both sides of North Atlantic, as far south as Massachusetts Bay, and British Isles, and in the North Sea*. To 127 fms.

a. Firth of Lorn, 50-110 fms. J. Murray, Esq.
b-f. Coast of Northumberland (dry and in spirit).

2. *Psolus fabricii*. (Plate VI. fig. 2.)

Cuvieria fabricii, *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 316, f.n.; *Ayres, Proc. Bost. Soc. N. H.* iv. (1854) p. 35; *Stimpson, Marine Invert. Grand Manan*, (1853) p. 16.

Psolus fabricii, *Semper, Hol.* (1868) pp. 62 & 272; *Marenzeller, Denks. Ak. Wien*, xxxv. (1878) p. 388; *Duncan & Sladen, Echinod. Arctic Sea*, (1881) p. 10; *Lampert, Seewalzen*, (1885) p. 120; *Théel, Chall. Rep. Hol.* (1886) p. 128.

Lophothuria fabricii, *Verrill, Proc. Bost. Soc. N. H.* x. (1866) p. 354.

Holothuria squamata, *Fabricius, Faun. Grœnl.* (1780) p. 356; *Gould, Inv. Anim. Mass.* (1841) p. 346.

The curved back and vertical sides covered by large overlapping plates, among which are some that are smaller; as the margin is approached the plates become quite small; the plates increase in size with the animal; a special set of smaller, more rod-like plates round mouth and anus, both of which are on the dorsal surface. Podia arranged in an irregular double row round the margin of the foot, a few only extending into the middle line.

Three inches or more long, about two broad.

Colour whitish, greyish, or light brown.

Distribution. Circumpolar, extending as far south as Massachusetts Bay; Shetland; Japan. 5-148 fms.

a. Shetland. J. Gwyn Jeffreys, Esq.

* Dr. Théel (*Chall. Rep.* 1886, p. 129) gives the British Islands as one of the localities for *P. squamatus*, and cites as his authorities "Norman, Hodge;" so far, however, as I am able to understand these excellent authorities, they agree in thinking that all specimens assigned to that species, and said to be of British origin, have been wrongly so assigned; see Norman, *Brit. Assoc.* 1868 (1869), p. 396, and Hodge, *Trans. Northumb. & Durh.* iv. (1872) p. 148.

*Incertæ sedis.***Colochirus andersoni.**

Colochirus andersoni, *Lampert, Seewalzen*, (1886) p. 128.

Holothuria sp., *J. Anderson, Ann. & Mag.* ix. (1862) p. 189, pl. xi.

This would certainly appear to be a *Colochirus*, but that genus is not represented beyond the Indian and Pacific Oceans, except by one species found at Bahia. It was taken at Bressay, Shetland, and there is still some hope that the type may be recovered.

5. PHYLLOPHORUS.

Phyllophorus, *Grube, Actin. etc. Mittelm.* (1840) p. 38; *Semper, Hol. Phil.* (1867) p. 40; *Lampert, Seewalzen*. (1885) p. 18; *Théel, Chall. Rep. Hol.* (1886) p. 150; *Ludwig* (sens. emend.), *SB. Ak. Berl.* 1887, p. 1240; *id. Klass. u. Ordn.* (1891) p. 347.

Thyonidium, *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 303; *Semper, Hol. Phil.* (1868) p. 39; *Lampert, Seewalzen*, (1885) p. 18; *Théel, Chall. Hol.* (1886) p. 143.

Thyroidium, *Gray, Brit. Aud.* (1848) p. 11.

Duasmodyctyla, *Ayres, Proc. Bost. Soc. Nat. Hist.* iv. (1852) p. 244.

Hemicrepis, *J. Müller, Abh. Ak. Berl.* 1853 (1854), p. 209.

Urodemas, *Selenka, Zeitschr. f. wiss. Zool.* xvii. (1867) p. 352.

Pattalus, *id. op. cit.* xviii. (1868) p. 113.

Eucyclus, *Lampert, Seewalzen*, (1885) p. 290.

A polychirote dendrochirotous Holothurian in which there are more than fifteen tentacles, unequal in size; the smaller alternate with the larger and form an inner ring; podia scattered.

Key to the Species.

Tables in body-wall generally	1. <i>P. pellucidus</i> .
Tables, if present in body-wall, confined to anterior region	2. <i>P. drummondii</i> .

1. *Phyllophorus pellucidus*. (Plate V. fig. 3.)

Thyonidium pellucidum, *Düb. & Kor. Vet.-Ak. Hdlg.* 1844 (1846), p. 303, pl. iv. figs. 15-17, pl. xi. fig. 57; (*non Holothuria pellucida*, *Vahl in Zool. Dan.* iv. (1806) p. 17, pl. cxxxv. fig. 1); ? *Fleming, Brit. An.* (1828) p. 483; ? *Forbes & Goods. in Athenæum*, 1839, no. 618, p. 647; ? *Sars, Nyt Mag.* vi. (1851) p. 164; *Semper, Hol. Phil.* (1868) p. 274; *Lampert, Seewalzen*, (1885) p. 170; *Théel, Chall. Rep. Hol.* (1886) p. 145.

? *Cucumaria hyalina*, *Forbes, Brit. Starf.* (1841) p. 221 (fide auctor. multor.).

Pentacta pentactes, *Oersted, De region. mar.* (1844) p. 74 (fide *Düb. & Kor.*).

Thyonidium hyalinum, *Lütke, Vid. Medd.* 1857, p. 69; *Sars, Forh. Vid. Selsk. Christ.* 1858 (1859), p. 169; *id. Norg. Ech.* (1861) p. 111; *Norman, Rep. Brit. Assoc.* 1868 (1869), p. 317; *Ijungman, Vet. Ak. Förh.* 1879, p. 129.

Phyllophorus pellucidus, *Ludwig, Klass. u. Ordn.* (1891) p. 347.

Body elongated, constricted at either end, with a thin, almost transparent wall; the five longitudinal muscular bands quite apparent. Twenty tentacles, arranged in pairs, alternately smaller and larger. Very little order in the disposition of the podia, which are small and by no means closely packed. Tables generally distributed in the body-wall, but not numerous; characterized chiefly by the teeth at the top of the spire.

Colour pale brown in spirit.

Two to four inches long, and nearly half as wide in the middle of the body.

Distribution. Both sides of Atlantic, as far south as British Isles and Florida Reef; Arctic Ocean (White Sea). 5-70 fms.

a. The Minch. J. Gwyn Jeffreys, Esq.
b-d. Firth of Lorn, 60-70 fms. J. Murray, Esq.

2. *Phyllophorus drummondii*. (Plate V. fig. 4 & Plate VII. fig. 4.)

Holothuria drummondii, *Thompson, Ann. & Mag.* v. (1840) p. 100.

? *Cucumaria communis*, *Forbes, Brit. Starf.* (1841) p. 217.

Cucumaria drummondii, *id. t. c.* p. 223; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 443.

Thyone portlockii, *id. t. c.* p. 238.

? *Holothuria fusus*, *Oersted, De reg. mar.* (1844) p. 74 (fide *Düb. & Kor.*).

Thyonidium commune, *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 305, pl. iv. figs. 18-23, pl. xi. fig. 51; *Lampert, Seewalzen*, (1885) p. 176.

Thyonidium drummondii, *Gray, Brit. Rad.* (1848) p. 11.

Thyonidium drummondii, *Sars, Norg. Ech.* (1861) p. 110; *Théel, Chall. Rep. Hol.* (1886) p. 143.

Phyllophorus drummondii, *Ludwig, Klass. u. Ordn.* (1891) p. 347.

? *Thyonidium dubeni*, *Norman, Rep. Brit. Assoc.* 1868 (1869), p. 317.

Semperia drummondii, *Hérouard, Arch. Zool. expér.* vii. (1889) p. 683.

Body elongated, tapering sometimes slightly posteriorly; wall, in spirit, somewhat wrinkled, sometimes marked by longitudinal grooves, much thicker than in *P. pellucidus*. Tentacles somewhat irregular in disposition, the smaller not always arranged in pairs, all of a deep violet colour. The podia more numerous than in *P. pellucidus*, best developed on the ventral surface, pretty regularly disposed along the ambulacra.

Colour of body creamy or white.

May be more than five inches long, but is not nearly as broad in the middle as *P. pellucidus*.

Distribution. East side of North Atlantic from British Channel to Norway. To 80 fms.

a, b. Off Kerrera, 20 fms. J. Murray, Esq.
c. Firth of Lorn, 70-80 fms. J. Murray, Esq.
d, e. Cornwall.

6. HOLOTHURIA.

- Holothuria (pars), *Linn. Syst. Nat.* xii. (1767) p. 1089; *Gunnerus, Act. Holm.* 1767, p. 115; *O. F. Müll. Prod. Zool. Dan.* 1776, p. 231; *Lamk. An. s. Vert.* (1801) p. 351; *Cuvier, Règne An.* (1821) p. 310; *de Bl. Dict. Sci. Nat.* xxi. (1821) p. 310; *Jäger, De Hol.* (1833) p. 21; *de Bl. Act.* (1834) p. 192; *Brandt, Prodr. descr. An.* (1835) p. 53.
- Actinia, Pallas, Misc. Zool.* 1766, p. 152 (non *Linnæus*).
- Holothuria, *Goldfuss, Zoologie*, (1820) p. 177; *Düb. & Kor. Vet. Ak. Hdlg.* 1844 (1846), p. 318; *Selenka, Zeits. f. w. Zool.* xvii. (1867) p. 321; *Semp. Hol. Phil.* (1868) p. 77; *Lampert, Seewalz.* (1885) p. 16; *Théel, Chall. Rep. Hol.* (1886) p. 202; *Bell, Ann. & Mag.* viii. (1891) p. 108; *Ludwig, Bronn's Kl. u. Ordn.* i. (1891) p. 329.
- Fistularia, Lamk. An. s. Vert.* iii. (1816) p. 74.

Aspidochirote Holothurians with twenty tentacles, more or less, without anal "teeth" as in *Actinopyga*, or C-shaped deposits as in *Stichopus*; the genital tubes in one tuft; the podia usually scattered, sometimes in the form of pedicels, sometimes of papillæ.

Key to the Species.

- | | |
|---|----------------------------|
| Pedicels only | 1. <i>H. intestinalis.</i> |
| Pedicels and papillæ | 2. <i>H. tremula.</i> |
| Pedicels almost entirely ventral. | 3. <i>H. nigra.</i> |
| Two rows of pedicels on either side of the body . . . | 4. <i>H. aspera.</i> |

1. *Holothuria intestinalis.* (Plate VI. fig. 3.)

Holothuria intestinalis, Ascanius & Rathke, Icones, v. (1805) pl. xlv.; *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 321, pl. iv. figs. 28-33; *Forbes & Goodsir, Trans. Roy. Soc. Edin.* xx. (1853) p. 309, pl. ix. fig. 1; *Sars, Norg. Ech.* (1861) p. 113; *Norman, Rep. Brit. Assoc.* 1866 (1867), p. 195; *Jarzynsky, Trans. Petersb. Soc. Nat.* i. (1870) p. 319; *Marenzeller, Verh. zool.-bot. Ges. Wien*, xxvii. (1877) p. 121; *Lampert, Seewalzen*, (1885) p. 60; *Théel, Chall. Rep. Hol.* (1886) p. 209.

Fistularia mollis, Sars, Beskriv. og Jagttag. (1835) p. 40.

Thyonidium scabrum, Sars, Forh. Vid. Selsk. Christ. 1867 (1868), p. 19; *G. O. Sars, op. cit.* 1871 (1872), p. 27 f. n.

Body elongated; skin wrinkled, often entangling debris of sand and shell, a little rough to the touch; podia numerous, scattered, larger on the dorsal than the ventral surface. Deposits in the form of tables only; these have a disk with a central hole and about ten perforations round it, with perhaps some smaller; margin of disk wavy; spire well-developed, with a transverse bar, and terminating in short spines.

Colour yellowish in spirit.

Size up to 9 or 10 inches in length; breadth one third to one fourth the length.

Distribution. Eastern side of North Atlantic, from British Islands northwards; White Sea. To 672 fms.

- a. The Minch. J. Gwyn Jeffreys, Esq.
 b-c. Kilbrennan Sound, 50 fms. 3/4/88. John Murray, Esq.
 d-f. 4 miles S.E. Sanda, 30-38 fms. 19/3/88. John Murray, Esq.
 g-k. North of Scalpa, 40-60 fms. John Murray, Esq.

2. *Holothuria tremula*. (Plate VI. fig. 4.)

Holothuria tremula, *Gunnerus, Vet.-Akad. Hdlg.* xxviii. (1767) p. 119, pl. iv. fig. 3; *Linn. Syst. Nat.* xii. (1767) p. 1090 (partim); *Ascanius & Rathke, Icones*, (1805) pl. xlv.; *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 319, pl. iv. figs. 24-27; *Sars, Norg. Ech.* (1861) p. 113; *Selenka, Zeit. f. wiss. Zool.* xvii. (1867) p. 340, pl. xix. figs. 90-93; *Norman, Ann. & Mag.* vi. (1880) p. 435; *Lampert, Seewalzen*, (1885) p. 83; *Théel, Chall. Rep. Hol.* (1886) p. 212; *Bell, Ann. & Mag.* iv. (1889) p. 444; *id. J. Mar. Biol. Assoc.* i. (1890) p. 326.

Holothuria elegans, *O. F. Müller, Prod. Zool. Dan.* (1776) p. 231; *id. Zool. Dan.* (1788) p. 1, pls. i.-iii.; *de Bl. Dict. Sci. Nat.* xxi. (1821) p. 316; *Jäger, De Hol.* (1833) p. 22.

Holothuria (Thelenota) *elegans*, *Brandt, Prod. descr. An.* (1835) p. 53.

Fistularia elegans, *Lamk. An. s. Vert.* iii. (1816) p. 75.

Body elongated, skin thick, with conical papillæ on the dorsal surface; more or less extensive rosy patches which, after immersion in spirit, gradually become dark. The mouth surrounded by two circlets of papillæ. The ventral podia somewhat variable in size and number. The tables (Pl. VI. fig. 4) have delicate disks with four large central and a varying number of smaller peripheral angulated holes; the margin with a number of angular projections. A number of simple or branched rods present near the podia.

Distribution. Eastern side of North Atlantic from Bay of Biscay to Norway. 45-672 fms.

- a, b. 45 miles off Blackrock, 500 fms. Royal Dublin Society.
 c. 50 miles W. $\frac{1}{2}$ S. of Dursley Head, 325 fms. R. Irish Academy.
 d, e. 49° to 50° N., 9° to 11° W., 70-400 fms. G. C. Bourne, Esq.
 f, g. Ross of Mull, 45-60 fms. John Murray, Esq.

3. *Holothuria nigra*. (Plate VI. fig. 5 & Plate VIII. fig. 5.)

Holothuria nigra, *auct.*

The Nigger or Cottonspinner, *Peach, Ann. & Mag. N. H.* xv. (1845) p. 171, pl. xiv.

Cucumaria niger, *Kinahan, Nat. Hist. Rev.* vi. (1859) p. 369.

Holothuria niger, *Foot, op. cit.* vii. (1860) p. 394.

Holothuria nigra, *Bell, P. Z. S.* 1884, pp. 372 & 563; *id. Nature*, xxx. (1884) pp. 146 & 335; *Lampert, Seewalzen*, (1885) p. 92; *Tregelles, Trans. Penzance Nat. Hist. Soc.* ii. (1886) p. 204; *id. tom. cit.* (1888) p. 376; *Macmunn, J. Mar. Biol. Assoc.* i. (n. s.) (1889) p. 57; *Minchin, Ann. & Mag. N. H.* x. (1892) p. 273.

? *Forbsia* *, *Couch, Cornish Fauna*, ii. (1841) p. 73.

* Not *Psolus forbesi* as Peach cites it.

Body elongated, flattened behind, with the podia almost entirely confined to the ventral surface. Integument very soft, body-wall rather thick, deposits scarce. Dorsal surface papillose. The deposits are perforated with four large holes.

Colour—sometimes dark above, with yellow tentacles and lower surface, but it may be of “all shades, from sienna to rose-colour and delicate pink.”

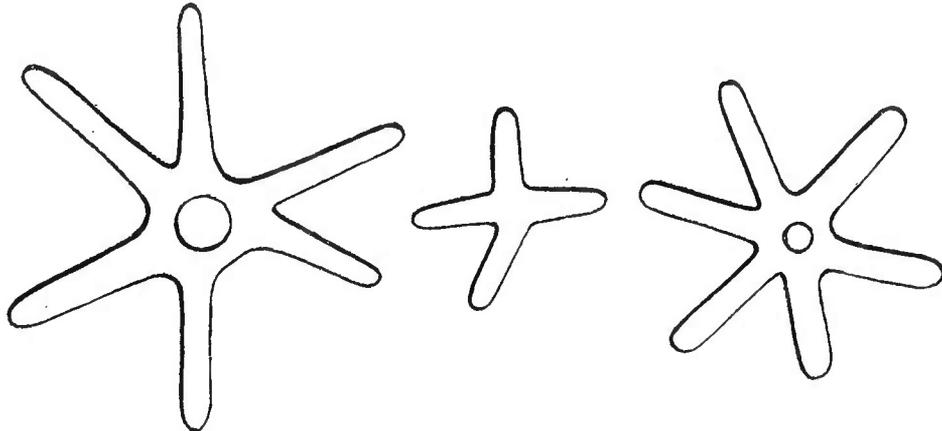
Remarkable for the large size of the Cuvierian organs, some of the tubes of which may often be seen protruding from the anus; or a packet ready for expulsion may be seen in the cloaca. These tubes are very extensile, and have great sticking powers.

Distribution. Not certainly known except in the British area; common off West Irish coasts.

<i>a.</i> Cleggan Bay, 4–9 fms.	Royal Dublin Society.
<i>b.</i> Donegal Bay, 30 fms.	Royal Dublin Society.
<i>c.</i> Kenmare River.	
<i>d-i.</i> Durgan, near Falmouth.	J. Snell, Esq.
<i>j, k.</i> Polperro, 20 fms.	
<i>l.</i> Coast of Cornwall.	G. F. Tregelles, Esq.
<i>m-o.</i> Coast of Cornwall.	
<i>p.</i> Plymouth.	

4. *Holothuria aspera*.

Holothuria aspera, *Bell, Ann. & Mag.* iv. (1889) p. 445, pl. xviii. fig. 3.



Spicules of *Holothuria aspera*. × 220.

This species is only known from a single specimen, which is remarkable for its spicules; they have, typically, a central cavity and six projecting spokes. They are densely deposited in the skin, which is peculiarly rough. Above the skin is wrinkled, below it is smooth; on each side there is a single row of not closely packed podia.

Colour dirty grey. Length 77, greatest breadth 46 mm.

a. S.W. coast of Ireland, 1000 fms. (Type.) ‘Flying Fox’ Exp.

Stichopus natans.

- Holothuria natans, *M. Sars, Vid.-Selsk. Forh.* 1867 (1868) p. 20.
 Stichopus natans, *G. O. Sars, Vid.-Selsk. Forh.* 1871 (1872), p. 30; *M. Sars, Faun. litt. Norveg.* iii. (1877) p. 58, pl. vii. figs. 18-41.

Mr. Sladen (*Proc. Roy. Ir. Acad.* i. (1891) p. 702) reports that this species was taken from 750 fms., in lat. 50° 1' N., long. 11° 50' W. It is, of course, quite possible, but the condition of the specimen, as seen by me in June 1892, is such that, considering how much the species is said by Sars to resemble *H. tremula*, I cannot on its evidence alone admit the species into our list. So far as I can form a judgment from the specimen, I am inclined to doubt very strongly its being an example of *S. natans*.

Stichopus tizardi.

- Stichopus (?) tizardi, *Théel, Proc. Roy. Soc. Ed.* xi. (1882) p. 696; *id. Chall. Rep. Hol.* (1885) p. 193.

Of this species, which can hardly be said to be satisfactorily known, Dr. Théel remarks in his 'Challenger' Report:—

"When I first described this species I had only some fragments at my disposal. Lately I have received some new specimens dredged at about the same locality, but unfortunately even these are very deformed and macerated, consequently their true shape is difficult to state. The following may complete the former description. Body elongate, equally rounded at each extremity, flattened. Mouth ventral, with twenty yellow tentacles. Anus subdorsal. Dorsal surface with conical processes, few in number, of unequal size, the largest measuring 5 to 10 mm. in length; those processes which attain a greater size are thinly placed on or in the neighbourhood of the two dorsal ambulacra, while the smaller are to be found partly in very limited numbers scattered among the larger, partly more crowded, forming a simple row along the sides of the body and round its anterior extremity. The pedicels probably form a double row along each lateral ventral ambulacrum; but on the odd ambulacrum, marked out by a deep furrow, I could not convince myself of the presence of any such appendages. The calcareous ring is very reduced, in the larger specimens absent. Two genital bundles, one on each side of the dorsal mesentery. A single Polian vesicle and madreporic canal. Body-wall thick, strengthened by C-shaped bodies and tables. In some parts of the body the spines grow much larger and possess much more numerous transverse beams; in others all the tables become very robust, with a greater number of holes in the highly dilated ends of the arms, and with the spire more irregularly developed and highly spinous. As a rule, the four rods which constitute the spire are almost parallel and provided with spines. The dorsal processes carry numerous spinous rods and tables with very long spires."

Known only from the Faeroe Channel.

a-c. Faeroe Channel, 516 fms.

'Triton' Exp.

d-f. Faeroe Channel, 570 fms.

'Triton' Exp.

I have nothing to add to Dr. Théel's account; his label bears the words "var. *mollis*," but the species is so imperfectly known that special varieties are hardly to be distinguished.

CRINOIDEA (*see* p. 17).

ANTEDON.

- Antedon, *de Fréminville, Nouv. Bull. Soc. Philom.* ii. (1811) p. 349; *Norman, Ann. & Mag.* xv. (1865) p. 101; *P. H. Carpenter, Chall. Rep. Comat.* (1888) p. 85.
- Asterias, *Linn. Syst. Nat.* x. (1758) p. 661; *op. cit.* xii. (1766) p. 1098 (pars).
- Asteriatites, *Schlotheim, Taschenbuch f. d. Mineralogie*, vii. 1. (1813) p. 68.
- Alecto, *Leach, Zool. Misc.* ii. (1815) p. 61; *Say (Alectro), J. Acad. Nat. Sci. Philad.* v. (1825) p. 153; *J. Müll. Ber. Ak. Berl.* 1841, p. 182; *id. Abh. Ak. Berlin*, 1841 (1843), p. 203; *id. (pars), Abh. Ak. Berl.* 1847 (1849), p. 238.
- Comatula, *Lamk. An. s. Vert.* ii. (1816) p. 530; *Miller, Nat. Hist. Crin.* (1821) p. 128; *de Bl. Dict. Sci. Nat.* lx. (1830) p. 229; *Ag. Mém. Soc. Neuch.* i. (1836) p. 193.
- Comatulithes, *Schlotheim, Petrefactenkunde*, 1829, ii. p. 47.
- Pentacrinus, *V. Thompson, Mem. on Pentac. europæus*, (1827) p. 10; *Fleming, Brit. An.* (1828) p. 493.
- Hibernula, *Fleming, op. cit.* p. 494.
- Phytocrinus, *de Bl. Dict. Sci. Nat.* lx. (1830) p. 235.
- Glenotremites, *Goldfuss, Petref. Germ.* i. (1832) p. 159.
- Solanocrinites, *id. op. cit.* p. 166.
- Ganymeda, *Gray, Proc. Zool. Soc.* 1834, p. 15; *id. Brit. Rad.* (1848) p. 28.
- Pterocoma, *Ag. Mém. Soc. Neuch.* i. (1836) p. 193.
- Solacrinus, *id. op. cit.* p. 196.
- Decacnemus, *Bronn, Leth. Geognos.* 2nd ed. (1837) p. 273.
- Hertha, *Hagenow, Neues Jahrb.* 1840, p. 664.
- Comaturella, *von Münster, Beitr. z. Petrefact.* (1843) p. 97.
- Solanocrinus, *Bronn, Ind. Pal.* (1848) p. 1150.
- Decameros, *d'Orbigny, Prod. Pal.* ii. (1850) p. 121.
- Decacnemus, *Bronn, Leth. Geognos.* 3rd ed. (1851) ii. Th. iv. p. 133.
- Pterocoma, *d'Orbigny, Cours Élément.* ii. (1852) p. 139.
- Comatulina, *id. ibid.*
- Allionia, *Michelotti, Rev. et Mag. Zool.* xiii. (1861) p. 353.
- Hyponome, *Lovén, Forh. Skand. Naturf.* x. (1869) p. liv.
- Kallispongia, *Wright, Proc. R. Irish Acad.* ii. (1877) p. 754.
- Geocoma, *Fraas, Aus dem Orient*, ii. (1878) p. 214.

An Antedonid with five rays and central or subcentral mouth; oral pinnules devoid of comb, but all the pinnules with sacculi. Rays divided once or more, with the ambulacral grooves equally well developed on all the arms, which are of equal length. Centrodorsal generally hemispherical and conical; cirri twenty or more in number.

Length of arms	65 (broken)	70 *
Diameter of disk	8.5	7.5
Length of 1st pinnule	23.5	13
" " 4th " ..	12	
" " 8th " 	12	
Greatest length of cirri	46	26

This species appears to grow to a larger size in more northern latitudes; thus a specimen from Discovery Bay had arms 200 mm. long, disk 11 mm. wide, the first pinnule was 25 mm. long, and the greatest length of cirri almost 50 mm.

Distribution. Both sides of northern parts of North Atlantic and Arctic Ocean, 20–632 fms.

- a. 60° 14' N., 6° 17' W., 632 fms. 'Porcupine' Exp.
 b. { 60° 22' 40" N., 8° 21' W., 327 fms. }
 { or to }
 { 60° 31' 15" N., 8° 14' W., 430 fms. } 'Triton' Exp.

2. *Antedon bifida*. (Plate IX.)

Antedon rosacea, *auctorum nuperorum*.

Asterias bifida, *Penn. Brit. Zool.* iv. (1777) p. 55.

Antedon bifida, *Bell, Ann. & Mag.* iv. (1889) p. 432.

Asterias decacnemos, *Penn. Brit. Zool.* iv. (1777) p. 56.

Asterias pectinata, *Adams, Linn. Trans.* v. (1800) p. 10.

Antedon gorgonia, *Fréminville, Nouv. Bull. Soc. Philom.* ii. (1811) p. 349.

Alecto europæa, *Leach, Zool. Misc.* ii. (1815) p. 62.

Comatula mediterranea, *Lamk. An. s. Vert.* ii. (1816) p. 535;

Müller, Phys. Abh. Ak. Berlin, 1847 (1849), p. 252; *Heller, SB.*

Ak. Wiss. Wien, xlv. (1863) i. p. 444; *Barrois, Cat. Crust.* (1882) p. 35.

Comatula europea, *Forbes, Rep. Brit. Assoc.* 1850 (1851), p. 211.

Comatula europæa, *Sars, Nyt Mag.* x. (1859) p. 16.

Comatula rosacea, *Flem. Brit. An.* (1828) p. 490; *Blainv. Actinol.* (1834) p. 248; *Forbes, Wern. Mem.* viii. (1839) p. 128; *id. Brit. Starf.* (1841) p. 5; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 436; *Perrier, Arch. Zool. expér.* ii. (1873) p. 29.

Antedon rosacea †, *Norman, Ann. & Mag.* xv. (1865) p. 102; *Wyp. Thomson, Proc. Roy. Soc. Ed.* vii. (1872) p. 765; *Lang, Nature*, xiv. (1877) p. 527; *Hughes, Nature*, xv. (1877) p. 7; *Stebbing, t. c.* pp. 58, 366; *Hunt, t. c.* p. 59; *Mason, ibid.*; *Carpenter, t. c.* p. 197; *id. Tr. Linn. Soc. Lond.* ii. (1879) pl. i. fig. 1, pl. iv. figs. 12–17; *Dendy, Stud. Biol. Lab. Owens Coll.* i. (1886) p. 299; *Herdman, Liverpool M. B. C. Rep.* i. (1886) p. 131; *Haddon & Bell, Proc. Roy. Ir. Acad.* iv. (1886) p. 618; *Carpenter, Chall. Rep. Com.* (1888) p. 158; *Chadwick, Liverpool M. B. C. Rep.* ii. (1889) p. 48; *Perrier, Nouv. Arch. Mus.* ix. (1886) p. 53,

* All measurements, unless otherwise stated, are in millimetres.

† By some written *A. rosaceus*; I have not thought it necessary to distinguish them.

- 20 pls. & i. (1889) p. 171; *Barrois, Rev. Biol.* i. (1889) p. 33;
Macmunn, Q. J. Micr. Sci. xxx. (1890) p. 51 (colouring-matter).
Alecto rosea, J. Müller, Arch. f. Nat. 1841, p. 143.
Ganymeda pulchella, Gray, P. Z. S. 1834, p. 15; *id. Ann. & Mag.*
 vi. (1840) p. 158.
Astrophyton elizabethæ, McIntosh, Proc. Roy. Soc. Edin. 1865-6,
 p. 609, fig.
Antedon (Comatula, Lamk.) rosacea, Carpenter, Proc. Roy. Soc.
 1876, pp. 211 & 451.
Antedon europæus, Greef, SB. Ges. Marburg, 1876, p. 88.
 YOUNG STAGE: *Pentacrinus europæus, J. V. Thompson, Memoir on*
the Pentacrinus europæus, 1827.
 ANATOMY AND DEVELOPMENT: *Allman, Tr. R. Soc. Ed.* xxiii.
 (1863) p. 241; *Wyv. Thomson, Phil. Trans.* 156. (1865) p. 513;
W. B. Carpenter, Phil. Trans. 157. (1866) p. 671; *id. Proc. Roy.*
Soc. Lond. xxiv. (1876) pp. 211 & 451; *Greef, SB. Ges. Marburg,*
 1876, p. 16; *Ludwig, Zeit. f. w. Zool.* xxviii. (1877) p. 255; *W. B.*
Carp. Proc. Roy. Soc. Lond. xxxvii. (1884) p. 67; *Jickeli, Zool.*
Anz. vii. (1884) pp. 346, 366, 448; *Marshall, Q. J. M. S.* xxiv.
 (1884) p. 507; *Perrier, Nouv. Arch. Mus.* ix. (1886) p. 53;
Barrois, Compt. Rend. cii. (1886) p. 1176; *id. Rec. Zool. Suis.* iv.
 (1888) p. 545.

$$A \frac{bc}{a}$$

As at present understood a very variable species.

Cirri ranging in number from about twenty to nearly forty, never as many as twenty joints, but ordinarily fifteen to eighteen. The flattened central part of the disk generally bare. The radials largely obscured by the cirri, and the first radials quite hidden by the centrodorsal; the second, much wider than long, cannot be seen till the cirri are removed; the axillary triangular with the sharp apex pointing outwards. The first brachial twice as wide without as within; the third a syzygy. Succeeding syzygies on eighth, twelfth, and then on every third or fourth. Number of arm-joints about 150 in an arm 100 mm. long. The arms are rather delicate and taper gradually to a very fine line; but some specimens are very much stouter, and the arm-joints are almost knobbed. The proximal pinnule much the longest, with most of its joints much longer than broad; the number of component joints varying between thirty-five and forty-five. The succeeding pinnules not more or little more than one-half the length of the first.

The larva pedunculated ("pentacrinoid stage") and fixed.

Colour very variable, rosy to deep purple, yellow, or orange, or mottled and spotted. In spirit brownish or yellowish, or flesh-coloured; sometimes differently coloured in different parts; cirri ordinarily much lighter. Dried, whitish.

Length of arms	70	85	80	70
Diameter of disk	7	8	9	7.5
Length of 1st pinnule	15	15	19	15
" " 4th " 	5	5.5	5.5	5.5
Greatest length of cirri	10	12	10.5	9.5

Distribution. Mediterranean, Eastern side of North Atlantic to Shetland. If the last views of Carpenter (Journ. Linn. Soc. xxiv. (1891), p. 68) are correct this protean species is represented off Bengal, for it would appear that *A. duebeni* is probably a synonym. Very abundant in places. To 100 fms.

a. Loch Houra.	John Murray, Esq.
b. Loch Etive, 15-20 fms.	John Murray, Esq.
c. Firth of Lorn, 50 fms.	John Murray, Esq.
d-l. Loch Craignish.	Hon. A. E. Gathorne Hardy.
m. Between Great Cumbrae and Wemyss Sound.	John Murray, Esq.
n. Between Sanda and Ailsa Craig.	John Murray, Esq.
o. 4 miles S.E. of Sanda.	John Murray, Esq.
p. Clyde.	A. Dendy, Esq.
q-t. Arran.	W. Carruthers, Esq.
u, v. Off S.W. Ireland, 250 fms.	'Flying Fox' Exp.
w, x. Kenmare River.	
y-b'. Blacksod Bay, W Ireland.	Dr. Grenfell.
c'-f'. Cleggan Bay, 4-8 fms.	R. Irish Academy.
g'-j'. Portaferry and co. Dublin.	Belfast Nat. Hist. and Phil. Soc.
k'. Calf of Man.	G. Swainson, Esq.
l'-n'. Off Liverpool.	
o'. Entrance of British Channel.	
p'-u'. Plymouth.	
v'-x'. Plymouth.	
y'. "British Ocean."	
z'-k''. British Seas.	
l'-p''. ? Lamlash Bay (<i>Hodge Coll.</i>).	R. Howse, Esq.

Appendix to A. bifida.

Antedon milleri.

Comatula fimbriata, *Miller, Nat. Hist. Crin.* (1821) p. 132, & pl. (frontispiece) (non *Lamk.*).

Comatula milleri, *Wyv. Thomson apud Norm. Ann. & Mag.* xv. (1865) p. 102.

Originally reported from Milford Haven, and since from Arran, Belfast, and mouth of Mersey; it is very doubtful if this species can be satisfactorily diagnosed. Prof. Wyville Thomson drew up the following:—

“Perisom of the disk with scattered warts, supported by groups of diverging spicules. Centro-dorsal plate uniformly convex and entirely covered with dorsal cirrhi. Cirrhi of from fifteen to eighteen joints; the longest of the joints about once and a half as long as broad. Terminal claw curved and acute; penultimate

joint without a trace of an opposing process. Proximal pinnules greatly longer than those succeeding them. Ovaries narrow and long, extending over more than half the length of the pinnules. Groups of interradial plates occupying the spaces between the radial axillaries. Of a rich brown or reddish-tawny colour. Average size 11 inches from tip to tip of the arms."

3. *Antedon petasus*.

- Alecto petasus*, *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 229, pl. vi. fig. 1; *Sars, Norg. Echin.* (1861) p. 1.
Comatula petasus, *Duj. & Hup. Echin.* (1862) p. 199.
Antedon petasus, *P. H. Carpenter, Tr. Linn. Soc. Lond.* ii. (1879) p. 29; *id. Proc. Roy. Soc. Ed.* xii. (1884) p. 373; *id. Chall. Rep. Com.* (1888) p. 158.
 ?*Antedon rosacea, auct.*; *P. H. Carp. Journ. Linn. Soc.* xxiv. (1891) p. 69.

$$A \frac{bc}{a}.$$

I have never seen this species from the British Seas; it was thus defined by Düben and Koren:—

"*Cirrhis dorsum totum obtegentibus*, sub—50, compressiusculis; *articulis* 11—17, *parum longioribus quam latioribus*; *brachiorum syzygiis plerumque 4-articulatis*; *pinnulis* (in quoque latere) sub—50, *quarum intima filiformis, longissima, tertiam plus duplo superans.*" Our two small specimens from Bergen agree with this.

Reported from 87 fms. off Faeroe Banks; found in N.E. Atlantic, 20 to 100 fms.

4. *Antedon tenella*.

- Asterias tenella*, *Retz. K. Svensk. Ak. Hdlgr.* iv. (1783) p. 241; *L., Gmel. Syst. Nat.* xiii. (1788) p. 3166; *Retz. Diss. Spec. Ast.* (1805) p. 33.
Alecto dentata, *Say, J. Acad. Philad.* v. (1825) p. 153.
Comatula mediterranea (?), *Sars, Beskriv. og Jagttagels.* 1835, p. 40, pl. 8. fig. 19.
Alecto sarsii, *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 231, pl. vi. fig. 2; *Lütke. Vid. Medd.* 1857, p. 107; *Sars, Norg. Echin.* (1861) p. 1; *Jarzynsky, Trans. Petersb. Soc. Nat.* i. (1870) p. 318.
Comatula (Alecto) sarsii, *J. Müll. Abh. Ak. Berl.* 1847 (1849), p. 254.
Comatula sarsii, *Alder, Ann. & Mag.* v. (1860) p. 74; *Duj. & Hup. Echin.* (1862) p. 199.
Antedon sarsii, *Norm. Ann. & Mag.* xv. (1865) p. 103; *Sars, Mem. Crin. viv.* (1868) p. 47, pls. 5 & 6 [pentacrinoid stage]; *Wyv. Thoms. Proc. Roy. Soc. Ed.* vii. (1872) p. 765; *Verrill, Am. J. Sci.* vii. (1874) p. 500; *id. op. cit.* xxiii. (1882) p. 135; *Bell, P. Z. S.* 1882, p. 534.
Antedon dentatum[a], *Verrill, Am. J. Sci.* xxiii. (1882) p. 222; *P. H. Carp. P. Z. S.* 1882 (1883), p. 746; *id. Proc. Roy. Soc. Ed.*

xii. (1884) p. 362; *Verrill, Ann. Rep. Comm. Fish.* 1882 (1884), p. 661; *P. H. Carp. Bijdr. Dierk.* 13. vi. (1886) p. 9.
Antedon tenella, *P. H. Carpenter, Chall. Rep.* (1888) p. 169; *id. Journ. Linn. Soc.* xxiv. (1891) p. 58, pl. ii. figs. 5-8.

$$A \frac{c}{ab}$$

Allied to the foregoing, but distinguished by the smaller number of cirrus-joints and the obscureness of the radials. Cirri numerous, as many as eighty, with less or more than twenty joints, some of the more proximal of which are greatly elongated, while some of the more distal carry spines. The free surface of the centrodorsal rounded or conical; it does not completely obscure the first radials, but the second is nearly hidden by the large backwardly projecting axillary, which is ordinarily wider than long, and whose distal angle nearly or quite separates the first brachials from any contact with one another; the second brachial has a very sharp backwardly directed angle, and the third is a syzygy. The four next are alternately very wide on one side and narrow on the other; a syzygy on the eighth, twelfth, and then after each two joints. The joints triangular, then more or less quadrate. The first pinnules long, of about forty joints; the next very much shorter, with only a few joints.

Exhibits a considerable amount of variation.

Colour in spirit white.

This is a small species with arms less than 50 mm. long., with the longest cirrus about 25 mm., and the first pinnule 15 mm. long.

Distribution. Both sides of North Atlantic, and Arctic Ocean (Kara Sea). 50-740 fms.

- a. $\left. \begin{array}{l} 60^{\circ} 11' 25'' \text{ N.}, 8^{\circ} 15' \text{ W.}, \text{ or} \\ 60^{\circ} 20' 15'' \text{ N.}, 8^{\circ} 8' \text{ W.}, \end{array} \right\} 285-433 \text{ fms. 'Triton' Exp. (St. 5).}$
 b. $60^{\circ} 6' \text{ N.}, 8^{\circ} 14' \text{ W.}, 440 \text{ fms.}$ 'Porcupine' Exp. (St. 51).
 c. $59^{\circ} 56' \text{ N.}, 6^{\circ} 27' \text{ W.}, 323 \text{ fms.}$ 'Porcupine' Exp. (St. 54).

5. *Antedon proluxa*.

Antedon proluxa, *Sladen, in Duncan & Slad. Echin. Greenland*, (1881) p. 77, pl. vi. figs. 7-10; *P. H. Carpenter, Bijdr. tot de Dierk.* xiv. (1887) p. 44, figs. 2 & 3; *id. Journ. Linn. Soc.* xxiv. (1891) p. 55, pl. ii. figs. 1-4.

Antedon sarsii, *v. Marenzeller, Denk. Ak. Wien*, xxxv. (1878) p. 381.

Antedon hystrix, *P. H. Carp. Proc. Roy. Soc. Edin.* xii. (1884) p. 365; *id. Chall. Rep.* (1888) p. 165.

Antedon celtica, *Nansen, Myzostomernes Anat.* (1885) p. 6.

Antedon quadrata, *Fischer, Die österreich. Polar-Station Jan Mayen*, iii. (1886) p. 31.

This species has given rise to a good deal of confusion, which Carpenter (*J. L. S.* xxiv. *l.c.*) has attempted to unravel. He does not, however, give a definite diagnosis, but rather indicates why it is to be distinguished from *A. tenella*, Retzius.

I offer, therefore, the following diagnosis with all reserve, as I have not been able to see fully mature specimens of this species.

$$A \frac{c}{bc}$$

Allied to *A. phalangium*, but distinguished by having the second pinnule smaller than the first. Cirri numerous and long (up to 60 mm.), with from 31 to 45 joints, and dimorphic. Axillary with a strong backward projection, which fits in and over a deep incision on the second radial; the second brachial also has a strong backward projection; the third brachial is a syzygy; typical number of joints in syzygial interval three.

Measurements. Both our specimens are a good deal broken; Carpenter gives diameter of centrodorsal as 5 mm., and spread as 17 cm.; length of first pinnule 15 mm., with 30 joints.

Colour in spirit pale brown.

Distribution. North Atlantic (east side) and Arctic Oceans (Kara Sea). 25 to 743 fms.

a. 60° 22' N., 8° 21' W., 327-430 fms.

'Triton' Exp.

b. ? Faeroe Channel.

'Porcupine' Exp.

6. *Antedon phalangium*.

Alecto phalangium, *J. Müll. Ber. Ak. Berl.* 1841, p. 182.

Comatula (Alecto) phalangium, *id. Abh. Ak. Berl.* 1849, p. 253.

Comatula woodwardii, *Barrett, Ann. & Mag.* xix. (1857) p. 33.

Comatula celtica, *M'Andrew & Barrett, Ann. & Mag.* xx. (1857) p. 44.

Comatula phalangium, *Duj. & Hupé, Echin.* (1862) p. 198.

Antedon celticus, *Norman, Ann. & Mag.* xv. (1865) p. 104; *Wyp.*

Thoms. Proc. Roy. Soc. Ed. vii. (1872) p. 765; *P. H. Carp. Tr.*

Linn. Soc. Lond. ii. (1879) pl. iv. figs. 1-8.

Antedon mediterraneus, *Wyp. Thoms. Proc. Roy. Soc. Ed.* vii. (1872) p. 765.

Antedon phalangium, *P. H. Carp. Tr. Linn. Soc. Lond.* ii. (1879) p. 29; *Marion, Ann. Sci. Nat.* viii. (1879) p. 40, pl. xviii.;

Ludwig, Mitth. Zool. Stat. Neapel, ii. (1880) p. 53; *P. H. Carp.*

Zool. Anz. iv. (1881) p. 521; *Bell, Proc. Zool. Soc.* 1882, p. 534;

P. H. Carp. P. Z. S. 1882 (1883), p. 746; *id. Proc. Roy. Soc. Ed.*

xii. (1884) p. 361; *id. Trans. Linn. Soc.* ii. (1886) p. 476, pl. 57;

id. Chall. Rep. Com. (1888) p. 158, pl. xxvii. figs. 23-29, pl. xxviii.

figs. 1-3; *Bell, Ann. & Mag.* iv. (1889) p. 433; *P. H. Carp.*

Journ. Linn. Soc. xxiv. (1891) p. 67.

$$A \frac{bc}{c}$$

Cirri from about thirty-five to forty-five in number, with the distal joints shorter than broad, square, or rather longer than broad; specimens with very long joints found in the Mediterranean, but not known from the British Seas; with or without a penultimate spine. The cirri vary in length, and may have as many as fifty joints.

The centrodorsal is large, flattened on its free surface, rounded or

conical; the central portion is always free of cirrus-sockets. It does not hide the radials, the second of which varies somewhat in form but may be said to be generally wider than long, with an incision of varying depth along its distal edge; the depth of the incision varies with the form of the axillary, which may have three, four, or five sides.

Ten fairly stout arms, the first brachial inconstant in form but always much smaller than the second, the third a syzygy; the next four more oblong, with a backwardly directed process alternately on the inner and outer sides; the ninth a syzygy; the succeeding joints triangular, with frequent syzygies; then squarer, then longer than broad.

The first two pinnules long and subequal, of thirty joints or more, the basal quite short, the rest a good deal elongated; the succeeding pinnules are shorter and their joints longer, except at the base. Disk naked.

Colour in life said to be green, rather pale brown in spirit, white when dried.

Measurements. All the specimens from the British area are so injured in one way or another, that a table of comparative measurements would only be misleading; the arms are about 150 mm. long, the cirri are of very various lengths (up to about 40 mm.), the disk 5 to 7 mm. across; the two first pinnules are about 10 mm. long.

Distribution. Mediterranean; Eastern side of North Atlantic, as far out as Madeira, and as far north as the Hebrides. Shallow water to 700 fms.

a-i. The Minch.

'Porcupine' Exp.

j. Skye, 25 to 40 fms. [Type of *Comatula woodwardi*
(*C. celtica*), Barrett.]

k. S.W. Ireland, 250 fms.

'Flying Fox' Exp.

ASTEROIDEA (*see* p. 18).

ARCHASTERIDÆ (*see* p. 19).

PARARCHASTERINÆ (*see* p. 19).

PONTASTER.

Pontaster, *Sladen, Chall. Nar.* i. (1885) p. 610; *id. Chall. Rep. Ast.* (1889) p. 23.

A Pararchasterine with small disk and long tapering rays.

1. *Pontaster tenuispinis.*

Astropecten tenuispinus, *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 251, pl. viii. figs. 20-22; *Duj. & Hup. Echin.* (1862) p. 419.
Archaster tenuispinus, *Sars, Norg. Ech.* (1861) p. 38, pl. 3. figs. 5-7;

Liittk. Vid. Medd. 1871 (1872), p. 240; *Moeb. & Bütschli, JB. Comm. Kiel*, ii. & iii. (1875) p. 148; *Perr. Arch. Zool.* v. (1876) p. 268; *Kor. & Dan. Nyt Mag.* xxiii. (1877) 3. p. 59; *id. Norske Nordhavs Asteroidea*, (1884) p. 85.

Pontaster tenuispinus, *Sladen, Chall. Rep. Ast.* (1889) p. 28.

Pontaster tenuispinis, *Bell, Ann. & Mag.* iv. (1889) p. 433; *id. P. Z. S.* 1892, p. 430, pl. xxvi.

Pontaster tenuispinus, var. *platynota*, *Sladen, Chall. Rep. Ast.* (1889) p. 29.

Pontaster hebitus, *id. op. cit.* p. 33.

Pontaster limbatus, *id. op. cit.* p. 35.

The proportion of R to *r* of disk varies between $3\frac{1}{2}$ and $7\frac{2}{5}$; a very variable species in many characters.

Disk and arms flat, but the depth of the side at the angle of the disk varies somewhat; the arms taper regularly and, as a rule, end in fine points. The bases of the arms on the dorsal surface sometimes, but not always, marked by a perforated area (the "papularium"), of an elongate lens-like form containing from about ten to twenty holes. The sides of the arms, above, bounded by a pretty stout superomarginal, which may, however, be so thin as to be merely a line on the upper surface. There may be as many as 40 superomarginals, and pretty constantly each carries a well-developed spine, the base of which is surrounded by a number of spinelets. A similar, or sometimes rather stouter, spine is borne by each inferomarginal, and one or more of the surrounding spinelets may be prominent on account of their length. The intermediate plates on the lower surface are, as a rule, thickly covered with spines, but in these last there are, at times, reductions. The spines on the ambulacral plates vary considerably in number and disposition, but the most usual arrangement appears to be a row of about six small spines along the groove, with one, two, or three larger spines set transversely. Pedicellariæ present or absent. Delicate spines may sometimes be seen rising from the dorsal paxilliform plates.

R = 10 ; 10 ; 11.5 ; 13 ; 14 ; 14 ; 16.5 ; 18.

r = 74 ; 47 ; 55 ; 49 ; 64 ; 72 ; 66 ; 61.

Distribution. Both sides of North Atlantic, as far south as Scilly Islands; Arctic Ocean, Kara Sea. 70 to 778 fms.

<i>a.</i> Faeroe Channel, 365 fms.	'Porcupine' Exp. (St. 65).
<i>b, c.</i> Faeroe Channel, 363 fms.	'Porcupine' Exp. (St. 54).
<i>d-f.</i> Faeroe Channel, 540 fms.	'Knight Errant' Exp. (St. 8).
<i>g-i.</i> Faeroe Channel, 608 fms.	'Triton' Exp. (St. 9).
<i>k.</i> Faeroe Channel, 305 fms.	'Porcupine' Exp.
<i>l-p.</i> Off Valentia, 100-150 fms.	'Porcupine' Exp.
<i>q-w.</i> S.W. coast of Ireland, 315 fms.	'Flying Fox' Exp.
<i>x-z.</i> S.W. coast of Ireland, ? 250 fms.	'Flying Fox' Exp.
<i>a'-d'.</i> S.W. coast of Ireland, 90-400 fms.	G. C. Bourne, Esq.
<i>e'-h'.</i> S.W. of Scilly Islands, 305 fms.	'Porcupine' Exp.

PLUTONASTERINÆ (*see* p. 20).**PLUTONASTER.**

Plutonaster, *Sladen, Chall. Nar. i.* (1885) p. 610; *id. Chall. Rep. Ast.* (1889) p. 81.

A Plutonasterine with thick, generally unarmed superomarginals, which extend on to the abactinal surface, without pedicellariæ.

Key to the Species.

Two rows of adambulacral spines ... 1. *P. bifrons*.
 Five rows of adambulacral spines ... 2. *P. pareli*.

1. Plutonaster bifrons.

Archaster bifrons, *Wyv. Thoms. Depths of the Sea*, (1873) p. 122, figs. 17 & 74.

Plutonaster bifrons, *Sladen, Chall. Rep. Ast.* (1889) p. 84.

$$R = 3 \cdot 2 r \text{ to } 4 \cdot 8 r.$$

Disk rather large; arms distinct, tapering rather rapidly and quite regularly. Ambulacral grooves rather wide, bordered by two rows of spines; of the inner, which are smaller, there are ordinarily nine or ten, in the outer row there is only one, which is much larger, and has near its base a number of spinelets. The intermediate plates on the ventral surface are arranged in very regular rows, and are covered by a number of fine spines among which one larger is generally seen; these plates extend but a very short way on to the arms. The inferomarginals are at first wider than long, but about the middle of the arm are almost quadrate; they carry a single (very rarely 2 or 3) short spine; the superomarginals are rather large, but of much the same form; their single, very rarely double, spine is no longer, but the granulation with which they are covered is coarser. The upper and lower plates (30–35) correspond exactly, and the sutures which separate the neighbouring plates are uncommonly distinct. The paxilliform plates of the upper surface are small, delicate, and regular; the madreporite is not apparent, but its position may be easily recognized by the less crowded arrangement of the paxillæ which hide it.

Colour creamy yellow.

R.	r.
81	17
69	19
41	12
29	9

Distribution. Both sides of North Atlantic, between Faeroe Channel and Portugal, and off Massachusetts. 210 to 1360 fms.

- a-c.* Faeroe Channel, 530 fms. 'Knight Errant' Exp. (St. 7).
d-f. Faeroe Channel, 555 fms. 'Triton' Exp. (St. 11).
g-j. Faeroe Channel (*Thomson coll.*). John Murray, Esq.
k. West of Donegal Bay, 1360 fms. 'Porcupine' Exp. (St. 19).

2. *Plutonaster parelii*.

- Astropecten parelii*, *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846),
 p. 247, pl. vii. figs. 14-16.
Archaster parelii, *Sars, Norg. Ech.* (1861) p. 35; *Thomson, Depths
 of the Sea*, (1873) pp. 122, 181, 456.
Plutonaster (Tethyaster) parelii, *Sladen, Chall. Rep. Ast.* (1889)
 p. 102.

$$R = 2r \text{ (nearly).}$$

Arms short and broad, disk large; marginals very large, extending considerably on to both ventral and dorsal surfaces. Ambulacra rather narrow, bordered by a very large number of spines; these are in five transverse rows, and the inner have again five in each long row; in the outer the spines are much larger and less numerous. The intermediate plates, which extend but a short way beyond the disk, are covered with large flat granules and a few larger flattened spines, of much the same size as the largest of the adambulacral spines. The inferomarginals and superomarginals at the rounded angles of the disk very long, wider within than without; further out the plates are wider, and the outer and inner edges are of the same breadth. About twenty-five to thirty plates on either side of each arm; these plates are sometimes broken into two; they are in each row covered by a close pavement of polygonal plates, some of which, in the lower series, become prolonged into distinct spines. The dorsal surface is occupied by a regular pavement of quadrate or polygonal plates, each of which may be resolved into a number of fine spines flattened, at their free ends. Among them the madreporite, which is situated not far from the centre, may be easily detected.

Colour said by Düben and Koren to be "intense sanguineus;" in spirit creamy yellow, the marginals lighter than the rest.

R.	r.
19	8

Distribution. Eastern side of North Atlantic north of Great Britain. Very rare in the British seas. 155-1608 fms.

- a.* North of Ireland, 1360 fms. 'Porcupine' Exp.

PORCELLANASTERIDÆ (*see* p. 20).CTENODISCINÆ (*see* p. 20).

CTENODISCUS.

Ctenodiscus, *M. Tr. Syst. Ast.* (1842) p. 76; *Perr. Arch. Zool. expér.* iv. (1875) p. 302; *Vig. op. cit.* vii. (1878) p. 226.

With the characters of the subfamily.

1. *Ctenodiscus crispatus*. (Plate X. figs. 1-3.)

Asterias crispata, *Retz. Diss. Spec. Ast.* (1805) p. 17.

Asterias polaris, *Sabine, Suppl. to Appendix of Parry's Voyage*, (1824) p. ccxxiii, pl. i. figs. 2 & 3.

Astropecten polaris, *Gray, Ann. & Mag.* vi. (1840) p. 180.

Ctenodiscus polaris, *M. Tr. Syst. Ast.* (1846) pp. 76 & 129, pl. v. fig. 5.

Ctenodiscus pygmæus, *id. op. cit.* p. 76.

Ctenodiscus crispatus, *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 253; *Sars, Nyt Mag.* vi. (1851) p. 160; *Stimpson, Inv. Grand Manan*, (1853) p. 15; *Lütken, Vid. Medd.* 1857, p. 45; *Sars, Norg. Ech.* (1861) p. 26; *Verrill, Proc. Bost. Soc. N. H.* x. (1866) pp. 345 & 356; *Perrier, Ann. Sci. Nat.* xii. (1869) p. 298; *Stuxberg, Efv. Vet.-Akad. Förh.* xxxv. (1879) no. 3, p. 30; *Jarzynsky, Cat. Ech. in mari albo apud Wagner, Wirbellos. Weiss. Meer.* (1885) p. 170.

Ctenodiscus corniculatus, *Perrier, Arch. Zool. expér.* v. (1875) p. 300; *Viguiet, Arch. Zool. expér.* vii. (1878) p. 228; *Duncan & Sladen, Greenl. Ech.* (1881) p. 49; *Koren & Danielssen, Norske Nordhavs Ast.* (1884) p. 84; *Sladen, Chall. Rep. Ast.* (1889) p. 171.

$$R = 2r.$$

General form stellate, with rather deeply incurved sides, flattened; a large terminal plate. Ambulacra wide, with large suckers, and bordered by a row of spines, three to each plate, and externally to them one or two others, which are generally rather smaller. The ventral surface spineless. The marginals with spines; the supero-marginals are elongated from above downwards and form a vertical wall on every side of the disk; neither on them nor on the infero-marginals is a spine always developed, but it is generally; it is never large, and there is never more than one. There are about fifteen marginals on either side of each arm. The paxilliform plates of the upper surface are very delicately stellate and closely packed. The madreporite, which is distinct and rather deeply grooved, is not far from the margin of the disk.

Coleur in spirit creamy yellow.

R.	r.
28.5	14
26	14
24	11

Distribution. Both sides of the northern part of the Atlantic, and Arctic Ocean. 7-632 fms.

a. Faeroe Channel, 60° 0' 0" N., 5° 13' 0" W., 312 fms. 'Porcupine' Exp.

ASTROPECTINIDÆ (see p. 20).

ASTROPECTININÆ (see p. 20).

Key to the Genera of Astropectininae.

- A. Superomarginal plates with a prominent ridge.
- | | |
|--|------------------------|
| Superomarginals much smaller than inferomarginals | [p. 65. |
| Superomarginals nearly or quite equal to inferomarginals | 1. LEPTOPTYCHASTER, |
| | 2. ASTROPECTEN, p. 66. |
- B. No prominent ridge to superomarginals.
- | | |
|--|----------------------|
| Spinelets simple; ambulacral armature a straight series of numerous and uniform spinelets | 3. PSILASTER, p. 68. |
| Spinelets in sheath; ambulacral armature an angulated series of a few spinelets, not all alike | [p. 69. |
| | 4. BATHYBLASTER, |

1. LEPTOPTYCHASTER.

Leptychaster, *Smith, Ann. & Mag.* xvii. (1876) p. 110.

Leptychaster, *id. Phil. Trans.* clxviii. (1879) p. 277; *Stad. Chall.*

Rep. Ast. (1889) p. 175.

Flattened, with narrow ambulacra; superomarginals smaller than inferomarginals, intermediate plates extending only partly along the rays.

1. Leptychaster arcticus.

Astropecten arcticus, *M. Sars, Nyt Mag.* vi. (1851) p. 161; *id. Faun.*

litt. Norv. ii. (1856) p. 61, pl. ix. figs. 16-18; *id. Norg. Ech.*

(1861) p. 32; *Duj. & Hup. Echin.* (1862) p. 428.

Archaster lütkeni, *Barrett, Ann. & Mag.* xx. (1857) p. 46, pl. iv.

fig. 3; *Duj. & Hup. Echin.* (1862) p. 428.

Archaster arcticus, *Verr. Am. J. Sci.* xvi. (1878) p. 373; *Storm, Vid.*

Norsk. Selsk. Skrif. Throndjhem, viii. (1879) p. 252.

Leptychaster arcticus, *Sladen, Chall. Rep. Ast.* (1889) p. 189.

$$R = 2.25 r.$$

A small species, with a large disk and rapidly tapering arms, the angles between which are distinctly rounded; the rather narrow ambulacra are bounded by a row of long spines arranged by threes on each adambulacral, outside of which are other rows so closely packed as to be almost disorderly in their disposition; the intermediate plates which fill up the rather large interbrachial area, but

do not extend far into the rays, are closely covered with sharp spiniform granules. The marginals are short but quite distinct, and the superomarginals, though much less wide than the inferomarginals, remain distinct to the top of the arm. They are both covered by large granular plates, which sometimes take on the appearance of spines; there are from 20 to 40 marginals on either side of each arm. The dorsal surface formed of the ends of fine paxillæ, the form of which is obscured by the integument which invests them.

Colour: dry or in spirit, white; alive, cinnabar to orange.

		Breadth of arm at base.
R.	r.	
18	8	7
15	7	5·5

Distribution. East and western sides of northern part of Atlantic to Arctic Ocean. 20–690 fms.

a, b. Faeroe Channel, 1312 fms. 'Porcupine' Exp. (St. 82).
c, d. Between Faeroe and Shetland, 640 fms. 'Porcupine' Exp. (St. 65).

2. ASTROPECTEN.

Astropecten, C. F. Schultze, *Betrachtung versteiner. Seesterne*, (1760) p. 50; *Gray, Ann. & Mag.* vi. (1840) p. 180; *M. Tr. Syst. Ast.* (1842) p. 67; *Norm. Ann. & Mag.* xv. (1865) p. 115; *Perr. Arch. Zool. exp.* iv. (1875) p. 302; *Viguier, op. cit.* vii. (1878) p. 231; *Sladen, Chall. Rep. Ast.* 1889, p. 175.

Stellaria, *Nardo (non Möller), Isis*, 1834, p. 716.

Asterias, *Ag. (non Linn.)*, *Mém. Soc. Neuch.* i. (1836) p. 191; *Forbes, Mem. Wern. Soc.* viii. (1839) p. 118; *M. Tr. Arch. f. Nat.* 1840, p. 323.

Crenaster, *d'Orb. Prodr. Pal.* i. (1849) p. 240.

An *Astropectinine* in which there is no webbed marginal fringe; the superomarginal plates have a prominent ridge, all the marginals are more or less quadrate in form, and those of the upper series are nearly of the same size as those of the lower.

Key to the Species.

Marginals with rectangular sides 1. *A. irregularis*.
Marginals wedge-shaped 2. *A. sphenoplax*.

1. *Astropecten irregularis*.

Asterias irregularis, *Penn. Brit. Zool.* iv. (1777) p. 52, no. 57.

Astropecten irregularis, *Gray, Ann. & Mag.* vi. (1840) p. 182; *id. Brit. Rad.* (1848) p. 18; *Duj. & Hup. Ech.* (1862) p. 414; *Norman, Ann. & Mag.* xv. (1865) p. 116; *Hodge, Tr. Northumb. & Durh.* iv. (1872) p. 133; *Perr. Arch. Zool.* v. (1876) p. 288; *Kor. & Dan. Norske Nordhavs Asteroidea*, (1884) p. 82; *Sladen, Chall. Rep. Ast.* (1889) p. 209.

- Asterias aranciaca*, O. F. Müll. (*non Linn.*) *Prod. Zool. Dan.* (1776) p. 234, no. 2831; *id.* *Zool. Dan.* iii. (1789) p. 3, pl. lxxxiii.; *Flem. Brit. An.* (1828) p. 486; *Johnston, Loudon's Mag. Nat. Hist.* ix. (1836) p. 298, fig. 43.
- Asterias aurantiaca*, *Forbes, Mem. Wern. Soc.* viii. (1839) p. 118; *id.* *Brit. Starf.* (1840) p. 130; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 440.
- Astropecten mülleri*, *M. Tr. Arch. f. Nat.* x. (1844) p. 181; *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846) p. 246; *Sars, Norg. Ech.* (1861) p. 28; *Perr. Ann. Sci. Nat.* xii. (1869) p. 297; *Möb. & Bütschli, JB. Comm. Kiel*, ii. & iii. (1875) p. 146.
- Astropecten echinulata*, *M. Tr. Arch. f. Nat.* x. (1844) p. 181.
- Astropecten acicularis*, *Norm. Ann. & Mag.* xv. (1865) p. 116.

$$R = 3 r \text{ to } 4.5 r.$$

Flat; arms well marked off from disk, tapering regularly and rather rapidly to an obtuse end. Ambulacral groove wide, bordered by three rows of spines, flattened and blunt at their tips, stronger without than within. The plates on the ventral surface are thickly covered with short, blunt, stout spinules, among which (especially near the angle of the mouth) a few longer and sharper spines may be scattered. At the sides the inferomarginal plates, which project somewhat beyond the superomarginals, bear a single row of long outwardly and upwardly curved spines; the superomarginals, which are more than twice as long vertically as they are horizontally, are closely covered with spinous granules, which on the extreme upper edge become developed into one, two, or three short conical spines. The paxillæ on the upper surface small, in numerous regular rows. A prominent central ossicle. Madreporite rather large, distinct, near margin.

The number of marginal plates varies with the length of the arms; a specimen of moderate length (5 to 6 inches) has about 40 on either side of each arm.

Colour very variable, from light red to yellow, with or without purple marks; in spirit, light or dark yellow; dry, darkish brown to light yellow above, rather lighter below.

R.	r.	Width of arm at base.
92	21	20
79	17	18.5
61	15	15
49	15	15
42	12	10.5
15	5	5.5

Distribution. Eastern side of Atlantic from Norway to Liberia; Mediterranean. 10-1000 fms.

- a-e.* East of the Shetland Islands, 64-75 fms. 'Porcupine' Exp. (Sts. 67 & 68).
- f.* Between Scotland and Faeroe Banks, 374 fms. 'Porcupine' Exp. (St. 46).
- g.* Ayrshire. Prof. E. Forbes.
- h.* N.W. of Achill Head, 183 fms. 'Porcupine' Exp. (St. 18).

i.	Off Achill Head, 500 fms.	Royal Dublin Soc.
j, k.	Off West coast, Ireland, 250 fms.	
l, m.	Off West coast, Ireland, 315 fms.	
n.	Off West coast, Ireland, (?) fms.	
o.	S.W. coast, Ireland, 1000 fms.	
p-t.	Off South Sound, 20-25 fms.	R. Irish Acad.
u-x.	Off the Skelligs, 90 fms.	R. Irish Acad.
y-b'.	Blackrock Bay.	R. Irish Acad.
c'.	Galway Bay, 15 fms.	R. Dublin Soc.
d'.	40 miles off Bolus Head, 115 fms.	R. Dublin Soc.
e'-g'.	Kenmare River.	
h'-k'.	Newcastle, co. Down.	Belfast Nat. Hist. Soc.
l', m'.	Portaferry, Strangford Lough.	Belfast Nat. Hist. Soc.
n', o'.	Coast of Ireland.	Earl of Enniskillen.
p', q'.	Off Liverpool.	
r'-t'.	Plymouth.	
u', v'.	Cullercoats, Nov. 1890.	R. Howse, Esq.
w'-z'.	Montrose, July 16/18, 1890.	W. Duncan, Esq.
a'', b''.	Outer Haaf, Shetland, 80-100 fms.	Rev. Canon Norman.

2. *Astropecten sphenoplax*. (Plate XI.)

Astropecten sphenoplax, *Bell, Proc. R. Dubl. Soc.* vii. (1892) p. 522, pl. xxiii.

R nearly equal to $5r$; breadth of arm at base equal to diameter of disk. Marginal plates about 30, the lower sharply cut at their free edge so as to be wedge-shaped or to leave a gap between each plate. No spines on the superomarginals, or a few scattered spines, or prominent spines are pretty regularly developed from the angle to the middle of the arm, one on each plate, and more distally there are distinct spinous tubercles. The arms taper rather rapidly, and near the tip the whole of the dorsal surface is occupied by the superomarginals. The adambulacral plates are rather closely covered by fine spines arranged in two or more definite rows, or in two definite rows and the remainder more irregular. About ten spines at the sides of the inferomarginals, some of which are so long as to extend beyond the hinder edge of the plate next in front, and some of which are quite short. Madreporite quite close to a superomarginal.

Colour, in spirit, straw to brown.

$$R = 52; 51; 49. \quad r = 11.5; 11; 11.5.$$

a-e.	45 miles off Blackrock (N.N.W. of Achill Island), 500 fms.	} Royal Dublin Soc.
	Only known locality.	

3. PSILASTER.

Psilaster, *Sladen, Chall. Nar.* i. (1885) p. 611; *id. Chall. Rep. Ast.* (1889) p. 221.

An *Astropectinine* in which there is no marginal fringe; the

superomarginals have no ridge and are not channelled; the spines are not enclosed in sheaths, and those on the sides of the ambulacral groove are subequal, numerous, and in a straight row.

1. *Psilaster andromeda*.

Astropecten andromeda, *M. Tr. Syst. Ast.* (1842) p. 129; *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 250, pl. vii. figs. 18 & 19; *Sars, Norg. Echn.* (1861) p. 30; *Duj. & Hup. Echin.* (1862) p. 420; *Möb. & Bütschli, JB. Comm. Kiel*, ii. & iii. (1875) p. 148; *Kor. & Dan. Nyt Mag.* xxiii. (1877) p. 65; *iid. Norske Nordhavs Asteroidea*, (1884) p. 81, pl. xiv. fig. 16.

Astropecten christii, *Düb. & Kor. Øfv. Vet.-Akad. Förh.* 1844 (1845), p. 113.

Psilaster andromeda, *Sladen, Chall. Rep. Ast.* (1889) p. 224.

$$R = 3.2 r \text{ to } 4.2 r.$$

Arms well marked off from disk, with rather deep sides, tapering regularly but not rapidly to a somewhat sharp point. Ambulacra wide, bordered by a single row of rather delicate spines, of which there are about eight on each plate; beyond these are three rows of shorter and finer spines, two or three in each row. The inferomarginals are large, much wider than long, bear a few spines and a number of scale-like tubercles, in some cases covered by membrane. The superomarginals, of which there are 30 to 40 on the side of every arm, correspond in number to the inferomarginals; they are characterized by the presence on them of rather large scales, but on them, as on the lower plates, the central part is, in dry specimens, bare. The plates of the dorsal surface are small, with delicate paxillar spines; the madreporite, which is not conspicuous, is rather nearer the margin than the centre of the disk.

R.	r.	Breadth of arm at base.	Height of do.
69	16.5	16	10.5
64	17.5	17	10
55	16	14	9
40	12.5	11.5	7

Distribution. European coast, from Bay of Biscay to Kola Peninsula. 40–690 fms.

- a. 59° 37' N., 7° 19' W., 530 fms. Voy. 'Knight Errant' (St. 7).
 b. 59° 40' N., 7° 21' W., 516 fms. Voy. 'Knight Errant' (St. 10).
 c, d. 59° 29' N., 7° 13' W., 555 fms. Voy. 'Knight Errant' (St. 11).
 e. 50° 29' 26" N., 11° 4' W., 400 fms. G. C. Bourne, Esq.

4. BATHYBLASTER.

Bathybiaster, *Dan. & Kor. Nyt Mag.* xxvii. (1883) p. 285; *iid. Norske Nordhavs Aster.* (1884) p. 94; *Slad. Chall. Ast.* (1889) p. 175; *Bell, P. Z. S.* 1891, p. 230.

Astropecten (pars), *Dan. & Kor. Nyt Mag.* xxiii. 3. (1877) p. 62.

Flattened, with very wide ambulacra, at the sides of which lie

peculiarly modified spines; interbrachial spaces closely beset with pedicellaria-like scales. Marginals confined to the sides of the arms; the dorsal paxillar area free of pores on the disk and along the middle of the arms. Anus present or absent. The adambulacrals form a series of angles which project into the ambulacral groove, and bear spines on either side. No epiproctal cone.

1. *Bathybiaster vexillifer*.

Archaster vexillifer, *Wyv. Thoms. Depths of the Sea*, (1873) p. 150, fig. 25.

Astropecten vexillifer, *Viguiet, Arch. Zool. expér.* vii. (1878) p. 240.

Bathybiaster vexillifer, *Sladen, Chall. Rep. Ast.* (1889) p. 243

Bell, P. Z. S. 1891, p. 228, pls. xxiii. & xxiv.

$$R = 5 r.$$

Arms and disk flat; the former with deep vertical sides formed by the marginals, of which there are about 70 in each row; those of the superomarginal series have each a single short spine near the upper edge, and the inferomarginal similar and subequal spines near the upper and lower edges. The adambulacral spines are arranged by fours on two sides of a triangular plate, the apex of which bears a spine. Connected with this spine is a grooved spiniform body or "vexillum," the edges of which are finely denticulated. A small anal orifice. Madreporite small, near margin of disk.

a. Faeroe Channel, 344 fms. 'Porcupine' Exp. (St. 76).

Unique specimen.

LUIDIINÆ (see p. 21).

LUIDIA.

Luidia, *Forbes, Mem. Wern. Soc.* viii. (1839) p. 123; *M. Tr. Syst. Ast.* (1842) p. 77; *Norm. Ann. & Mag.* xv. (1865) p. 117; *A. Ag.*

Mem. Mus. C. Z. v. (1877) p. 117; *Vig. Arch. Zool. expér.* vii. (1878) p. 228; *Sladen, Chall. Rep. Ast.* (1889) p. 244.

Hemicnemis, *M. Tr. Ber. Ak. Berl.* 1840, p. 104.

Petalaster, *Gray, Ann. & Mag.* vi. (1840) p. 183.

A Luidiine with elongated, flattened rays, frequently more than five in number, and exhibiting a marked tendency to break off with great power of repair.

Key to the Species.

Seven or eight rays	.....	...	1. <i>L. ciliaris</i> .
Five rays	.....	.....	2. <i>L. sarsi</i> .

1. *Luidia ciliaris*.

Asterias rubens, *Johnston (non Linn.), Loudon's Mag. Nat. Hist.* ix. (1836) p. 144, fig. 20.

Asterias ciliaris, *Philippi, Arch. f. Nat.* iii. (1837) p. 194.

- Luidia fragilissima*, Forbes, *Mem. Wern. Soc.* viii. (1839) p. 123, pl. iii. fig. 8 (pars); *id. Brit. Starf.* (1841) p. 135 (pars); *Maitland, Faun. Belg. Sept.* (1851) p. 88; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 441.
- Asterias pectinata*, Couch, *Mag. Nat. Hist.* iv. (1840) p. 34.
- Luidia* ? *ciliaris*, Gray, *Ann. & Mag.* vi. (1840) p. 183.
- Luidia ciliaris*, Duj. & Hup. *Echin.* (1862) p. 433 (pars); *Perr. Ann. Sci. Nat.* xii. (1869) p. 300, pl. 18. fig. 17; *Fischer, Act. Soc. Linn. Bordeaux*, xxvii. (1872) p. 363; *Perr. Arch. Zool. expér.* v. (1876) p. 262; *Ludw. Mitth. zool. Stat. Neap.* i. (1879) p. 544; *Sladen, Chall. Rep. Ast.* (1889) p. 254.
- Asterias imperati*, *Delle Ch. Descr. An. Sic. cit.* iv. (1841) p. 57.
- Luidia savignii*, M. Tr. *Syst. Ast.* (1842) p. 77 (pars); *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 254 (pars); *Sars, Norg. Ech.* (1861) p. 26; *Norm. Ann. & Mag.* xv. (1865) p. 117; *Heller, Zooph. u. Ech. Adriat. Meer.* (1868) p. 55; *Scott, Proc. Roy. Phys. Soc. Edin.* 1890-1 (1892), p. 82.

R = 5 r to 7 r (about).

Rays seven or eight, long, well marked off from the disk, tapering very slightly, so that the sides are almost parallel till quite close to the end, which is wedge-shaped and very fragile. Ambulacra wide, bounded by one row of small delicate, and an outer row of longer and stronger spines; in both sets the neighbouring spines are rather widely separated from one another. Beyond the adambulacral plates is a row of respiratory pores, which are immediately succeeded by the inferomarginals, carrying a row of three or four, as well as a number of small, but closely packed, rather delicate spines. Paxillæ of upper surface numerous, regular, stellate above. Madreporite small, obscure, near edge of disk. Pedicellariæ trivalve, very broad, arranged regularly on either side of adambulacral ossicles.

Colour of spirit-specimens faded yellow to brownish, lighter below, sometimes with darker patches; dry, more or less orange, darker alongside the arms, below lighter to greyish.

R.*	r.
220	30
195	32.5
180	32.5
155	22
134	16
16	12

Distribution. Eastern side of Atlantic from Faeroe to Cape Verde; Mediterranean. To 87 fms.

a. Arran.	W C. Trevelyan, Esq.
b, c. S.W. coast of Ireland, 55 fms.	
d. Kenmare River.	
e, f. Isle of Man.	Prof. E. Forbes.

* The arms of one and the same specimen, even when uninjured, are not all of the same length.

- g. Oyster-beds, off Stackpole Head, Jan. 1889.
 h. Cornwall.
 i. Polperro.
 j. Falmouth. W. P. Cocks, Esq.
 k. Plymouth. Prof. Stewart.
 l. Plymouth.
 m, n. Berwick. Dr. G. Johnston.
 o. Shetland Islands. E. M. Nelson, Esq.

2. *Luidia sarsi*.

- Luidia fragilissima*, Forbes, *Mem. Wern. Soc.* viii. (1839) p. 123; *id. Brit. Starf.* (1841) p. 135 (pars).
Luidia sarsii, *Düb. & Kor. Gefv. Vet.-Akad. Förh.* 1844 (1845), p. 113; Sars, *Nyt Mag.* x. (1859) p. 46; *id. Norg. Ech.* (1861) p. 25; *Norm. Ann. & Mag.* xv. (1865) p. 118; Hodge, *Trans. North. & Durh.* iv. (1872) p. 134; *Dan. & Kor. Norske Nordhavs Ast.* (1884) p. 94; Sladen, *Chall. Rep. Ast.* (1889) p. 258; Scott, *Proc. R. Phys. Soc. Edin.* 1890-1 (1892), p. 82.
Luidia savignii, *Düb. & Kor. Vet.-Ak. Hdlg.* 1844 (1846) p. 254 (pars).

$$R = 5 r \text{ (nearly).}$$

Five arms, not very long, tapering rather rapidly, so that they have the form of elongated triangles, rather but not very fragile. Ambulacra wide, bordered by three rows of spines, of which the median is the larger, while the innermost is directed towards the groove; there is a row of respiratory pores followed by infero-marginals as in *L. ciliaris*, the three or four large spines carried by which are proportionately and the smaller spines are absolutely larger than in the other species; the rays of the stellate heads of the paxillæ are also longer, and one ray often forms a projecting spine. Madreporite small, obscure, marginal. Pedicellariæ rare, small, papilliform.

Colour, in spirit or dry, white.

R.*	r.
35	6.5
31	6

Distribution. Eastern side of Atlantic from Norway to Cape Verde. To 374 fms.

- a-c. Between Scotland and Faeroe Banks, 'Porcupine' Exp. (St. 46).
 374 fms.
 d-f. Off Island of North Rona, 33 fms. 'Knight Errant' Exp. (St. 3).
 g-j. East of Shetland Islands, 64 and 'Porcupine' Exp. (Sts. 67 &
 75 fms. 68).
 k, l. Outside Valentia. R. Irish Acad.
 m. Donegal Bay, 33-37 fms. R. Irish Acad.

* The arms of the same specimen may differ a little in length.

PENTAGONASTERIDÆ (*see* p. 21).PENTAGONASTERINÆ (*see* p. 21).*Key to the Genera of Pentagonasterinæ.*

- Body pentagonal 1. PENTAGONASTER, p. 73.
 Body with elongated arms. 2. NYMPHASTER, p. 75.
Incertæ sedis.
 Marginals indistinct 3. HIPPIASTERIAS, p. 76.

1. PENTAGONASTER.

- Pentagonaster, *C. F. Schultze, Betr. verst. Seesterne*, (1760) p. 50; *Perr. Arch. Zool. exp.* v. (1876) p. 6; *Sladen, Chall. Rep. Ast.* (1889) p. 264.
 Goniaster (pars), *Ag. Mém. Soc. Neuch.* i. (1836) p. 191; *M. Tr. Arch. f. Nat.* vi. (1840) p. 322.
 Astrogonium, *M. Tr. (pars) Syst. Ast.* (1842), p. 52; *Sladen, Chall. Rep. Ast.* (1889) p. 263.

Body flat, pentagonal, sides nearly straight; marginals not numerous, usually covered with granules; dorsal intermediate plates hexagonal or irregular in form, covered with flat granules and extending to the ends of the rays; no valve-like pedicellariæ.

Key to the Species.

- R is less than 2 *r* 1. *P. granularis*.
 R is more than 2 *r* 2. *P. greeni*.

1. *Pentagonaster granularis*. (Plate X. figs. 4, 5, & 6.)

- Asterias granularis*, *Retzius, Vet.-Akad. Hdlg.* iv. (1783) p. 238; *Abilg. in Zool. Dan.* iii. (1788) p. 19, pl. xcii.; *Retz. Diss. Spec. Ast.* (1805) p. 10.
Asterias tessellata, var. A, *Lamk. An. s. Vert.* ii. (1816) p. 552; *id. op. cit.* 2nd ed. (1840) iii. p. 238.
Astrogonium granulare, *M. Tr. Syst. Ast.* (1842) p. 57; *Sars, Norg. Ech.* (1861) p. 46.
Astrogonium boreale, *Barrett, Ann. & Mag.* xx. (1857) p. 47, pl. iv. fig. 5.
Goniaster granularis, *Lütke, Vid. Medd.* 1864 (1865), p. 146.
Pentagonaster granularis, *Kor. & Dan. Norske Norhavs Ast.* (1884) p. 58; *Sladen, Chall. Rep. Ast.* (1889) p. 268.
Pentagonaster balteatus, *Sladen, Proc. R. Irish Acad.* i. (1891) p. 688, pl. xxv.
Pentagonaster concinnus, *id. t. c.* p. 690, pl. xxvi.

$$R = 1.3r \text{ to } 1.4r.$$

Small, sides slightly curved. About seven supero- and infero-marginals on either side of each arm with a single terminal plate. Ambulacra very narrow, bordered by two rows of spines, of which there are two or three on each plate; those of the inner row are

longer than those of the outer but are not so stout. The intermediate plates uniformly but coarsely granulated, the granulation much coarser than that on the marginal plates, from which it becomes more or less lost. The plates of the dorsal surface regularly hexagonal or sometimes irregular, covered by broad flat granules. Madreporite inconspicuous.

Colour, dried, white.

R.	r.	Greatest depth.
19	13	6
15.5	11	4.5

Distribution. Both sides of North Atlantic; to Arctic Ocean and White Sea on the east. 20–750 fms.

a, b. Faeroe Channel, 440 fms.

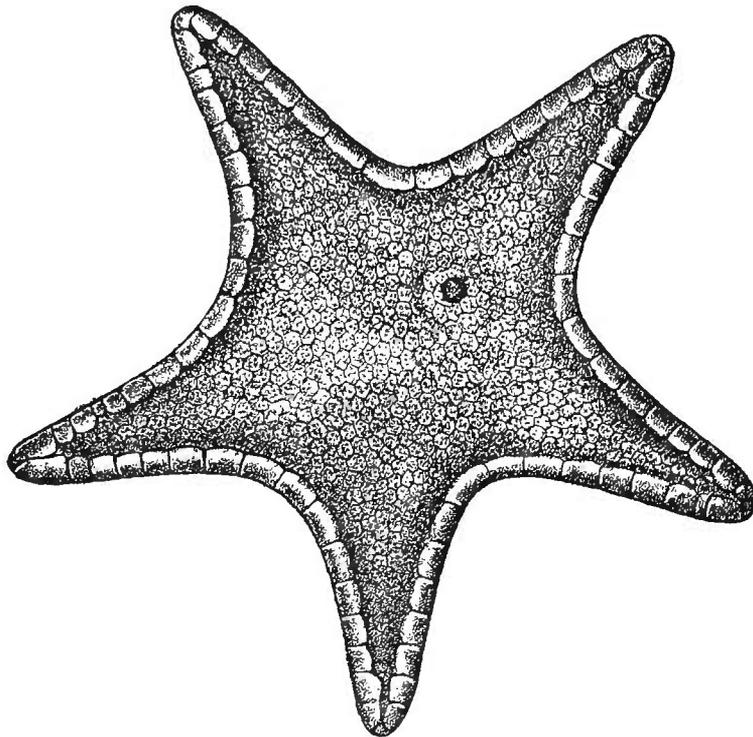
'Porcupine' Exp. (St. 51).

2. *Pentagonaster greeni*.

Astrogonium greeni, *Bell, Ann. & Mag.* iv. (1889) p. 433, pl. xix. fig. 4.

$$R=27, r=12.5.$$

The curve between the arms is well rounded; there are seven or



Pentagonaster greeni.

eight superomarginal and seven to nine inferomarginal plates; those of the upper and lower series do not correspond regularly; the

innermost are longer than wide; one or two about the middle of the row tend to be square, and the more external are wider than long; the terminal superomarginal plate is elongated, and the more so when there are seven than when there are eight plates, while the terminal inferomarginal plate is triangular. The abactinal plates of the disk are uniformly granulated and are irregular in shape, with a not very well marked tendency to be hexagonal in form. The ultimate, and sometimes also the penultimate, superomarginal of either side of each arm is not separated from its fellow by any of the abactinal plates.

The granules of the plates of the actinal are somewhat coarser than those of the abactinal surface; on each side of the middle line of the arm there are two rows of plates, one of which extends to the end of the arm and the other halfway. The adambulacral spines are short and square at their tip, so that they differ hardly at all from the granules of the adjacent plates; they are arranged in a single row, and there appear to be five on each adambulacral plate. The groove is exceedingly narrow, and the tube-feet are not to be seen in the single specimen collected. There are no signs of any pedicellariæ, and there are no spines. The madreporite is undistinguishable. The appearance of the specimen in alcohol is somewhat leathery, owing to the comparatively thick membrane with which it is invested.

a. South-west coast of Ireland, 1000 fms. (Type.) 'Flying Fox' Exp.

Only one specimen is known at present.

2. NYMPHASTER.

Nymphaster, *Sladen, Chall. Narr. i.* (1885) p. 602; *id. Chall. Rep. Ast.* (1889) p. 294.

Flattened, with elongated arms formed by the marginals alone or by them and a single row of intermediate plates. Intermediate plates of dorsal surface with flat tops, ordinarily hexagonal in form, not extending beyond the disk. Adambulacral spines in longitudinal rows. Spines on inferomarginals reduced or absent.

1. Nymphaster subspinosus.

Pentagonaster subspinosus, *Perr. Nouv. Arch. Mus. vi.* (1884) p. 234, pl. vi. figs. 1 & 2.

Nymphaster protentus, *Sladen, Chall. Exp. Ast.* (1889) p. 303; *Bell, Ann. & Mag. iv.* (1889) p. 435; *Sladen, Proc. R. Irish Acad. i.* (1891) p. 694.

Nymphaster subspinosus, *Norm. in Bourne, Journ. Mar. Biol. Assoc. i.* (1890) p. 327.

$$R = 4r \text{ (nearly).}$$

Arms five, taper rapidly; superomarginals touch along middle

line; interbrachial angles rounded. The two sets of marginals equal in number—about thirty on either side of each arm, uniformly and rather coarsely granulated. Ambulacra narrow, bounded by a set of seven to ten spines, outside which is a set of less numerous but shorter spines, and beyond these there are scattered spiniform granules. The intermediate plates are covered by stout spiny granules and are of moderate size. The intermediate plates of the dorsal surface tend to be hexagonal in form and are covered with rounded or knob-like granules. The madreporite is distinct but has no special boundary of spines. Pedicellariæ are few and small.

Colour, in spirit, white; dried, light brick, darker on disk above and below.

R.	r.	Breadth of arm at base.	Height of ditto.
110	26	15	11 (4-armed spec.)
101	26	18	9
83	24	14	7.5
71	18	13.5	7

Distribution. West Indies; south-west of the Canary Islands; south-west of Ireland. 163–1525 fms.

a-e. South-west coast of Ireland, 315 fms. (one 'Flying Fox' Exp. four-rayed).

Incertæ sedis.

3. HIPASTERIAS.

Hippasteria, *Gray, Ann. & Mag.* vi. (1840) p. 279; *Perr. Arch. Zool. exp.* v. (1876) p. 86; *Viguier, op. cit.* vii. (1878) p. 176.
 Goniaster (pars), *Ag. Mém. Soc. Neuchât.* i. (1836) p. 191; *Forbes, Brit. Starf.* (1841) p. 122; *Norm. Ann. & Mag.* xv. (1865) p. 123.
 Astrogonium, *M. Tr. Syst. Ast.* (1842) p. 52 (pars).

Arms extending a little or no distance beyond the disk; marginals indistinct. Intermediate plates of both surfaces covered with protuberant rounded granules, among which are scattered, more thickly on the ventral surface, large sessile bivalved pedicellariæ. Spines replaced by tubercles, except in the ambulacral grooves, where the spines are very stout and have broad ends.

1. Hippasterias phrygiana.

Asterias equestris (pars), *Linn. Syst. Nat.* xii. (1766), p. 1100; *Lamk. An. s. Vert.* ii. (1816) p. 555.
Asterias phrygiana, *Parelius, Norsk. Vid. Selsk. Skrifter*, iv. 1768, p. 425, pl. xiv. figs. 1 & 2; *Müll. Prod. Zool. Dan.* (1776) p. 234, no. 2829; *L., Gmel. Syst. Nat.* xiii. (1788) p. 3163.
Goniaster phrygianus, *Ag. Mém. Soc. Neuchâtel*, i. (1836) p. 191; *Scott, Ann. Scot. Nat. Hist.* i. (1892) p. 49.
Asterias johnstoni, *Gray, Loudon's Mag. Nat. Hist.* ix. (1836) p. 146.
Hippasterias plana, *H. europæa*, *H. johnstoni*, *Gray, Ann. & Mag.* vi. (1841) p. 279.

- Goniaster equestris, *Forbes, Brit. Starf.* (1840) p. 125.
 Asterias (Goniaster) equestris, *Gould, Inv. Massach.* (1841) p. 344.
 Astrogonium phrygianum, *M. Tr. Syst. Ast.* (1842) p. 52; *Sars, Norg. Ech.* (1861) p. 44; *Duj. & Hup. Ech.* (1862) p. 390.
 Goniaster abbensis, *Forbes, Ann. & Mag.* xi. (1843) p. 280, pl. vii.
 Astrogonium aculeatum, *Barrett, Ann. & Mag.* xx. (1857) p. 47, pl. iv. fig. 4.
 Goniaster phrygianus, *Norman, Ann. & Mag.* xv. (1865) p. 123; *Hodge, Tr. North. & Durh.* iv. (1872) p. 135.
 Hippasterias plana, *Perr. Arch. Zool. exp.* v. (1876) p. 86; *Dan. & Kor. Norske Nordhavs Ast.* (1884) p. 59; *Sladen, Chall. Rep. Ast.* (1889) p. 34; *Scott, Proc. R. Phys. Soc. Ed.* 1890-1 (1892), p. 82.
 Hippasteria phrygiana, *Verr. Rep. Comm. Fish.* 1883 (1885), p. 542.

$$R = 2r; \text{ or } 2R = 3r.$$

Proportion of rays to radius of disk varies within wide limits; disk with concave, plane, or convex sides, more or less tumid above. Among known British species it may be at once distinguished by the presence of a vast number of large bivalve sessile pedicellariæ. Arms short, triangular, obtuse at their tips. Ambulacral groove narrow; the spinulation at its sides very variable and irregular; the most typical arrangement is that of two inner rows of rather large blunt spines and a row or two rows of twice as many smaller spines. In small specimens the large bivalve pedicellariæ on the ventral surface are pretty regularly surrounded by subequal tubercles of some size, but in larger specimens the arrangement of the tubercles is less regular and their similarity in size is less marked. In moderate-sized to large specimens there are from 15 to 20 superomarginals and about the same number of inferomarginals. The most ordinary arrangement is the possession of three tubercles by the most proximal, two by the more distal, and one by the terminal superomarginals; and these may be set, when there is more than one, vertically to one another. On the inferomarginals the number of tubercles is less constant and their disposition less orderly. The upper surface is rougher than the lower owing to the greater projection of the tubercles, among which are numerous bivalve pedicellariæ. The madreporite is placed about midway between the centre and the edge of the disk, is distinct, and of fair size. In the largest specimens the disk exhibits a tendency to become tumid and the marginals get pressed down to the lower surface.

Colour in life "pale orange" (*Wingate*), in spirit white; when dried brown to white.

R.	r.	Height of disk.
126	71	15
121	61	22
118	55	18
113	68	36
111	56	24
90	40	15

Distribution. Northern parts of Atlantic, on both sides; White Sea. To 150 fms.

<i>a.</i> Coast of Northumberland.	R. Howse, Esq.
<i>b.</i> Coast of Northumberland.	
<i>c.</i> North of England.	Dr. G. Johnston.
<i>d.</i> North of England.	Dr. G. Johnston. (4-rayed form.)
<i>e.</i> St. Abb's Head, Berwickshire.	Prof. E. Forbes.
<i>f, g.</i> St. Andrews.	Prof. M'Intosh.
<i>h, i.</i> Montrose, July 1889.	W. Duncan, Esq.
<i>j.</i> Aberdeen.	L. G. Esson, Esq.
<i>k, l.</i> Coast of Ross-shire.	Dr. Sutherland.
<i>m, n.</i> English coast.	Dr. Bowerbank.

MIMASTERINÆ (see p. 21).

MIMASTER.

Mimaster, *Sladen, Proc. Roy. Soc. Ed.* xi. (1882) p. 702; *id. Trans. Roy. Soc. Ed.* xxx. (1883) p. 579; *id. Chall. Rep. Ast.* (1889) p. 331.

With the characters of the subfamily (see p. 21).

1. *Mimaster tizardi*.

Mimaster tizardi, *Sladen, Proc. R. Soc. Edinb.* xi. (1882) p. 702; *id. Trans. R. Soc. Edinb.* xxx. (1883) p. 580, pl. xxxiv.; *id. Chall. Rep. Ast.* (1889) p. 333.

$$R = 2 \cdot 2 r.$$

A large species, with short triangular rays, swollen disk, thin margins formed by the marginal plates alone. Paxillæ compact and subequal. Rather less than forty marginal plates in each series, the lower larger than the upper. Adambulacral armature formed of delicate spines varying in number and arrangement. Madreporite obscure.

Colour, in spirit, yellowish or light brown.

<i>a.</i> Faeroe Channel, 555 fms.	'Knight Errant' Exp. (St. 4).
<i>b, c.</i> Faeroe Channel, 516 fms.	'Triton' Exp. (St. 10).
<i>d.</i> Faeroe Channel, 555 fms.	'Triton' Exp. (St. 11).

Not known from any other locality.

GYMNASTERIIDÆ (see p. 21).

Key to the Genera of Gymnasteriidæ.

- A. No spines on dorsal plates 1. PORANIA, p. 79.
- B. Spines or spinelets on dorsal plates.
 - a.* Superomarginals obscure.
 - i. With no broad marginal fringe .. 2. RHEGASTER, p. 80.
 - ii. With a broad marginal fringe 3. CHEILASTER, p. 81.
 - β.* Superomarginals distinct 4. LASIASTER, p. 81.

1. PORANIA.

- Goniaster (pars), *Ag. Mém. Soc. Neuch.* i. (1836) p. 191; *Forbes, Mem. Wern. Soc.* viii. (1839) p. 118; *id. Brit. Starf.* (1841) p. 122.
 Porania, *Gray, Ann. & Mag.* vi. (1840) p. 288; *Norman, Ann. & Mag.* xv. (1865) p. 122; *Sladen, Chall. Rep. Ast.* (1889) p. 356.
 Asteropsis (pars), *M. Tr. Syst. Ast.* (1842) p. 64.

Porania is a Gymnasterid in which the marginal plates carry spines, but in which there is no row of spines along the middle of each ray. The plates of the dorsal surface are covered with membrane, but with only few, if any, spines. On the lower surface the intermediate plates are large and closely packed.

1. *Porania pulvillus.* (Plate X. figs. 7 & 8.)

- Asterias pulvillus*, *O. F. Müll. Zool. Dan.* i. (1788) p. 19, pl. xix.
Goniaster templetoni, *Forbes, Mem. Wern. Soc.* viii. (1839) p. 118, pl. iv. figs. 1 & 2; *id. Brit. Starf.* (1840) p. 122; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 440.
Porania gibbosa, *Gray, Ann. & Mag.* vi. (1840) p. 288.
Asteropsis pulvillus, *M. Tr. Syst. Ast.* (1842) p. 64; *Sars, Norg. Ech.* (1861) p. 44; *Duj. & Hup. Ech.* (1862) p. 410.
Porania pulvillus, *Gray, Brit. Rad.* (1848) p. 22; *Norm. Ann. & Mag.* xv. (1863) p. 122; *Perr. Arch. Zool. expér.* v. (1876) p. 96; *Henderson, Proc. Roy. Phys. Soc.* ix. (1887) p. 333; *Sladen, Chall. Rep. Ast.* (1889) p. 360.

$$R = 2r.$$

Rays rather short, triangular, tapering rapidly to a rounded point. Ambulacral groove moderately wide, with two rows of distinct, stout, blunt spines on either side. The integument on the lower surface is marked out into definite areas, corresponding with most of which (for a few do not extend as far as the margin) are two short marginal spines. The upper surface is smooth and greasy to the touch, and the only processes on it are the scattered groups of papulæ; in dried specimens the surface is closely reticular; the dorsal plates can often be seen. The large madreporite is often obscured by the thick skin and is placed high up on the descending side of the disk. Considerable differences obtain in the height of the disk.

Colour in life bright red above, lighter below; in spirit yellowish; dried, red to dark brown.

R.	r.	Height of disk.
74	35	25
73	33	21
55	27	17
55	26	22
33	16	12
29	15	10
28.5	13	10

Distribution. Eastern North Atlantic. To 106 fms.

a. Off Island of North Rona.	'Knight Errant' Exp. (St. 7).
b-d. Lamlash Bay.	Prof. Herdman.
e,f. Arran.	Dr. Leach.
g, h. Between Arran and Ailsa Craig, 28 fms.	John Murray, Esq.
i-l. Kilbrennan Sound, 10-20 fms.	John Murray, Esq.
m-p. 4 miles S.E. of Sanda Island, 30-35 fms.	John Murray, Esq.
q. Scotland.	
r. Off West coast of Ireland, 53° 15' N., 11° 51' W., 106 fms.	'Porcupine' Exp. (St. 8).
s. Off Valentia.	'Lightning' Exp.
t. Killybeg Harbour, 14-16 fms.	R. Dublin Soc.
u. Davalaun, 30 fms.	R. Dublin Soc.
v. Off Ballycottin.	R. Irish Acad.
w. Youghal.	Belfast Nat. Hist. Soc.
x-z. Off Liverpool.	
a'. Tenby.	
b'. Falmouth.	Dr. P. Cocks.
c', d'. Plymouth.	
e'. Ross-shire.	Dr. Sutherland.
f'. British Seas.	

2. RHEGASTER*.

Rhegaster, *Sladen, Trans. Roy. Soc. Ed.* xxxii. (1883) p. 155; *id. Chall. Rep. Ast.* (1889) p. 367.

A Gymnasterid in which the marginal plates carry spines, but in which there is no row of spines along the middle line of each ray. The plates of the dorsal surface are closely covered with fine spines, but there is no marginal fringe.

1. Rhegaster murrayi.

Rhegaster murrayi, *Sladen, Trans. R. Soc. Ed.* xxxii. (1883) p. 156, pl. xxvi. figs. 2-7; *id. Chall. Rep. Ast.* (1889) p. 368.

$$R = 1.3 r.$$

According to Mr. Sladen this species, of which only a single specimen is known, is nearly allied to *R. tumidus*, Stuxberg, but differs in the shorter ray, the "marginal contour is distinctly festooned by the inferomarginal plates, and each of these bears a group of enlarged spinelets;" the spinelets are said to be more simple in character than in *R. tumidus*, and the papulæ more numerous on the lower surface.

a. Faeroe Channel, 285-433 fms. 'Triton' Exp.

* This genus, as well as "*Marginaster*" and *Lasiaster*, have been established on quite immature specimens, a circumstance which probably will give rise to much misconception in the future.

3. CHEILASTER.

Marginaster (vox hybr.), *Perrier, Bull. Mus. Comp. Zool.* ix. (1881) p. 16 (n. n.); *id. Nouv. Arch. du Mus.* iv. (1884) p. 229; *Sladen, Chall. Rep. Ast.* (1889) p. 364.

No more than Mr. Sladen, who temporarily accepts the genus, can I, who have only seen one specimen, and that one of 12 millim. in diameter, add anything to Prof. Perrier's diagnosis, which does not err on the side of length. It runs thus:—

“Petites astéries pentagonales ou à bras peu marqués; ossicules recouverts par un tégument mince; ossicules eux-mêmes délicats; d'ordinaire légèrement épineux.—Corps bordé par une double rangée de plaques marginales bien distinctes.”

1. Cheilaster fimbriatus.

Marginaster fimbriatus, *Sladen, Chall. Rep. Ast.* (1889) p. 365, pl. lviii. figs. 4-6.

$R = 6$; $r = 5$ mm.

Mr. Sladen distinguishes this species as having groups of granules on the abactinal plates, but no comb of spinelets on the superomarginal plates; it has a row of spinelets on the actinal interradial areas set parallel to the margin.

a. $56^{\circ} 15' N.$, $11^{\circ} 25' W.$, 1360 fms. ‘Porcupine’ Exp. (Type.)

4. LASIASTER.

Lasiaster, *Sladen, Chall. Rep. Ast.* (1889) p. 371.

In cataloguing this genus I must repeat the word of warning I gave under *Rhegaster*, and I must disclaim any share of responsibility for the introduction of another genus based on two small specimens, which are recognized as being immature. It differs from *Rhegaster* in having well-developed superomarginal plates, and there is consequently a thick wall-like side to the body. All the intermediate plates bear isolated groups of spinelets.

1. Lasiaster villosus.

Lasiaster villosus, *Sladen, Chall. Rep. Ast.* (1889) p. 372, pl. lviii. figs. 7-10.

I am unable to deduce from Mr. Sladen's description the specific diagnosis of this form, and as the only two specimens I have seen are immature I cannot draw up one myself. The figures will show the student all he can be told.

a, b. $59^{\circ} 34' N.$, $7^{\circ} 18' W.$, 542 fms. ‘Porcupine’ Exp. (Types.)

ASTERINIDÆ (see p. 22).

Key to the Genera of Asterinidæ.

- i. Abactinal plates thick and crescentic. Body slightly swollen 1. ASTERINA, p. 82.
 ii. Abactinal plates thin and lamellar. Body quite flat 2. PALMIPES, p. 83.

1. ASTERINA.

Asterina, *Nardo*, *Isis*, 1834, col. 716; *Ag. Mém. Soc. Neuchât.* i. (1836) p. 192; *Forbes*, *Mem. Wern. Soc.* viii. (1839) p. 119; *Gray*, *Ann. & Mag.* vi. (1840) p. 289; *Forbes*, *Brit. Starf.* (1840) p. 119; *Norm. Ann. & Mag.* xv. (1865) p. 121; *Perr. Arch. Zool.* v. (1876) p. 214; *Vig. t. c.* (1878) p. 207; *Sladen*, *Chall. Rep. Ast.* (1889) p. 376.

An Asterinid in which the marginal plates are not larger than the others; the papulæ are distributed over the whole of the upper surface, the skeletal plates of which are thick and crescent-shaped and imbricated; the disk is large and more or less flat.

1. *Asterina gibbosa*. (Plate X. figs. 9 & 10.)

- Asterias gibbosa*, *Penn. Brit. Zool.* (1777) p. 62; *Turton*, *Brit. Faun.* (1807) p. 140; *Penn. op. cit.* (1812) p. 128; *Fleming*, *Brit. An.* (1828) p. 486; *de Blainv. Man. d'Act.* (1834) p. 238.
Asterias verruculata, *Retz. Diss. Ast.* (1805) p. 12.
Asterias exigua, *Delle Chiave, Mem. An. s. Vert. Nap.* ii. (1825) p. 353, pl. xviii. fig. 1; *id. Desc. An. s. Vert. Sic. cit.* (1841) iv. p. 55, v. p. 122, pl. 125. fig. 1.
Asterias pulchella, *de Bl. Man. d'Act.* (1834) p. 238.
Asterina minuta, *Nardo*, *Isis*, 1834, col. 716; *Ag. Mém. Soc. Neuch.* i. (1836) p. 192.
Asterina gibbosa, *Forbes*, *Mem. Wern. Soc.* viii. (1839) p. 120; *Forbes*, *Brit. Starf.* (1840) p. 119; *Gray*, *Ann. & Mag.* vi. (1840) p. 289; *Thompson*, *Nat. Hist. Irel.* iv. (1856) p. 440; *Norm. Ann. & Mag.* xv. (1865) p. 121; *Lütke. Vid. Medd.* 1864 (1865), p. 138; *Gray*, *Synopsis*, (1866) p. 16; *Perr. Arch. Zool. expér.* v. (1876) p. 215; *Giard*, *Bull. Sci. Nord*, i. (1878) p. 297; *Ludw. Zeitschr. f. wiss. Zool.* xxxi. (1878) p. 295 (genital organs); *Vig. Arch. Zool. expér.* vii. (1878) p. 207, pl. xiv. figs. 8-12; *Ludw. Mitth. zool. Stat. Neapel*, i. (1879) p. 540; *Henderson*, *Proc. R. Phys. Soc. Ed.* ix. (1887) p. 332; *Barrois*, *Rev. Biol.* i. (1888) p. 70.
Asterias membranacea, *Grube*, *Actin. etc. Mittelm.* (1840) p. 26.
Asteriscus verruculatus, *M. Tr. Syst. Ast.* (1842) p. 41; *Sars*, *Nyt Mag.* xix. (1857) p. 49; *Lorenz*, *SB. Ak. Wien*, xxxix. (1860) p. 678; *Duj. & Hup. Echin.* (1862) p. 375; *Heller*, *SB. Ak. Wien*, xlvi. (1862) p. 444; *Perr. Ann. Sci. Nat.* xii. (1869) p. 290, pl. 18. fig. 10; *Lacaze-Duth. Arch. Zool. expér.* iii. (1874) p. 18 (development).
Asteriscus gibbosus, *Fischer*, *Act. Soc. Linn. Bordeaux*, xxvii. (1872) p. 366.

$$R = 2r \text{ (nearly).}$$

A small species with short wide arms; they and the body pretty thick. Ambulacral grooves rather narrow, fringed by a row of spines arranged in triplets at the sides of the ossicles. The whole of the lower surface is covered with short, sharp, slender spines, ordinarily arranged in pairs; at the margin the spines are shorter, and they are still shorter on the dorsal surface, over which they are scattered with less regularity. The madreporite is rather nearer the centre than the margin, is not at all prominent, irregular, often triangular in form. Two spines are often so arranged in relation to one another as to simulate a pedicellaria.

Colour "greenish yellow, sometimes tinged with red, and sometimes brownish;" dark brown to yellowish when dry, or almost white, as it is also when in spirit. Four- or six-rayed forms not uncommon.

R.	r.	Height of disk.
22.5	12	9
19	10.5	7
16.5	8.5	7
10	6	3
8	4.5	3.3

Distribution. Eastern side of tropical and temperate North Atlantic, English Channel and Irish Sea; Mediterranean. 0-35 fms.

<i>a-c.</i> Millport, Cumbrae.	D. Robertson, Esq.
<i>d.</i> Smerwick Harbour.	R. Irish Acad.
<i>e.</i> Lahinch, co. Clare.	Belfast Nat. Hist. Soc.
<i>f.</i> Strangford Lough, Sept. 1835.	Belfast Nat. Hist. Soc.
<i>g-j.</i> Lambay Island.	Belfast Nat. Hist. Soc.
<i>k-m.</i> Off Liverpool.	
<i>n-z.</i> Falmouth.	W. P. Cocks, Esq.
<i>a'</i> . Plymouth Sound.	Dr. Leach.
<i>b'-d'</i> . Plymouth.	
<i>e'-g'</i> S. of St. Peter's Port, Guernsey.	Prof. Bell.
<i>h'</i> . Channel Islands.	Dr. Günther.

2. PALMIPES

Anseropoda (vox hybr.), *Nardo, Isis*, 1834, col. 716.

Palmipes, *Ag. Mém. Soc. Neuchât.* i. (1836) p. 192; *Forbes, Mem.*

Wern. Soc. viii. (1839) p. 119; *Gray, Ann. & Mag.* vi. (1840)

p. 288; *Forbes, Brit. Starf.* (1840) p. 116; *Gray, Brit. Rad.* (1848)

p. 21; *Norm. Ann. & Mag.* xvi. (1865) p. 120; *Viguier, Arch. Zool.*

vii. (1878) p. 212; *Sladen, Chall. Rep. Ast.* p. 376; *Bell, Ann. &*

Mag. vii. (1891) pp. 234 & 465; *Norman, op. cit.* p. 384.

Asteriscus (pars), *M. Tr. Syst. Ast.* (1842) p. 39.

An Asterinid in which the marginal plates are not larger than the others; the papulæ are confined to the radial portions of the upper surface, the skeletal plates of which are thin, scale-like, and provided with tufts of spinelets; the papulæ are in a single row

on each side of the median radial line. The disk is large and extraordinarily flat.

1. *Palmipes placenta*.

Asterias placenta, *Penn. Brit. Zool.* iv. (1777) p. 53, pl. xxxi. fig. 59 A.

Asterias membranacea, *Retz. Vet.-Akad. Nya Hdlg.* iv. (1783) p. 238; *L. ed. Gmel. Syst. Nat.* (1788) p. 3164; *Retz. Diss. Spec. Ast.* (1805) p. 12; *Lamk. An. s. Vert.* ii. (1816) p. 558; *Delle Ch. Descr. An. Invert. Sic. cit.* iv. (1841) p. 56, v. (1841) p. 122, pl. 127. figs. 8-10, 12, 14, 15.

Asterias cartilaginea, *Flem. Brit. An.* (1828) p. 485.

Anseropoda membranacea, *Nardo, Isis*, 1834, col. 716.

Palmipes membranaceus, *Ag. Mém. Soc. Neuchât.* i. (1836) p. 192; *Forbes, Mem. Wern. Soc.* vii. (1839) p. 119, pl. iii. fig. 3; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 440; *Duj. & Hup. Echin.* (1862) p. 373; *Fischer, Act. Linn. Soc. Bord.* xxvii. (1872) p. 367; *Perrier, Arch. Zool. expér.* v. (1876) p. 210; *Viguiér, Arch. Zool. expér.* vii. (1878) p. 212, pl. xiv. figs. 1-5; *Ludw. Mitth. zool. Stat. Neap.* i. (1879) p. 541; *Scott, Proc. R. Phys. Soc. Edin.* 1890-91 (1892) p. 82.

Asteriscus palmipes, *M. Tr. Syst. Ast.* (1842) p. 39; *Heller, Zooph. u. Echin. Adriat. Meer.* (1868) p. 53; *Schmidtlein, Mitth. zool. Stat. Neap.* i. (1878) p. 126.

Palmipes placenta, *Norm. Ann. & Mag.* xv. (1865) p. 120; *Parfitt, Trans. Devon Assoc.* v. (1872) p. 359.

$$2R = 3r \text{ (nearly).}$$

A perfectly flat species, liable to a good deal of distortion in drying. Of the form of a pentagon with curved or angulated sides; sometimes almost round. Ambulacra rather wide, fringed by a row of spines, ordinarily set by fives on each ossicle; outside these there is a transverse row of three or four spines. The ossicles on the ventral surface carry from ten to two or three spines according as they are near to or far from the mouth; these spines are much longer than the much finer and more glossy spinelets, which are more numerous represented on the ossicles of the dorsal surface. The small, rather obscure madreporite is quite close to the centre of the disk.

Colour red in the centre and at the edges, above and below; red along the rays above; elsewhere white. Gradually fades when dead; the red colour quite lost in spirit-specimens.

R.	r.
93	63.5
72.5	51
70	42.5
54	32
40	26
36	29
27	21

The five Rs and rs are frequently respectively different in one and the same specimen.

Distribution. Shores of Great Britain, Ireland, and France :
Mediterranean. To 30 fms.

<i>a.</i> The Minch.	'Porcupine' Exp.
<i>b.</i> Loch Aber, 70-80 fms.	John Murray, Esq.
<i>c-f.</i> Loch Lorn, 5-110 fms.	John Murray, Esq.
<i>g, h.</i> 4 miles S.E. Sanda, 30-35 fms. 17/3/88.	John Murray, Esq.
<i>i-l.</i> West coast of Scotland.	John Murray, Esq.
<i>m.</i> Kenmare River.	
<i>n.</i> Ballywalter, co. Down.	Belfast Nat. Hist. Soc.
<i>o, p.</i> Off Liverpool.	
<i>q.</i> West of Lundy, Feb. 1888.	
<i>r.</i> Cornwall.	G. F. Tregelles, Esq.
<i>s, t.</i> Falmouth.	W. P. Cocks, Esq.
<i>u.</i> Plymouth Sound.	Dr. Leach.
<i>v.</i> Plymouth Sound.	C. Prideaux, Esq.
<i>w-y.</i> Plymouth.	
<i>z, a'.</i> Weymouth, 5 fms., Sept. 1880.	Edgar A. Smith, Esq.
<i>b'-d'.</i> Weymouth Bay.	
<i>e'-g'.</i> Worthing.	F. Dixon, Esq.
<i>h'.</i> Brighton.	R. Hudson, Esq.
<i>i'.</i> Aberdeen.	Geo. Sim, Esq.

STICHAETERIDÆ (see p. 22).

Key to the Genera of Stichasteridæ.

- i. Ambulacral groove not constricted at intervals.
 - a.* Primary calycinal plates not obvious 1. STICHAETER, p. 85.
 - b.* Primary calycinal plates very obvious 2. NEOMORPHASTER, [p. 87.]
- ii. Ambulacral groove constricted repeatedly . . . 3. ZOROASTER, p. 87.

1. STICHAETER.

Stichaster, *M. Tr. Ber. Ak. Berl.* 1840, p. 102; *Norm. Ann. & Mag.* xv. (1865) p. 125; *Perr. Arch. Zool.* iv. (1875) p. 299; *Viguier, Arch. Zool.* vii. (1878) p. 105.

Tonia, *Gray, Ann. & Mag.* vi. (1840) p. 180.

Asteracanthion, *M. Tr. Syst. Ast.* (1842) p. 14.

Cœlasterias (pars), *Verr. Trans. Connectic. Acad.* i. (1867 *[71]) p. 247.

Stephanasterias, *id. Bull. Essex Inst.* iii. (1872) p. 5.

A Stichasterid in which the skeleton of the arms is formed of regular rows of contiguous granulated plates. There are four rows of podia for the whole length of the arm.

1. Stichaster roseus.

Asterias rosea, *O. F. Müll. Zool. Dan.* ii. (1788) p. 35, pl. lxxvii.

Linkia rosea, *Thompson, Ann. & Mag.* v. (1840) p. 245.

* Date claimed by Prof. Verrill.

- Cribella rosea*, Forbes, *Brit. Starf.* (1840) p. 106; Thompson, *Faun. Irel.* iv. (1856) p. 439; Maitland, *Anim. Belg. sept.* (1851) p. 90.
Asteracanthion roseus, Düb. & Kor. *Vet.-Ak. Hdlg.* 1844 (1846), p. 241; Perr. *Ann. Sci. Nat.* xii. (1869) p. 229, pl. xvii. fig. 7.
Henricia rosea, Gray, *Brit. Rad.* (1848) p. 20.
Asteracanthion roseus (pars), M. *Tr. Syst. Ast.* (1842) p. 17.
Stichaster roseus, Sars, *Norg. Ech.* (1861) p. 86; *Norm. Ann. & Mag.* xv. (1865) p. 125; Hodge, *Tr. Nat. Hist. Soc. North. & Durh.* iv. (1872) p. 136; Perr. *Arch. Zool. expér.* iv. (1875) p. 347; Dan. & Kor. *Norsk. Nordh. Ast.* (1885) p. 30.

$$R = 7r.$$

Rays long, tapering gradually, rather sharply marked off from the disk, blunt at tip, with a prominent terminal plate. Ambulacral groove pretty wide, with a double or triple row of blunt, closely packed, rather irregularly disposed spines, beyond which are two or three rows of smaller, almost tubercle-like spines. The ossicles of both surfaces are arranged in very regular rows, among which that which extends along the middle line of the back is conspicuous. The ossicles are irregularly oval in form and the tubercles with which they are closely covered are squarish and flat-headed; there are seven or eight rows on either side the middle line, and the ossicles in those at the side of and on the ventral surface of each arm are larger than those on the dorsal surface. The definiteness of the arrangement of the rows of ossicles is less marked and the tuberculation does not form so close a pavement in specimens from 55 or 200 fathoms; in the Croulin specimen the tubercles are almost spines. The papular spaces are distinct but never large. The disk is small, the madreporite on its side is prominent and surrounded by a circlet of flat tubercles.

Colour in life, orange or reddish; dried or in spirit, pale yellow.

R.	r.	Breadth of arm at base.
112	19	18
92	12	12.5

Distribution. Coasts of Norway, Holland, British Isles. To 200 fms.

- | | |
|---|--------------------|
| a. Croulin Id., Skye, 30 fms. | R. M'Andrew, Esq. |
| b. Ayrshire. | Prof. E. Forbes. |
| c. Kilbrennan Sound, 10-20 fms. | J. Murray, Esq. |
| d. 30 miles off Achill Head, 144 fms. | R. Irish Acad. |
| e, f. S.W. coast of Ireland, 55 fms. | |
| g. 50° 50' 15" N., 11° 12' 30" W., 200 fms. | G. C. Bourne, Esq. |
| h. S.W. Ireland. | Dr. Grenfell. |
| i. Port Erin, I. of Man, Easter 1889. | |
| j. Plymouth. | |
| k. Aberdeen. | G. Sim, Esq. |
| l-p. — ? | 'Porcupine' Exp. |

2. NEOMORPHASTER.

Glyptaster, *Sladen, Chall. Narr. i.* (1885) p. 612 (*non* Glyptaster, *Hall*).
Neomorphaster, *Sladen, Chall. Rep. Ast.* (1889) p. 436.

A Stichasterid in which the primitive calycinal plates remain well marked on the disk, but in which the adambulacral plates do not form projecting angles into the ambulacral grooves. By the former character distinguished from *Stichaster*, by the latter from *Zoroaster*; otherwise it might well be placed in either of these genera.

1. Neomorphaster eustichus.

Neomorphaster eustichus, *Sladen, Chall. Rep. Ast.* (1889) p.
pl. lxvi. figs. 3 & 4, & pl. lxviii. figs. 9 & 10.

R is equal to rather more than 4 r.

Disk moderate, pretty deep at the sides, with a circlet of large papulæ close to its margin; the plates of the disk arranged radially and interradially only, save in the centre, where there may be one or more. Along the arms there is a central row of ossicles, and on either side of it there are four rows; these are all arranged very regularly and the plates are separated by large papulæ and ornamented with a spiny granulation. On the adambulacral plates there are ten lines of simple subequal spines.

Colour in spirit, yellowish white.

R. *	r.	Breadth of arm at base.	Height of disk.
48	11	9	9
40	9	8·7	7·5
32	7	6	4·5
21	5	4·5	3·7

Dredged off S.W. coast of Ireland (51° 1' N., 11° 50' W., 750 fms.); and off Azores (900 and 1000 fms.).

3. ZOROASTER.

Zoroaster, *Wyv. Thoms. Depths of the Sea* (1873) p. 154; *Perr. Nouv. Arch. Mus.* vi. (1884) p. 195; *id. Ann. Sci. Nat.* xix. (1885) art. 8, p. 16; *Slad. Chall. Rep. Ast.* (1889) p. 416.

Arms five, more or less rigid, elongated, arched; covering spines well developed. Ambulacral tubes quadriserial at base of arm, with small sucking-disks; adambulacral plates hidden in groove.

In the definition of this genus and in the assignment of it to the family Stichasteridæ, it will be seen that I follow Professor Perrier's earlier arrangement rather than that since proposed by Mr. Sladen, for which no definite reasons are conclusively stated.

* These measurements are taken from a series of specimens dredged from the west of Fayal, Azores (St. 73, Voy. 'Challenger').

1. *Zoroaster fulgens*.

Zoroaster fulgens, *Wyv. Thoms. Depths of the Sea*, (1873) p. 154, fig. 26; *Sladen, Chall. Rep. Ast.* (1889) p. 418.

Arms five, greatly elongated, stiff, sometimes much compressed from side to side, with a prominent dorsal ridge formed of a series of projecting knobs; sometimes less compressed and the lophial line less distinct. Ambulacra wide at base but tapering gradually, so that the quadriserial arrangement of the subconical suckers ceases before the tip of the arm is reached. The adambulacral plates are hidden within the groove, and every alternate one forms a process set at right angles to the long axis of the arm, and projecting into the groove; owing to the position and form of the plates the adambulacral spines intrude among the tubes. The lower part of the sides of the arms are thickly covered with needle-like spines, which become shorter the higher up they are on the sides of the arms; the plates on the dorsal surface and disk have each a stronger spine, and are covered with a thick coating of small sharp spines or spiniform tubercles. The mouth is deeply depressed, and the spines which surround it are the longest. The madreporite is small and inconspicuous.

Colour in spirit, milky white; when alive a "brilliant yellow scarlet" (*Wyv. Thoms.*).

R.	r.	Breadth of arm at base.	Height of do.
125	12.5	13	14
121	12.5	13	11
89	10	9	9
78	9	9	9
55	8	7	7

Distribution. Atlantic, from Nova Scotia to Pernambuco on the west, Faeroe and Hebrides on the east. 500–1350 fms.

- a.* Faeroe Channel, 555 fms. 'Triton' Exp. (St. 11).
b-f. Faeroe Channel, 570 fms. 'Triton' Exp. (St. 13).
g. Faeroe Channel, 542 fms. 'Porcupine' Exp. (St. 47 A).

SOLASTERIDÆ (see p. 22).

SOLASTER.

Solaster, *Forb. Mem. Wern. Soc.* viii. (1839) p. 120; *id. Brit. Starf.* (1840) p. 109; *M. Tr. Syst. Ast.* (1842) p. 26; *Viguier, Arch. Zool. expér.* vii. (1878) p. 134; *Dan. & Kor. Norsk. Nordh. Exp. Aster.* (1884) p. 51*.

* The evidence by which these authors rebut the distinctness of *Solaster* and *Crossaster* as maintained by some writers, of whom I was once one (see *Ann. & Mag.* viii. (1881) p. 140), is complete.

- Crossaster, *M. Tr. Ber. Ak. Berl.* (1840) p. 103.
 Solaster and Crossaster, *Sladen, Chall. Rep. Ast.* (1889) p. 442.
 Lophaster, *Verrill, Amer. Journ. Sci.* xvi. (1878) p. 214.

Rays five or more; marginal plates more or less well developed, but concealed by the skin. External plates beset with penicilli-form paxillæ, the spaces between which contain papulæ of variable number.

Key to the Species.

- Rays twelve or more* 1. *S. papposus*.
 Rays less than twelve, but more than five . . . 2. *S. endeca*.
 Rays five 3. *S. furcifer*.

1. *Solaster papposus*.

- Asterias helianthemoides* (?), *Penn. Brit. Zool.* (1777) iv. p. 56.
Asterias papposa, *Fabr. Faun. Grænl.* (1780) n. 364; *Gmel. Syst. Nat.* (1788) p. 3160; *Lamk. An. s. Vert.* (1816) ii. p. 559; *Flem. Brit. An.* (1828) p. 487; *de Bl. Man. d'Act.* (1834) p. 241; *Johnston, Loudon's Mag. N. H.* ix. (1836) p. 474, fig. 69.
Stellonia papposa, *Ag. Mém. Soc. Sci. Nat. Neuchâtel*, i. (1836) p. 192.
Solaster papposa, *Forbes, Mem. Wern. Soc.* viii. (1839) p. 121; *id. Brit Starf.* (1840) p. 112; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 440.
Solaster (*Polyaster*) *papposa*, *Gray, Ann. & Mag.* vi. (1840) p. 183; *id. Brit. Rad.* (1848) p. 19.
Crossaster papposus, *M. Tr. Arch. f. Nat.* vi. (1840) p. 183; *Verr. Proc. Bost. Soc. N. H.* x. (1866) pp. 345 & 356; *A. Ag. Mem. Mus. C. Z.* v. (1877) p. 99, pl. xii.; *Dunc. & Slad. Arct. Echinod.* (1881) p. 36, pl. iii. figs. 1-4.
Solaster papposus, *M. Tr. Syst. Ast.* (1842) p. 26; *Lütke. Vid. Medd.* 1857, p. 40; *Duj. & Hup. Echinod.* (1862) p. 353; *Norman, Ann. & Mag.* xv. (1865) p. 122; *Hodge, Nat. Hist. Trans. Northumb. & Durh.* iv. (1872) p. 134; *Perr. Arch. Zool. expér.* iv. (1875) p. 358; *Viguier, Arch. Zool. expér.* vii. (1878) p. 134; *Kor. & Dan. Norske Nordhavs Exp. Ast.* (1884) p. 48.

$$R = 2r \text{ (nearly).}$$

Arms twelve to fifteen; spines arranged in distinct tufts, separated from one another by their own width or more; more closely packed on disk than on arms. Lateral spines prominent. Varies considerably in colour; arms proportionately longer with age.

$$R=110; r=45.$$

$$R=98; r=45.$$

$$R=89; r=39.$$

$$R=68; r=31.$$

$$R=47; r=20.5.$$

$$R=27; r=14.$$

Distribution. Both sides of North Atlantic, as far south as Massachusetts and French coasts; Arctic Ocean. To 640 fms.

* See var. *septentrionalis*, p. 90.

<i>a-e</i> . Faeroe Channel, 60° 25' N., 8° 10' W., 384 fms.	'Porcupine' Exp.
<i>f-k</i> . Faeroe Channel, 60° 14' N., 6° 17' W., 632 fms.	'Porcupine' Exp.
<i>l, m</i> . Firth of Lorn, 70-80 fms.	J. Murray, Esq.
<i>n, o</i> . Loch Craignish.	Hon. A. E. Gathorne Hardy.
<i>p-s</i> . Kilbrennan Sound.	J. Murray, Esq.
<i>t</i> . Mouth of Kilbrennan Sound.	J. Murray, Esq.
<i>u</i> . Between Great Cumbrae and Wemyss Sd.	J. Murray, Esq.
<i>v-x</i> . Between Sanda Id. and Ailsa Craig.	J. Murray, Esq.
<i>y, z</i> . West coast of Scotland.	J. Murray, Esq.
<i>a'</i> . Tuskar, S. Ireland.	Dr. Grenfell.
<i>b'</i> . S. or W. Ireland.	Dr. Grenfell.
<i>c', d'</i> . Ballyhome Bay, co. Down, 3 Sept. and 1 Oct., 1834.	Belfast Nat. Hist. Soc.
<i>e'</i> . Isle of Man.	Prof. Edward Forbes.
<i>f'-h'</i> . Liverpool.	
<i>i', j'</i> . Tenby.	Dr. Bowerbank.
<i>k'</i> . Oyster-beds, W. of Tenby.	
<i>l'</i> . Falmouth.	W. P. Cocks, Esq.
<i>m'</i> . Plymouth.	Prof. Stewart.
<i>n'</i> . Plymouth.	
<i>o'-u'</i> . Weymouth Bay (one specimen 8-armed).	
<i>v'-w'</i> . Lulworth, 4 fms., July 1889.	F. J. B. Beckford, Esq.
<i>x'</i> . Poole, 572 fms., July 1889.	F. J. B. Beckford, Esq.
<i>y', z'</i> . Outside Portland Breakwater, 10 fms.	Rev. S. O. Ridley.
<i>a''</i> . St. Leonards, July 1888.	R. I. Pocock, Esq.
<i>b'', c''</i> . Ramsgate.	Miss Rye.
<i>d''</i> . Whitstable.	S. Saunders, Esq.
<i>e''</i> . Cullercoats, Oct. 1890.	R. Howse, Esq.
<i>f''-u''</i> . Montrose, June 13, 18, 27; July 1; Aug. 1, 3, 8; Sept. 10, 21—1889.	W. Duncan, Esq.
<i>v''</i> . Aberdeen.	L. G. Esson, Esq.
<i>w'', x''</i> . East coast of Ross-shire.	Dr. Sutherland.
<i>y''-c'''</i> . Moussa, Shetland.	E. M. Nelson, Esq.
<i>d'''</i> . England.	Dr. Leach.

Var. septentrionalis.

Crossaster papposus, var. *septentrionalis*, *Sladen, Proc. Roy. Soc. Ed.*
xi. (1884) p. 704; *id. Chall. Rep. Ast.* (1889) p. 444.

With ten arms.

a. Faeroe Channel, 375 fms. 'Knight Errant' Exp. (St. 2).

2. *Solaster endeca*.

Asterias endeca, *Linn. Mantissa*, (1771) p. 543; *Gmel. Syst. Nat.*
xiii. (1788) p. 3162; *Lamk. An. s. Vert.* ii. (1816) p. 560; *de Bl.*
Man. d'Act. (1834) p. 241.

Asterias aspera, *O. F. Müll. Prod. Zool. Dan.* (1776) p. 234.

Asterias endica, *Flem. Brit. An.* (1828) p. 487.

Stellonia endeca, *Ag. Mém. Soc. Sci. Nat. Neuchât.* i. (1836)
p. 192.

Solaster endeca, *Forbes, Mem. Wern. Soc.* viii. (1839) p. 121; *id.*
Brit. Starf. (1840) p. 109; *M. Tr. Syst. Ast.* (1842) p. 26;

Stimpson, Mar. Inv. Grand Manan, (1853) p. 14; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 439; *Lützk. Vid. Medd.* 1857, p. 35; *Sars, Norg. Ech.* (1861) p. 75; *Norman, Ann. & Mag.* xv. (1865) p. 122; *Hodge, Nat. Hist. Trans. Northumb. & Durh.* iv. (1872) p. 135; *Perr. Arch. Zool. expér.* iv. (1873) p. 359; *Dunc. & Slad. Ech. Greenl.* (1881) p. 40; *Kor. & Dun. Norske Nordh. Exp. Ast.* (1884) p. 50.

Solaster (Endeca) endeca, *Gray, Ann. & Mag.* vi. (1840) p. 183; *id. Synops. Starf. B. M.* (1866) p. 5.

$$R = 2.5 r \text{ (nearly).}$$

Arms nine to eleven; the tufts of spines less brush-like and much more closely packed than in *S. papposus*; on the disk they may touch their neighbours. Lateral spines less prominent than in *S. papposus*. Often purplish in hue, especially on the disk; but not constant in colour. Arms decrease a little in proportionate length with age.

$$R = 106; r = 39.$$

$$R = 105; r = 38.$$

$$R = 90; r = 32.$$

$$R = 81; r = 32.$$

$$R = 65; r = 26.$$

$$R = 58; r = 21.$$

$$R = 40; r = 13.$$

Distribution. Both sides of North Atlantic, north of coast of France and United States; that is, about 3 degrees of latitude north of *S. papposus*; Arctic Ocean. To 150 fms.

a. Firth of Lorn, 70-80 fms.	John Murray, Esq.
b. Loch Craignish.	Hon. A. E. Gathorne Hardy.
c. Between Great Cumbrae and Wemyss Sound.	John Murray, Esq.
d. West coast of Scotland.	John Murray, Esq.
e. S. or W. Ireland.	Dr. Grenfell.
f. Strangford Lough.	Belfast Nat. Hist. Soc.
g. Belfast Bay.	
h. Off Liverpool.	
i. Cullercoats, Oct. 1890.	R. Howse, Esq.
k. Firth of Forth.	Dr. Leach.
l-o. Montrose, July 13/20; Aug. 27, 1889.	W. Duncan, Esq.
p, q. Aberdeen.	G. Sim, Esq.
r, s. E. coast of Ross-shire.	Dr. Sutherland.
t. East coast of Scotland.	F. Day, Esq.
u. Moussa, Shetland.	E. M. Nelson, Esq.

3. Solaster furcifer.

Solaster furcifer, *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 243, pl. vi. figs. 7-10; *Sars, Norg. Ech.* (1861) p. 77; *Wyv. Thoms. Depths of the Sea*, (1873) p. 119; *Stuxberg, Œfv. Vet.-Ak. Hdlg.* 1878, no. 3, p. 32.

Lophaster furcifer, *Verrill, Am. J. Sci.* xvi. (1878) p. 214; *Dunc. &*

Slad. Echinod. Arctic Sea, (1881) p. 43; *Sladen, Chall. Rep. Ast.* (1889) p. 459.
Chætaster borealis (n. n.), *Düben, Öfv. Svensk. Ak. Förh.* 1844 (1845), p. 113.

$R = 3r$ (nearly).

Arms five; spines in delicate tufts, rather widely spread or rather coarser and more closely packed; arms wide and flat; the marginals of both series with an elongated pedicle; three or four spines on each adambulacral plate. Colour in spirit yellowish.

Not known to grow as large as its congeners.

Distribution. Both sides of North Atlantic; on the East not known south of Faeroe Channel; on the West as far south as the Gulf of Maine. To 605 fathoms.

a. Faeroe Channel, 384 fms.

'Porcupine' Exp.

CORETHRUSTERIDÆ (see p. 23).

CORETHRUSTER.

Korethruster, *Wyv. Thoms. Depths of the Sea*, (1873) p. 120 (n. n., but *fig. of K. hispidus*, sp. n.); *Dan. & Kor. op. cit.* p. 95; (?) *Perr. Nouv. Arch. Mus.* vi. (1884) p. 211; *Slad. Chall. Ast.* (1889) p. 462.
Corethruster, *v. Marenz. Denkschr. Ak. Wien*, xxxv. (1878) p. 383.

1. *Corethruster hispidus*.

Corethruster hispidus, *Wyv. Thoms. Depths of the Sea*, (1873) p. 120, fig. 15; *v. Marenz. Denkschr. Ak. Wien*, xxxv. (1878) p. 383; *Dan. & Kor. Norske Nordhavs Ast.* (1884) p. 95, pl. xii.; *Sladen, Chall. Rep. Ast.* (1889) p. 464, pl. lxxx. figs. 6-9.

Body thick; rays in young twice, in older forms four times as long as radius of disk. Spines very long, arranged in tufts of 6-10, which are united at their base. Adambulacral spines in two rows, flat and hollow. Pale yellow.

Measurements of single British specimen:—

$R = 8.5$, $r = 4.5$; height = 4; spines = 2 mm.

Distribution. Northern Atlantic. So far as is known from the eastern side only. The species spoken of by Mr. Whiteaves (*Ann. & Mag.* x. (1872) p. 346) is, as he informs me, *Pteraster militaris*, and not, as might be supposed, *Corethruster hispidus*. 101-632 fms.

a. Faeroe Channel, 60° 14' N., 6° 17' W., 632 fms.

'Porcupine' Exp.

PTERASTERIDÆ (see p. 23).

Key to the Genera of Pterasteridæ.

- a. Adambulacral spines in transverse combs;
 spines united by a web 1. PTERASTER, p. 93.
 b. Adambulacral spines not forming transverse
 combs; spines not united by a web... 2. HYMENASTER, p. 94.

1. PTERASTER.

Pteraster, *M. Tr. Syst. Ast.* (1842) p. 127; *Sladen, Chall. Rep. Ast.* (1889) p. 469.

A Pterasterid in which the adambulacral plates carry transverse combs of spines; the spines are webbed; the supradorsal membrane is provided with muscular fibrous bands, which are not arranged in a reticular manner, and usually contains spicules.

1. Pteraster militaris.

Asterias militaris, *O. F. Müll. Prod. Zool. Dan.* (1776) p. 234, no. 2828; *J. Rathke, in Zool. Dan.* iv. (1806) p. 13, pl. 131.
Asteriscus militaris, *M. Tr. Syst. Ast.* (1842) p. 44.
Pteraster militaris, *id. t. c.* p. 128; *Düb. & Kor. Vet.-Ak. Hdlg.* 1844 (1846) p. 246, pl. vii. figs. 11-13; *Stimps. Inv. Grand Manan*, (1853) p. 15; *Kor. & Dan. Faun. litt. Norv.* ii. (1856) p. 55, pl. viii. figs. 1-8; *Lütke. Vid. Medd.* 1857, p. 43; *Sars, Norg. Echin.* (1861) p. 48, pl. iii. figs. 8, 9, pls. iv., v., vi. figs. 1-13; *Duj. & Hup. Echin.* (1862) p. 434; *Moeb. & Bütschli, JB. Comm. Kiel*, ii. & iii. (1875) p. 147; *Perr. Arch. Zool. exp.* v. (1876) p. 301; *Kor. & Dan. Norske Nordhavs Asteroidea*, (1884) p. 70; *Slad. Chall. Rep. Ast.* (1889) p. 471.

$$R=2 r.$$

Body high, stellate, the sides of adjoining rays forming a slightly obtuse angle with one another; ambulacra moderately wide, bounded by a transverse comb of four to six spines; this is on its outer side attached to the membrane which connects the marginal spines with one another. The paxilliform spines which bear the supradorsal membrane end in two or three spinelets.

$R=22.5$; $r=10.5$. Greatest height=13. Breadth of arm at base 14 millim.

Distribution. Both sides of North Atlantic, as far south as Grand Manan on the west and coast of Norway on the east. A characteristic arctic form, and said to increase in size the further north it is met with. 10-600 fms.

a. Faeroe Channel, 530 fms.

'Triton' Exp.

Var. *prolata*.

Pteraster militaris, var. *prolata*, *Sladen, Trans. Roy. Soc. Ed.* xxxii. (1884) p. 153, pl. xxvi. fig. 1; *id. Chall. Rep. Ast.* (1889) p. 472.

Mr. Sladen distinguishes a specimen from the Faeroe Channel (608 fms.) in which, "although it accords in the main with the diagnostic formula of that species [i. e. *P. militaris*], the majority of the characters differ more or less in degree." The rays are said to be long and narrow. $R=58$ to 60 millim.; $r=18$ millim. I have not seen the form, and have no opinion to offer.

2. *Pteraster personatus*.

Pteraster personatus, *Sladen, Proc. R. Irish Acad.* i. (1891) p. 694, pl. xxviii.

$R = 70$; $r = 25$ millim.

This species is stated to have the facies of *Hymenaster* and to be intermediate in many respects between *Pteraster* and *Hymenaster*. The comb of adambulacral spines forms a regular semicircular curve and is curved round aborally at the margin of the furrow. There are no secondary or superficial spines on the actinal surface of the mouth-plates.

Found at $51^{\circ} 1' N.$, $11^{\circ} 50' W.$ 750 fms.

2. HYMENASTER.

Hymenaster, *Wyv. Thoms. Depths of the Sea*, (1873) p. 120; *Dan. & Kor. Norske Nordh. Ast.* (1884) p. 79; *Sladen, Chall. Rep. Ast.* (1889) p. 470.

A *Pterasterid* in which there are no transverse adambulacral combs of spines and no web; the marsupial cavity is spacious. The well-developed supradorsal membrane contains muscular fibres. Spiracula present. Spinelets of paxillæ short, and not protruding through the membrane.

1. *Hymenaster pellucidus*.

Hymenaster pellucidus, *Wyv. Thoms. Depths of the Sea*, (1873) p. 120, fig. 16; *Dan. & Kor. Nyt Mag.* 1877, p. 68, pl. iv. figs. 1-14; *id. Norske Nordhavs Ast.* (1884) p. 72, pl. xiii. figs. 1-17, pl. xv. figs. 7 & 8; *Slad. Chall. Rep. Ast.* (1889) p. 508.

$R = 2r$.

Abactinal surface arching towards the centre, actinal surface flat. Five large paxillæ round the funnel-shaped aperture of the marsupium, each of which carries six to eight short and eight to ten long calcareous needles; the remaining paxillæ have four long and three short needles. Each adambulacral plate has three spines, two of which face inwards, while the third faces the semilunar aperture on the lateral margin of the ray. Madreporite circular.

Colour very red; integument translucent.

Distribution. Eastern side of North Atlantic as far as Jan Mayen and Spitsbergen. 70 to 1539 fms.

a. Faeroe Channel, 580 fms.

'Porcupine' Exp. (St. 59).

Specimens from 12 to 80 millim. in diameter have been examined by Messrs. Koren and Danielssen, from whose diagnosis that just given has been drawn up.

2. *Hymenaster giganteus*.

Hymenaster giganteus, *Sladen, Proc. R. Irish Acad.* i. (1892) p. 696, pl. xxviii.

$R=160$; $r=102$ millim. (approximately).

Distinguished from *H. pellucidus* by "its large size and coarse habit, as well as by the whole character of the abactinal surface," where "the radial areas are well marked out, distinct from the fringe and interradial membrane."

One (or ? more) specimen taken at 750 fms. at $51^{\circ} 1' N.$, $11^{\circ} 50' W.$

ECHINASTERIDÆ (see p. 23).

HENRICIA.

- Henricia*, *Gray, Ann. & Mag.* vi. (1840) p. 184; *Bell, Ann. & Mag.* vi. (1890) p. 473.
Linkia, *Forbes (non Nardo), Mem. Wern. Soc.* viii. (1839) p. 120.
Cribella, *Forbes (non Ag.), Brit. Starf.* (1840) p. 106.
Cribrella, *Lütken, Grönl. Echinod.* (1857) p. 30; *Norm. Ann. & Mag.* xv. (1865) p. 124; *Perr. Arch. Zool. expér.* iv. (1875) p. 373; *Viguier, Arch. Zool. expér.* vii. (1878) p. 123; *Sladen, Chall. Rep. Ast.* (1889) p. 540.
Echinaster, *M. Tr. Syst. Ast.* (1842) p. 22 (pars).

An Echinasterine with transversely set adambulacral spines, with the dorsal spinelets grouped, not solitary; disk small; a single small spine deeply set on either side of ambulacral groove.

1. *Henricia sanguinolenta*.

- Asterias sanguinolenta*, *O. F. Müll. Prod. Zool. Dan.* (1776) p. 234, no. 2836; *Retzius, Diss. Ast.* (1805) p. 22.
Echinaster sanguinolentus, *Sars, Arch. f. Nat.* x. (1844) p. 169 (development); *Jarzynsky, Trans. Petersb. Soc. Nat.* i. (1870) p. 318.
Cribrella sanguinolenta, *Lütk. Vid. Medd.* 1857, p. 31; *Norman, Ann. & Mag.* xv. (1865) p. 124.
Cribella sanguinolenta, *Duj. & Hup. Echinod.* (1862) p. 349.
Asterias pertusa, *O. F. Müll. Prod. Zool. Dan.* (1776) p. 235, no. 2839.
Asterias oculata, *Penn. Brit. Zool.* iv. (1777) p. 52.
Asterias spongiosa, *Fabr. Faun. Grönl.* (1780) p. 368, no. 363; (?) *Gould, Inv. Mass.* (1841) p. 345; *Desor, Proc. Boston Soc. N. H.* iii. (1848) p. 67.
Asterias seposita, *Retz. Diss. Spec. Ast.* (1805) p. 21.
Linkia oculata, *Forbes, Mem. Wern. Soc.* viii. (1839) p. 120.
Henricia oculata, *Gray, Ann. & Mag.* vi. (1840) p. 184.
Cribella oculata, *Forbes, Brit. Starf.* (1840) p. 100.
Cribrella oculata, *Perrier, Arch. Zool. expér.* iv. (1875) p. 373; *Dunc. & Slad. Arctic Ech.* (1881) p. 32, pl. ii. figs. 18-21.
Echinaster oculatus, *M. Tr. Syst. Ast.* (1842) pp. 24 & 127; *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 241; *Martens, Arch. f. Nat.* 1866, p. 54.

Echinaster eschrichtii, *M. Tr. Syst. Ast.* (1842) p. 25; *Brandt, Midd. Reise*, ii. (1851) p. 52.

Echinaster sarsi, *M. Tr. Arch. f. Nat.* 1844, p. 178.

$$R=5r.$$

Rays 5, taper very gradually, blunt at tip; ambulacrum very narrow, spines at its side sharp and spiny or blunt and clavate, irregularly disposed in sets of double transverse rows in which there are from four to seven. The papulæ are small, and the ossicles which separate them are covered by fine spines or rounded tubercles; the ossicles on the ventral are larger and more regularly disposed than those on the dorsal side. Madreporite not very obvious, rather nearer centre than edge of disk.

Colour blood-red to yellow.

This is a remarkably variable species. The spinulation of the ossicles of the dorsal surface may be so profuse and the spines so long that the whole surface may seem as if it were covered by them; in other specimens there is rather tuberculation than spinulation, and the tubercles may be produced into a number of points or be rounded. Very considerable differences are also to be observed on the spines of the ventral surface.

R.	r.	Breadth of arm at base.
83	16.5	18
78.5	18	20
71	14	16
68	14	17
55	12	14
44	9	12
23	6.5	6

Distribution. Both sides of North Atlantic as far south as Grand Manan: Arctic Ocean; presence in Mediterranean doubtful; North Sea. Littoral to 1350 fms.

<i>a-d.</i> Faeroe Channel, 440 fms.	'Porcupine' Exp. (St. 51).
<i>e-i.</i> Faeroe Channel, 384 fms.	'Porcupine' Exp. (St. 52).
<i>j, k.</i> Faeroe Channel, 363 fms.	'Porcupine' Exp. (St. 54).
<i>l-n.</i> Faeroe Channel, 125 fms.	'Porcupine' Exp. (St. 62).
<i>o.</i> Faeroe Channel, 458 fms.	'Porcupine' Exp. (St. 90).
<i>p.</i> E. Shetland Islands, 240 fms.	'Triton' Exp. (St. 1).
<i>q.</i> E. Shetland Islands, 516 fms.	'Triton' Exp. (St. 10).
<i>r-u.</i> E. Shetland Islands, 555 fms.	'Triton' Exp. (St. 11).
<i>v-e'.</i> N.E. Shetland Islands, 345 fms.	'Porcupine' Exp. (St. 65).
<i>f'-i'.</i> E. Shetland Islands, 203 fms.	'Porcupine' Exp. (St. 74).
<i>j'.</i> Off North Rona, 53 fms.	'Knight Errant' Exp. (St. 3).
<i>k', l'.</i> Loch Craignish.	Hon. A. E. Gathorne Hardy.
<i>m', n'.</i> Loch Hourn, 70 fms.	John Murray, Esq.
<i>o'-u'.</i> Loch Etive, 15-20 fms.	John Murray, Esq.
<i>v'.</i> Loch Fyne, 80 fms.	John Murray, Esq.
<i>w'.</i> Sound of Mull, 70 fms.	John Murray, Esq.
<i>x'.</i> Between Sanda and Ailsa Craig.	John Murray, Esq.
<i>y'-c''.</i> West coast of Scotland.	John Murray, Esq.

- d''*, *e''*. Strangford Lough, 5 fms., Sept. 8, 1851. Belfast Nat. Hist. Soc.
- f''-j''*. Off Wexford, 30-40 fms. 'Porcupine' Exp.
- k''*. Kenmare River.
- l''*. Bantry Bay.
- m''*. Blacksod Bay, 5-6 fms. R. Irish Acad.
- n''*. Valentia. 'Lightning' Exp.
- o''*. Coast of Ireland. Earl of Enniskillen.
- p''*. Isle of Man. E. Forbes, Esq.
- q''-s''*. Off Liverpool.
- t''*. Dinas Head.
- u''*, *v''*. Tenby. Dr. Bowerbank.
- w''*. Falmouth. W. P. Cocks. (Ray divided.)
- x''-a³*. Plymouth Sound. Dr. W. P. Leach.
- b³-d³*. Plymouth.
- e³, f³*. Weymouth.
- g³, h³*. Lobster patch, Poole, 5½ fms., July 1889. F. J. B. Beckford, Esq.
- i³*. Worthing. Dr. S. P. Woodward. (Four-rayed.)
- j³, k³*. Black Rocks, Leith. Dr. Greville.
- l³*. Firth of Forth. Dr. Leach.
- m³*. St. Andrews. Prof. M'Intosh.
- n³*. St. Andrews (just deposited). Prof. M'Intosh.
- o³-r³*. Montrose, June, July, Sept., 1889. W. Duncan, Esq.
- s³, t³*. Aberdeen. L. G. Esson, Esq.
- u³, v³*. E. coast of Ross-shire. Dr. Sutherland.
- w³, x³*. Shetland. E. M. Nelson, Esq.

Var. *abyssicola*.

- Cribrella sanguinolenta*, var. *abyssicola*, *Norman, Rep. Brit. Assoc.* 1868 (1869), p. 313.
- Cribrella oculata*, var. *cylindrella*, *Sladen, Trans. Roy. Soc. Ed.* xxxii. (1884) p. 160, pl. xxvi. fig. 8.

Var. *curta*.

- Cribrella sanguinolenta*, var. *curta*, *Norman, Rep. Brit. Assoc.* 1868 (1869), p. 313.

With a species of such extensive range both horizontal and vertical variation is considerable, and it is a question whether definite varieties can be satisfactorily diagnosed.

ASTERIIDÆ (see p. 23).

ASTERIAS.

- Asterias*, *Linn. Syst. Nat.* x. (1758) p. 661 (pars); *Gray, Ann. & Mag.* vi. (1840) p. 178 (pars); *Perrier, Arch. Zool. exp.* iv. (1875) p. 302; *Bell, P. Z. S.* 1881, p. 492; *Sladen, Chall. Ast.* (1889) p. 560; *Perrier, Miss. Scient. Cap Horn*, vi. (1891) p. k 77.
- Stellonia*, *Nardo, Oken's Isis*, 1834, col 716 (pars); *Ag. Mém. Soc.*

Neuch. i. (1836) p. 191; *Forbes, Mem. Wern. Soc.* viii. (1839) p. 121.

Uraster, *Forbes, Brit. Starf.* (1840) p. 78.

Asteracanthion, *M. Tr. Ber. Ak. Berlin*, 1840, p. 101; *id. Syst. Ast.* (1842) p. 14 (pars).

Diplasterias, *Perrier, Miss. Scient. Cap Horn*, vi. (1891) p. k 77.

Arms five, or, if more, not fused so as to form a large disk; the abactinal skeleton well developed and bearing spines, but not tubercles.

I have (*P. Z. S.* 1881, p. 499) made an artificial scheme for the especial object of determining the numerous species of this large genus, but I cannot follow Prof. Perrier (*Miss. Scient. Cap Horn*, *Echinodermes* [1891], p. k 77) in his division of the genus into *Diplasterias*, defined as having "Deux rangées de piquants adambulacraires au moins," and *Asterias*, defined as having "Une seule rangée de piquants adambulacraires ou les piquants alternativement isolés et groupés par deux sur les plaques adambulacraires." This division is, I think, fully met by my groups of "Monacanthida" and "Diplacanthida."

Key to the Species.

Spines on upper surface few and large, or moderate and rather more numerous.

a. Major pedicellariæ scattered 1. *A. glacialis*.

b. Major pedicellariæ confined to neighbourhood of ambulacral groove 2. *A. muelleri*.

Spines small, numerous, irregular.

a. Arms rounded 3. *A. rubens*.

b. Arms flattened 4. *A. murrayi*.

c. Arms short and squat 5. *A. hispida*.

1. *Asterias glacialis*.

Asterias glacialis, *Linn. Syst. Nat.* x. (1758) p. 661; *id. op. cit.* xii. p. 1099; *id. ed. Gmel.* (1789) p. 3162; *O. F. Müll. Zool. Dan.* (1776) p. 234; *Lamk. An. s. Vert.* ii. (1816) p. 561; *Gray, Ann. & Mag.* vi. (1840) p. 179; *id. Brit. Rad.* (1848) p. 17; *Jarzynsky, Trans. Petersb. Soc. Nat.* i. (1870) p. 318; *Ludwig, Mitth. zool. Stat. Neap.* i. (1879) p. 537; *Greef, Zool. Anz.* v. (1882) p. 117; *Bell, op. cit.* p. 282; *Perrier, Ann. Sci. Nat.* xix. (1885) no. 8, p. 15; *Barrois, Rev. Biol.* i. (1888) p. 69.

Asteracanthion glacialis, *M. Tr. Syst. Ast.* (1842) pp. 14 & 126; *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 240; *Sars, Nyt Mag.* x. (1859) p. 51; *id. Norg. Ech.* (1861) p. 87; *Lorenz, SB. Ak. Wien*, xxxix. (1860) p. 677; *Duj. & Hup. Ech.* (1862) p. 330; *Fischer, Actes Soc. Linn. Bordeaux*, xxvii. (1869) p. 364; *Moeb. & Bütschli, JB. Comm. Kiel*, ii. & iii. (1875) p. 147.

Uraster glacialis, *Forbes, Brit. Starf.* (1840) p. 78; *id. Rep. Brit. Assoc.* 1843 (1844), p. 149; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 438.

Asterias spinosa, *Penn. Brit. Zool.* iv. (1777) p. 53.

Asterias angulosa, *O. F. Müll. Zool. Dan.* (1788) ii. p. 1, pl. xli.

Asterias echinophora, *Delle Chiaje, Mem. An. Nap.* ii. (1825) p. 356, pl. xviii. fig. 6.

Stellonia angulosa, *Ag. Mém. Soc. Neuch.* i. (1836) p. 192.

- Stellonia webbiana*, *D'Orbigny in Webb & Berthelot, Hist. Nat. Canar.* ii. (1839), *Mollusques, &c.* p. 148, pl. ii. figs. 8-13.
Asteracanthion webbianus, *Duj. & Hup. Echin.* (1862) p. 340.
Asterias madeirensis, *Stimpson, Proc. Bost. Soc. Nat. Hist.* viii. (1862) p. 263.
Marthasterias foliacea, *Jullien, Bull. Soc. Zool. Fr.* iii. (1878) p. 141.
Asterias (Stolasterias) glacialis, *Sladen, Chall. Rep. Ast.* (1889) p. 588.
Stellonia glacialis, *Forbes, Mem. Wern. Soc.* viii. (1839) p. 123.

Disk rather small, well defined; arms long, with sharp contours and rather long spines, arranged in regular rows, the number of which varies considerably. Ambulacra very wide, taper very gradually; spinulation monacanthid, the spines pretty stout, and blunt at their free ends; on either side a double row of short, rather sharp spines. All the remaining spines on the arms are set on rounded disks formed of an elevation of the integument and crowded with papulæ. These spines may be arranged in one median with a lateral row along the outer dorsal margin on either side, and the intermediate spaces almost altogether bare of even isolated spines. There is every intermediate stage between this and the presence of five regular subequal rows on the arms. The spines vary somewhat, but they are always pretty long and rather stout; the free end is blunt and may be coarsely ribbed. Madreporite rather obscure, not large. Pedicellariæ not very numerous.

Colour light yellow to white.

This species may attain to considerable dimensions:—

Ray-length.	Radius of disk.	Breadth of arm at base.	Depth of arm at base.	Spines.
40	8	9.5	9	3:2
66	14	16	6	5:4:3
92	13	16.5	9	3:2
100	10	15	9	2
160	17	21	14	2:3
200	24	36		5
230	26	42		6:7

Distribution. Eastern side of North Atlantic from Iceland to Cape Verde; Arctic Ocean; Mediterranean. 0-66 fms.

- a, b.* Kilbrennan Sound. John Murray, Esq.
c. Between island of Sanda and Ailsa Craig. John Murray, Esq.
d. Scotland. Duke of Argyll.
e. Berehaven. Rev. W. S. Green.
f, g. Lough Hyne.
h, i. Galway. Earl of Enniskillen.
j, k. Kenmare River.
l-o. Belfast Bay. Belfast Nat. Hist. Soc.
p-s. Off Liverpool.
t. Ilfracombe. Rev. Coper Abbs.
u. West of Lundy Island.
v-y. Falmouth. W. P. Cocks, Esq.
z-c'. Plymouth Sound. Dr. Leach.

- d'*. Plymouth Sound (disk with arms
just beginning to bud).
e'-k'. Plymouth Sound.
l'. Herm. Hon. A. E. Gathorne Hardy
& R. L. Spencer, Esq.
m'. British Seas.

2. *Asterias muelleri*.

- Asteracanthion mülleri*, *Sars, Faun. Litt. Norv.* i. (1846) p. 56, pl. viii. figs. 38 & 39; *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 240; *Sars, Norg. Ech.* (1861) p. 88; *Moeb. & Bütschli, JB. Comm. Kiel*, ii. & iii. (1875) p. 147.
Asterias mülleri, *Norm. Ann. & Mag.* xv. (1865) p. 127; *Jarzynsky, Trans. Petersb. Soc. Nat.* i. (1870) p. 318; *Hodge, Tr. North. & Durh.* iv. (1872) p. 138; *Bell, P. Z. S.* 1881, p. 510; *Dan. & Kor. Norske Nordhavs Ast.* (1884) p. 21.
Leptasterias mülleri, *Verrill, Proc. Bost. Soc. Nat. Hist.* x. (1866) p. 35.
Asterias (Leptasterias) mülleri, *Sladen, Chall. Rep. Ast.* (1889) p. 582.

$$R = 6 \text{ to } 4 r.$$

A small species with a striking resemblance to *A. glacialis*, but distinguished by the scarcity of major pedicellariæ, which are only found in the neighbourhood of the ambulacral groove. Arms convex, rather stout, with a central row of spines and one or two rows on either side, or with one of the rows irregular and poorly developed. Ambulacra rather narrow, bordered by spines which are generally alternately double and single; on the sides of the lower surface of the arm ordinarily two rows of spines. The greater number of the spines appear very prominent on account of the large number of minor pedicellariæ which are developed on them.

Colour in spirit whitish; when alive said to be red, violet, or ferruginous.

Not known to be as much as 5 inches in diameter.

Distribution. Both sides of North Atlantic; North Sea; White Sea. 53-433 fms.

- | | |
|--|-------------------------------|
| <i>a.</i> Faeroe Channel, 312 fms. | 'Porcupine' Exp. (St. 82). |
| <i>b.</i> Faeroe Channel, 285-433 fms. | 'Triton' Exp. (St. 5). |
| <i>c.</i> Off North Rona, 53 fms. | 'Knight Errant' Exp. (St. 3). |
| <i>d.</i> East of Shetland Isl., 64 fms. | 'Porcupine' Exp. (St. 67). |
| <i>e.</i> East of Shetland Isl., 75 fms. | 'Porcupine' Exp. (St. 68). |

3. *Asterias rubens*.

- Asterias rubens*, *Linn. Syst. Nat.* x. (1758) p. 661; *id. op. cit.* xii. (1766) p. 1099; *O. F. Müll. Prod. Zool. Dan.* (1766) p. 234; *Fabr. Faun. Groenl.* (1780) p. 369; *Retz. Vet.-Ak. Hdlg.* iv. (1783) p. 236; *Linn. S. N. ed. Gmel.* (1789) p. 3161; *Lamk. An. s. Vert.* ii. (1816) p. 562; *Sabine, Suppl. to Parry's Voy.* (1824) p. ccxxiii; *Gray, Brit. Rad.* (1848) p. 16; *von Mart. Arch. f. Nat.* xxxi. (1865) p. 351; *Norm. Ann. & Mag.* xv. (1865) p. 128; *Perr.*

- Arch. Zool. expér.* iv. (1875) p. 311; *Bell, Ann. & Mag.* vii. (1891) p. 469, pl. xiv.
- Asterias clathrata*, *Penn. Brit. Zool.* iv. (1777) p. 51.
- Asterias glacialis*, *id.* (not Linn.) *t. c.* p. 51; *Flem. Brit. An.* (1828) p. 487.
- Asterias holsatica*, *Retz. Diss. Spec. Ast.* (1805) p. 22.
- Asterias minuta*, *id. t. c.* p. 24.
- Asteracanthion rubens*, *M. Tr. Syst. Ast.* (1842) pp. 17 & 126; *Düb. & Kor. Vet.-Ak. Hdlg.* 1844 (1846), p. 241; *Sars, Norg. Ech.* (1861) p. 87; *Duj. & Hup. Ech.* (1862) p. 331; *Fischer, Act. Soc. Linn. Bordeaux*, xxvii. (1869) p. 364; *Jarzynsky, Trans. Petersb. Soc. Nat.* i. (1870) p. 318; *Greef, SB. Ges. Marburg*, 1871, p. 62; *Moeb. & Bütschli* (pars), *JB. Comm. Kiel*, ii. & iii. (1875) p. 147.
- Uraster rubens*, *Forbes, Brit. Starf.* (1840) p. 83; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 439.
- Asterias violacea*, *O. F. Müll. Zool. Dan.* ii. (1788) p. 7, pl. xlvi.; *L. ed. Gmel. Syst. Nat.* (1789) p. 3163; *Lamk. An. s. Vert.* ed. ii. t. iii. (1840) p. 256; *Gray, Brit. Rad.* (1848) p. 17; *Norm. Ann. & Mag.* xv. (1863) p. 128; *Perr. Arch. Zool.* iv. (1875) p. 313.
- Asteracanthion violaceus*, *M. Tr. Syst. Ast.* (1842) pp. 16 & 126; *Duj. & Hup. Ech.* (1862) p. 332; *Fischer, Act. Soc. Linn. Bordeaux*, xxvii. (1869) p. 365.
- Uraster violacea*, *Forbes, Brit. Starf.* (1840) p. 91; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 439.
- (?) *Asterias helgolandica*, *Ehrenberg, Phys. Abhand. Ak. Berl.* 1835 (1837), p. 212.

$$R = 7 r \text{ to } R = 4 r.$$

Arms generally five, rather stout, rounded, tapering very gradually, but not very narrow even at tip*, sometimes quite broad there. Dorsal surface covered with spines, subequal, generally of moderate size, closely packed, moderately numerous or sparse, in form they are pointed or more or less or quite blunt at their tips; a single, often more prominent row, which is either nearly straight or slightly zigzag, and then appearing at times to be double, runs along the middle of the back of each arm. Ambulacra wide, bordered by two rows of spines, the inner the thinner. A rather well-marked groove separates the outer adambulacral row from the next, which, with another, form a pretty regular series along either side of the lower surface of each arm; the outer of these has groups of two or three spines set a little obliquely to the long axis of the arm. Further out there is a wider groove and at the infero-lateral edge of the arm there is an irregularly double row of spines, which are often the strongest and best developed of any on the body; sometimes, however, the ventral spines are as strong or stronger. Madreporite generally quite distinct, near the margin of the disk, rather coarsely striate. A cirlet of minor pedicellariæ at the base of the spines; major pedicellariæ scattered over the arms, varying somewhat in the number to which they are developed.

* Except in *A. rubens* var. *attenuata*.

Colour red, orange, or purple.

Distribution. Eastern side of North Atlantic (Senegal to Finmark); Japanese Seas. Presence in Arctic Ocean uncertain, in Mediterranean very doubtful. 0-110 fms.

<i>a-c.</i> Off Island of North Rona.	Exp. 'Knight Errant.'
<i>d.</i> Gairloch.	John Murray, Esq.
<i>e.</i> Loch Etive.	John Murray, Esq.
<i>f.</i> Upper Loch Torridon.	John Murray, Esq.
<i>g.</i> Sound of Lorn, 5-110 fms.	John Murray, Esq.
<i>h.</i> Loch Craignish.	Hon. A. E. Gathorne Hardy.
<i>i-k.</i> Loch Goil, 45 fms.	John Murray, Esq.
<i>l.</i> Mouth of Kilbrennan Sound.	John Murray, Esq.
<i>m, n.</i> Mouth of Kilbrennan Sound, 22 fms.	John Murray, Esq.
<i>o-r.</i> Mouth of Kilbrennan Sound, 10-20 fms.	John Murray, Esq.
<i>s.</i> Near Trench and Kilbrennan Sound.	John Murray, Esq.
<i>t.</i> Between Great Cumbrae and Wemyss Ground.	John Murray, Esq.
<i>u-w.</i> Between Sanda and Ailsa Craig, 24 fms.	John Murray, Esq.
<i>x.</i> Kenmare River.	
<i>y-a'.</i> Kilkierran Bay.	R. Dublin Soc.
<i>b', c'.</i> Roundstone Bay.	R. Dublin Soc.
<i>d'-g'.</i> Galway Bay.	R. Dublin Soc.
<i>h'.</i> S.W. Ireland, 100 fms.	'Flying Fox' Exp.
<i>i'.</i> S.W. Ireland, 55 fms.	'Flying Fox' Exp.
<i>j'-l'.</i> S.W. Ireland.	R. Irish Acad.
<i>m'.</i> Donaghadee.	Belfast Nat. Hist. Soc.
<i>n', o'.</i> Tenby, low-water.	
<i>p'-r'.</i> Falmouth.	W P. Cocks, Esq.
<i>s'-w.</i> Plymouth.	
<i>x'-c''.</i> Sheerness.	Miss F. Buchanan.
<i>d''-r''.</i> Cullercoats.	R. Howse, Esq.
<i>s''-w''.</i> Firth of Forth.	Dr. Leach.
<i>x''.</i> Firth of Forth.	Prof. E. Forbes.
<i>y'', z'.</i> St. Andrew's Bay.	Dr. MacDonald.
<i>a³-z³.</i> Montrose, June 13, 18, 20, 21, 26 ; July 20, 1889.	W. Duncan, Esq.
<i>a⁴-m⁴.</i> Aberdeen.	G. Sim, Esq.
<i>n⁴, o⁴.</i> Moussa, Shetland.	E. M. Nelson, Esq.
<i>p⁴-z⁴.</i> Shetland.	E. M. Nelson, Esq.
<i>a⁵.</i> British.	

Var. *attenuata*.

Asterias rubens, var. *attenuata*, Hodge, *Trans. Northumb. & Durh.* iv. (1872) p. 137.

$$R = 7r \text{ to } R = 5.5r.$$

Arms long in proportion to diameter of disk, narrow at base; spines not numerous and sometimes feebly developed.

R.	r.	Breadth of arm at base.
105	15	14
75	13	15

- a.* Off North Rona, 53 fms. 'Knight Errant' Exp.
b. Tobermory, Mull, 30 fms. John Murray, Esq.

4. *Asterias murrayi*. (Plate XII. figs. 1 & 2.)

Asterias murrayi, *Bell, Ann. & Mag.* vii. (1891) p. 478, pl. xv.

$$R = 7 r.$$

Arms and disk flattened, the shallow sides nearly vertical; disk small; arms slender, with somewhat constricted bases. Ambulacra wide, feebly constricted at base, but otherwise tapering regularly; the ordinary arrangement of the adambulacral spines is the alternate disposal of one or two on successive plates. On the outer side of the shallow groove that bounds these spines is an irregular set of spines, which, where most orderly, are arranged in two longitudinal rows; sometimes they are grouped in threes, and the set is placed transversely to the long axis. The side of the arm is bare of spines; along its upper edge is a single row of spines; this never seems to be doubled. At first sight a large specimen may seem to have no other spines on its dorsal surface but a faintly indicated row along the middle line, and neither optical nor tactile examination will reveal many more, save just a few on and about the disk. The whole surface will, however, be found to be densely covered with pedicellariæ. On smaller specimens there are a larger number of smaller spines on the arms, but they are never numerous. Madreporite large, distinct, quite close to margin of disk.

Colour violet or greyish violet, darker when dried, lighter when preserved in spirit.

Hab. Only known from West coasts of Scotland and Ireland.

$$R = 173; 97. \quad r = 24; 14.$$

- a, b.* Upper Loch Fyne, 65 fms. John Murray, Esq.
c, d. Kilbrennan Sound, 22 fms. John Murray, Esq.
e, f. Between Great Cumbrae and Wemyss Ground. John Murray, Esq.
g, h. West coast of Ireland. R. Dublin Soc.

5. *Asterias hispida*. (Plate XII. figs. 3 & 4.)

Asterias hispida, *Penn. Brit. Zool.* iv. (1777) p. 52, fig. 58; *Norman, Ann. & Mag.* xv. (1865) p. 128; *Bell, P. Z. S.* 1881, p. 508; *Scott, Proc. R. Phys. Soc. Edin.* 1890-1 (1892), p. 81.

Stellonia hispida, *Forbes, Mem. Wern. Soc.* viii. (1839) p. 123.

Uraster hispida, *id. Brit. Starf.* (1840) p. 95; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 439.

Asterias rubens, var. *hispida*, *Hodge, Trans. Northumb. & Durh.* iv. (1872) p. 137.

$$R = 3.5 r \text{ to } 2 r.$$

A small squat form, not known to grow large. Arms short, broad at base, rather swollen, as is the disk. Ambulacra deep, very wide at base, bounded by a single row of rather strong spines; the next row of spines forms the ventro-lateral line; the dorsal

surface shows stoutish bars forming the framework of the arm, but the spines developed are few, short, and sharp. No major pedicellariæ. Madreporite near the edge of the disk, rather large.

Colour, when dried, light brown.

R.	r.	Breadth of arm at base.
12	3·5	4
9·5	4	3·5
9	3·5	3

a-f. Outer Skerries, Shetland.

g-i. Coast of co. Down.

Rev. Canon Norman.

Belfast Nat. Hist. Soc.

Asterias tenuispinis.

Asterias tenuispina, Lamk. *An. s. Vert.* ii. (1816) p. 561; *Ludwig, Mitth. zool. Stat. Neap.* i. (1879) p. 538.

I should have included this species in this Catalogue on the strength of a specimen stated, with a query, to have come from Lyme Regis, and presented by the late Lord Enniskillen, but for the very emphatic answer in the negative which the Rev. Canon Norman gave (*Ann. & Mag.* vi. (1890) p. 502) to my query (*t. c.* p. 424), "Is *Asterias tenuispinis*, Lamk., a 'British' species?"

BRISINGIDÆ (*see* p. 24).

Key to the Genera of Brisingidæ.

Without dorsal papulæ	1. BRISINGA, p. 104.
With dorsal papulæ ..	2. ODINIA, p. 105.

1. BRISINGA.

Brisinga, *Asbjørnsen, Fauna Litt. Norv.* ii. (1856) p. 95; *Sars, On some Remarkable Forms, &c.* (1875) p. 101; *Ludwig, Zeitschr. f. wiss. Zool.* xxxi. (1878) p. 216; *Sluden, Chall. Rep. Ast.* (1889) p. 601.

Disk small, rays less than or not much more than twenty, with ridge-like lateral and dorsal bands on the proximal part of the arms; no dorsal papulæ; major pedicellariæ numerous; no minor pedicellariæ.

1. *Brisinga endecacnemos.*

Brisinga endecacnemos, *Asbjørnsen, Faun. Litt. Norv.* ii. (1856) p. 95, pl. ix. figs. 1-15; *Sars, On some Remarkable Forms &c.* (1875) p. 101.

R = 13 or 14 r.

Arms eleven, long, delicate, with moderate transverse ridges on the proximal part of the arm; ambulacra wide, bordered by two or three more or less delicate spines, beyond which is a row of long and rather strong spines. Madreporite prominent.

Distribution. Eastern side of North Atlantic from Norway to Spain. 100-1095 fms.

- a.* Between Faeroe and Shetland Islands, 203 fms. 'Porcupine' Exp. (St. 74).
(Fragments of arms.)
b. 53 miles W. $\frac{1}{2}$ S. of Dursley Head, 325 fms. R. Irish Acad.
(Disk, three fragments of arms.)

2. *Brisinga coronata*.

Brisinga coronata, G. O. Sars, *Vid. Selsk. Förh.* 1871 (1872). p. 5;
id. *On some Remarkable Forms &c.* 1875, p. 102; *Wyv. Thoms.*
Depths of the Sea, (1873) p. 66, not fig. 5; *Dan. & Kor. Norske*
Nordhavs Ast. (1884) p. 104; *Perrier, Ann. Sci. Nat.* xix. (1885)
art. no. 8, p. 4; *Bell, Ann. & Mag.* iv. (1889) p. 435; *Sladen, Chall.*
Rep. Ast. (1889) p. 604; *id. Proc. R. Ir. Acad.* i. (1891) p. 698.

R = 18 to 20 r.

Arms varying in number from nine to thirteen, with strong transverse ridges in the proximal part of each arm; these are provided with strong spines. Ambulacra wide, bordered by three rows of spines, of which the innermost is very small and delicate and the outermost large and projecting. Madreporite not conspicuous. Pedicellariæ in large numbers.

Distribution. East side of North Atlantic from Lofoten Islands to coast of Spain. From 220 to 1360 fms.

- a.* Deep water, S.W. coast of Ireland. G. C. Bourne, Esq.
(A disk and pieces of arms.)
b. South of Rockall Bank, 630 fms. 'Porcupine' Exp.
(Fragments of arms.)
c. S.W. Ireland, 1000 fms. 'Flying Fox' Exp.

2. ODINIA.

Odinia, *Perrier, Ann. Sci. Nat.* xix. (1885) art. 8, p. 9; *Sladen, Chall.*
Rep. Ast. (1889) p. 597.
Brisinga, auct. (pars).

Disk small, rays less than or not much more than twenty, with ridge-like lateral and dorsal bands on the proximal part of the arms, which are swollen; a number of papulæ scattered among the plates of the dorsal skeleton; major pedicellariæ numerous, no minor present.

1. *Odinia pandina*.

Odinia pandina, *Sladen, Chall. Rep. Ast.* (1889) p. 598.
Brisinga coronata, *Wyv. Thoms.* (pars), *Depths of the Sea*, (1873)
p. 66, fig. 5.

R = 15 r (nearly).

Rays from thirteen to eighteen.

- a.* Faeroe Channel, 440 fms. 'Porcupine' Exp. (St. 51).
b. Faeroe Channel, 500 fms. 'Lightning' Exp. (St. 7).

OPHIUROIDEA (*see* p. 24).ZYGOPHIURÆ (*see* p. 25).OPHIOLEPIDIDÆ (*see* p. 25).*Key to Genera of Ophiolepididæ.*

- Bursal slits extend from mouth-plate to edge of
 disk OPHIURA, p. 106.
 Bursal slits less extensive OPHIOCTEN, p. 113.
- Incertæ sedis.*
- Disk with fine imbricated scales OPHIOCHITON, p. 114.

1. OPHIURA.

- Ophiura*, *Lamk. An. s. Vert.* ii. (1816) p. 540; *Agass. Mém. Soc. Neuch.* i. (1836) p. 192; *Forbes, Mem. Wern. Soc.* viii. (1839) p. 125; *id. Brit. Starf.* (1840) p. 22; *Norman, Ann. & Mag.* xv. (1865) p. 112; *Bell, Ann. & Mag. H. H.* viii. (1891) p. 339.
Ophiolepis, *M. Tr. Syst. Ast.* (1842) p. 89 (pars).
Ophioglypha, *Lyman, Ill. Cat. M. C. Z.* i. (1865) p. 40; *id. Chall. Rep. Oph.* (1882) p. 34.

No tooth-papillæ; teeth; mouth-papillæ often numerous. Naked radial shields often large; disk-scales rosulated. Arm-spines solid, smooth, and short. Disk notched for insertion of arm, and notch spinose. Bursal slits extend from mouth-plate to edge of disk.

Key to the Species.

- The arm-notch fringed by more than 25 spines 1. *O. ciliaris*.
 The arm-notch fringed by less than 20 spines.
 a. Mouth-plate as broad as long 2. *O. albida*.
 b. Mouth-plate longer than broad 3. *O. sarsi*.
 The arm-notch fringed by 7 or 8 short spines 4. *O. robusta*.
 The arm-notch fringed by very minute spines 5. *O. signata*.
 Small in size, with about 10 spines 6. *O. affinis*.
 No comb of spines above base of arm 7. *O. aurantiaca*.

1. *Ophiura ciliaris*.

- Asterias ophiura*, *Linn. S. N.* x. (1758) p. 662 (non *Linn. S. N.* xii. (1766) p. 1100); *O. F. Müll. Zool. Dan.* (1776) p. 235.
Asterias ciliaris, *Linn. S. N.* xii. (1766) p. 1101 (non *M. Houttuyn, Nat. Hist.* xiv. (1770) p. 470, pl. cxiii. 5).
Asterias ciliata, *Retz. Vet.-Akad. Hdlg.* iv. (1783) p. 239; *id. Diss. Spec. Ast.* (1805) p. 29.
Ophiura ciliata, *Nilss. Coll. Zool. Scan.* (1817) p. 14.
Ophiolepis ciliata, *M. Tr. Syst. Ast.* (1842) p. 91; *Gray, Brit. Rad.* (1848) p. 23.
Ophioglypha ciliata, *Ljungman, Öfv. Vet.-Ak. Förh.* 1871 (1872), p. 651; *Lyman, Chall. Rep. Oph.* (1882) p. 76; *Fjelstrup, Zool. Dan. Pigh.* (1890) p. 22, pl. i. fig. 1.
Asterias lacertosa, *Penn. Brit. Zool.* (1777) p. 53.

- Asterias texturata*, Lamk. *An. s. Vert.* (1816) p. 542 (pars); *Forbes, Mem. Wern. Soc.* viii. (1839) p. 125, pl. iv. figs. 3 & 4.
Ophiura texturata, Forbes, *Brit. Starf.* (1840) p. 22; *Maitland, An. Belg. sept.* (1851) p. 85; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 436; *Lüttk. Dansk. Vid. Selsk. Skrift.* v. (1859) p. 36, pl. i. figs. 1 a-1e.
Ophiura lacertosa, *Norm. Ann. & Mag.* xv. (1865) p. 112.
Ophioglypha lacertosa, *Lym. Ill. Cat. M. C. Z.* i. (1865) p. 40; *Ludw. Mitth. zool. Stat. Neapel*, i. (1879) p. 546; *Herdm. Proc. R. Phys. Soc. Ed.* v. (1880) p. 200; *Leslie et id. op. cit.* vi. (1881) p. 87; *Carus, Prod. faun. Med.* (1884) p. 92.
Asterias cordifera, *Delle Chiaje, Mem. An. Nap.* (1825) p. 358, pl. xx. fig. 12.
Asterias aurora, *Risso, Hist. Nat.* v. (1826) p. 273, fig. 29.
Ophiura ciliaris, *Bell, Ann. & Mag.* viii. (1891) p. 341.

A fair-sized species. Covering-scales of disk imbricated. Radial shields irregularly pyriform, each separated from its fellow by two or three large and several smaller scales. Five teeth; mouth-papillæ numerous—ten or more; the outermost the widest, the innermost rather delicate. Mouth-plate very variable in form, but always much longer than broad and always very large; typically constricted in its middle so as to be fiddle- or lyre-shaped; side mouth-plates small. Bursal slits long, very distinct, fringed on the outer side with a large number of fine short spines. Arms inserted into a wide notch in the disk, compressed from side to side at the base so as to produce a mesial ridge, flattened more distally. Lateral arm-plates carry seven spines, three of which are nearly twice as long as the four lower, but even they are shorter than the length of the plate; the lower diminish gradually in number as the distance from the disk is increased. The side arm-plates within the area of the disk separate the ventral plates from one another but do not meet in the middle line; beyond the area of the disk they touch one another. The under arm-plates are much wider than long, with a convex distal edge. The notch on either side of the arm is fringed by more than twenty-five spines.

Colour when dried dark slate or dirty yellow, sometimes mottled with darker. "Disk is generally reddish, marbled with purple-brown; the sides white; and the under surfaces are generally pale yellowish, or white" (*Forbes*): the reddish hue is sometimes retained in dried specimens.

$$R = 100; 72; 70.$$

$$r = 14; 11; 12.$$

Distribution. Eastern side of North Atlantic, Mediterranean. 7 to 100 fms.

- | | |
|---|-------------------|
| a. Sound of Mull, 30 fms., May 5, 1888. | John Murray, Esq. |
| b-f. Loch Etive, 25 fms. | John Murray, Esq. |
| g, h. Lower Loch Etive, 20-30 fms. | John Murray, Esq. |
| i-k. Gareloch, 18-23 fms. | John Murray, Esq. |
| l-n. Between Sound of Sanda and Ailsa
Craig, March 24, 1888. | John Murray, Esq. |
| o, p. West coast of Scotland. | John Murray, Esq. |

<i>q, r.</i> Blacksod Bay, 3-4 fms., April 24, 1891.	R. Irish Acad.
<i>s-v.</i> Blacksod Bay.	Dr. Grenfell.
<i>w.</i> West coast of Ireland.	R. Dublin Soc.
<i>x, y.</i> Belfast Bay.	Belfast Nat. Hist. Soc.
<i>z, a'.</i> Strangford Lough.	Belfast Nat. Hist. Soc.
<i>b'-d'.</i> Off Liverpool.	
<i>e', f'.</i> Pembrokeshire.	Mrs. Fenwick.
<i>g'.</i> S. Wales.	Mrs. Passingham.
<i>h'-k'.</i> Plymouth.	
<i>l', m'.</i> Weymouth Bay.	
<i>n', o'.</i> Weymouth.	
<i>p'.</i> Hastings, April 4, 1881.	S. O. Ridley, Esq.
<i>q'-u'.</i> Dover.	Mr. E. Tennent.
<i>v'.</i> Firth of Forth.	Prof. E. Forbes.
<i>w'-a''.</i> Montrose, June 18/26, July 22, Sept. 23, 1889.	W. Duncan, Esq.
<i>e'', f''.</i> British.	H. Ball, Esq.

2. *Ophiura albida.*

Ophiura albida, Forbes, *Mem. Wern. Soc.* viii. (1839) p. 125, pl. iv. figs. 5 & 6; *id. Brit. Starf.* (1840) p. 27; Thompson, *Nat. Hist. Irel.* iv. (1856) p. 436; Lütke, *Dansk. Vid. Selsk. Skrift.* v. (1859) p. 39, pl. i. fig. 2; *Norm. Ann. & Mag.* xv. (1865) p. 113; Jarzynsky, *Trans. Petersb. Soc. Nat.* i. (1870) p. 318.

Ophioglypha albida, Lym. *Ill. Cat. M. C. Z.* i. (1865) p. 49; Heller, *Zooph. u. Echin. Adriat. Meer.* (1868) p. 58; Ludw. *Mitth. zool. Stat. Neap.* i. (1879) p. 547; Herdman, *Proc. Phys. Soc. Ed.* v. (1880) p. 200; Leslie *et id. op. cit.* vi. (1881) p. 87; Carus, *Faun. Med.* (1884) p. 93; Hoyle, *Proc. Phys. Soc. Ed.* viii. (1885) p. 148; Barrois, *Rev. Biol.* i. (1888) p. 72; Ejelstrup, *Zool. Dan. Figh.* (1890) p. 23, pl. ii. fig. 1.

Ophiolepis ciliata (pars), *M. Tr. Syst. Ast.* (1842) p. 91.

Ophiolepis stenura, Lorenz, *SB. Ak. Wiss. Wien*, xxxix. (1860) p. 681.

Allied to *O. ciliaris*, but distinguished by not growing so large, having less numerous and more coarse disk-scales, a smaller number (less than twenty) comb-spines at the insertion of the arms, and no ventral pores owing to the union of the side arm-plates in the ventral middle line, and proportionately stouter arms. Mouth-plate pentagonal, as broad as long. Many of the upper disk-scales are quite large, and the radial shields therefore are by no means conspicuous. The side-spines are short, four or five to a plate. The lower arm-plates are more angulated and less curved along the distal edge than in *O. ciliaris*.

Colour when dried white; Forbes states that in life the disk and the centre of the arms are pink, with white or orange spots on the disk.

$$R = 27 ; 25 ; 21.5.$$

$$r = 5 ; 4 ; 5.$$

Distribution. North Atlantic (Eastern side); Arctic Ocean; Mediterranean. To 250 fms.

<i>a, b.</i> Firth of Lorn.	John Murray, Esq.
<i>c, d.</i> West coast of Scotland.	John Murray, Esq.
<i>e.</i> 34 miles off Achill Head, 175 fms.	R. Irish Acad.
<i>f-j.</i> Donegal Bay, 30 fms.	R. Irish Acad.
<i>k, l.</i> Blacksod Bay.	R. Irish Acad.
<i>m-p.</i> Valentia.	'Lightning' Exp.
<i>q-s.</i> Off Liverpool.	
<i>t, u.</i> Plymouth.	

3. *Ophiura sarsi.*

Ophiura sarsii, *Lüttk. Vid. Medd.* 1854 (1855), p. 101; *id. Dansk. Vid. Selsk. Skrift.* v. (1859) p. 42, pl. i. figs. 3 & 4; *Norm. Ann. & Mag.* xv. (1865) p. 113; *Jarzynsky, Trans. Petersb. Soc. Nat.* i. (1870) p. 318.

Ophioglypha sarsi, *Lyman, Ill. Cat. M. C. Z.* i. (1865) p. 41, figs. 2 & 3; *Marenz. Denk. Ak. Wien*, xxxv. (1878) p. 382; *Dunc. & Slad. Echin. Greenl.* (1881) p. 60, pl. iv. figs. 3 & 4; *Lyman, Chall. Rep. Oph.* (1882) p. 40; *Hoyle, Proc. Roy. Soc. Ed.* xii. (1884) p. 720; *id. Proc. Phys. Soc. Ed.* viii. (1885) p. 150; *Ludw. Zool. Jahrb.* i. (1886) p. 282; *Fjelstrup, Zool. Dan. Pigh.* (1890) p. 23, pl. ii. fig. 2.

Ophiura coriacea, *Lüttk. Vid. Medd.* 1854 (1855), p. 201.

A rather large species, not unlike *O. ciliaris*, but distinguished from it by its smaller mouth-shields, less numerous spines in arm-combs, the absence of ventral pores, stouter lateral plates, and longer arm-spines. Covering-scales of disk imbricated. Radial shields much wider without, where they nearly touch, than within. Four teeth; mouth-papillæ six or seven on either side. Mouth-plate shield-shaped, a little longer than broad. Bursal slits not very long, with a fringe of papillæ along the outer edge. Arm-notch in disk wide, with a comb of less than twenty spines. Arms carinate at base, and flattened more distally. The lateral plates, which are much thickened, meet below in a wide suture; the ventral plates form short triangles with straight distal edge; the arm-plates show a tendency to break up into smaller pieces, but the character is by no means so marked as in *Ophioplocus imbricatus*.

Colour in spirit milky white, or marked with light brown.

R is frequently equal to 6 r; r frequently = 10 mm.

Distribution. Both sides of North Atlantic; Arctic Ocean. To 345 fms.

<i>a-c.</i> Faeroe Channel, 345 fms.	'Porcupine' Exp. (St. 65).
<i>d, e.</i> Faeroe Channel, 290 fms.	'Porcupine' Exp. (St. 78).
<i>f-i.</i> Faeroe Channel, 312 fms.	'Porcupine' Exp. (St. 82).

4. *Ophiura robusta.*

Ophiopsis robusta, *Ayres, Proc. Bost. Soc. N. H.* iv. (1851) p. 134.

Ophiura squamosa, *Lüttk. Vid. Medd.* 1854, p. 100; *id. op. cit.* 1857, p. 50; *id. Danske Vid. Selsk. Skrift.* v. (1859) p. 46, pl. i. fig. 7; *Norm. Ann. & Mag.* xv. (1865) p. 114.

Ophiura fasciculata, *Forbes, Sutherl. Voy.* (1852) ii. p. ccciv.

Ophioglypha robusta, *Lyman, Ill. Cat. M. C. Z.* i. (1865) p. 45; *Marenz. Denk. Ak. Wien*, xxxv. (1878) p. 382; *Dunc. & Slad. Echin. Greenl.* (1881) p. 62, pl. iv. figs. 5-7; *Lyman, Chall. Rep.*

Oph. (1882) p. 77; *Fjelstrup, Zool. Dan. Pigh.* (1890) p. 24, pl. ii. fig. 4.

A rather small species with somewhat delicate arms. Covering-scales of disk imbricated, coarse, irregular in shape. Radial shields small, inconspicuous, very irregular and inconstant in shape. Six teeth; mouth-papillæ not numerous—three or four rather wide ones in each jaw-plate. Mouth-plate short, cordiform; mouth-plates band-like. Bursal slits well-marked. Notches in disk not very deep; arm-comb formed by a few quite short spines. Arms flat, upper plates large at base and regularly hexagonal, proximal sides diminish more distally; side arm-plates meet below, but lower arm-plates longer than in *O. ciliaris*; arm-spines usually three, the uppermost the longest but it is quite short. A single tentacle-scale.

Colour when dried white, or banded, spotted, or mottled with grey, brown, or red.

$$\begin{aligned} R &= 22; 16. \\ r &= 4.5; 3. \end{aligned}$$

Distribution. North Sea, North Atlantic (east and west); Arctic Ocean.

5. *Ophiura signata*.

Ophioglypha signata, *Verrill, Amer. Journ. Sci. & Arts*, xxiii. (1882) p. 220; *Lyman, Proc. Roy. Soc. Ed.* xi. (1883) p. 707; *Hoyle, op. cit.* xii. (1884) p. 715, pl. vii. figs. 4-8.
Ophioglypha affinis, *Verrill*, non *Lütken*.

This species, which I have not seen, is thus described by Prof. Verrill:—

“Disk varied in colour, rounded pentagonal, flattened above, or even concave when dried; covered with scales which form a distinct rosette; the dorsal surface is separated from the ventral by a marginal ridge, which becomes well-marked in dry specimens; notches, at the bases of the arms, slight, with an irregular and interrupted series of minute spinules; usually a short row of small, slender spinules on each side of the notch, and a small, irregular, isolated group in the middle, sometimes nearly obsolete, or represented by only one or two small spinules in the larger specimens; just below these there is a similar small group on the middle of the first visible arm-plate; the second arm-plate sometimes bears, also, two or more small spinules, but these never form a regular row. Disk-scales, when living, obscured more or less by a thin skin; the central scale and two alternating circles of five each, surrounding it, at a little distance, are round, dark-coloured, and distinctly larger than those that intervene, which are small but distinct, and often form rather regular circles around the larger scales; in the interbrachial spaces, near the edges, there are also larger scales; radial shields irregular, long-triangular, their edges more or less covered by small scales, and separated by a rather wide wedge of small scales, in several rows.

Oral plates short shield-shaped, the breadth and length about equal; the outer and lateral edges form a regular curve, the inner edges make an obtuse angle. Mouth-papillæ four on each side of each mouth-angle; the outer one is flat and broad, the others are slender, acute; the median papilla is larger, acute. The inner tentacle-pore is small, and usually has a single small scale on each side; the others have one small scale. The arms are not very long, tapering to rather slender tips, with a median ridge. Ventral arm-plates widely separated, crescent-shaped, wider than long, those near the base with a proximal angle. Upper arm-plates raised into a distinct median ridge, with a slightly prominent outer angle; those near the base are much shorter than broad; distally they become much longer than broad. Arm-spines three, rather slender and acute, the upper one is decidedly longer and larger than the next, its length equalling two arm-plates; the lowest is much the smallest. The genital slits have a row of very minute spinules along the upper half.

"The colour is variable; the disk is usually prettily marked by a rosette of brown or dark-grey spots on a paler ground, or the darker tint may take a star-shaped form, with five or ten rays, with the radial shields usually pale; or there may be a combination of the rosette and star; rarely the disk is nearly uniform pale grey, like the upper side of the arms. The larger specimens have the disk 10 mm. in diameter; length of the arms about 45 mm.

"This species is rather common in this region in deep water; we have also frequently dredged it farther north, in the Gulf of Maine; Bay of Fundy; and off Nova Scotia."

Specimens stated by Mr. Hoyle to have been dredged in Faeroe Channel, 327-640 fms.

6. *Ophiura affinis*.

- Ophiura affinis*, *Lüttk. Dansk. Vid. Selsk. Skrift.* v. (1859) p. 45, pl. ii. fig. 10; *Norm. Ann. & Mag.* xv. (1865) p. 113.
Ophioglypha affinis, *Lyman, Ill. Cat. Mus. C. Z.* i. (1865) p. 52; *Ludwig, Mitth. zool. Stat. Neap.* i. (1879) p. 547; *Lestie & Herdm. Proc. R. Phys. Soc.* vi. (1881) p. 87; *Lyman, Chall. Rep. Oph.* (1882) p. 77; *Fjelstrup, Zool. Dan. Figh.* (1890) p. 24, pl. ii. fig. 3.
Ophiura grubei, *Heller, SB. Ak. Wien*, xlvi. (1863) p. 431, pl. ii. figs. 13-16; *id. Zooph. u. Ech. Adriat. Meer.* (1868) p. 58.
Ophiura normani, *Hodge, Trans. Tynes. Nat. F. Club*, v. (1863) p. 296, pl. xvi.

A very small species, with arms stout at the base. The central and five primary plates of the disk are very distinct and large, and are surrounded by much smaller plates; along the median inter-radial line there are two plates almost as large as the primary, and the remainder are much smaller. The radials are of moderate size, wider without than within; the arm-comb consists of about ten small spines. Four small teeth; mouth-shield very large, pointed internally, about twice as long as wide; bursal slit rather

long. Under arm-plates quite small, wider than long, with a well-marked curve to the outer edge. A single tentacle-scale on joints beyond the disk. Lateral arm-plates meet below, bear about five spines, which are not as long as the plates except near the disk. Upper arm-plates oblong near disk, where they are wider than long, then quadrate, and then longer than square.

$$R=9; r=2.$$

Colour in spirit white; alive reddish yellow, occasionally pale sandy (*Hodge*).

Of this species *Hodge* remarks that it exhibits excessively lively movements and has wonderfully pliable rays.

Distribution. East and west coasts of North Atlantic, and Mediterranean. 10–192 fms.

7. *Ophiura aurantiaca*.

Ophioglypha aurantiaca, *Verrill*, *Amer. Journ. Sci.* xxiii. (1882) p. 141; *Lyman*, *Proc. R. Soc. Edinb.* xi. (1882) p. 707; *id.* *Bull. Mus. C. Z.* x. (1883) p. 240; *Hoyle*, *Proc. R. Soc. Edinb.* xii. (1884) p. 717.

Ophiopleura aurantiaca, *Verrill*, *op. cit.* p. 248.

Of this species, which I have not seen, some specimens with broken arms were dredged in the warm area of the Faeroe Channel at 516–570 fms.

Mr. *Lyman* gives as its "special marks":—

"Disk covered by a smooth skin, through which the scales of the upper surface are scarcely to be made out, while those of the lower surface are more distinct. Three wide flattened arm-spines, the upper one longer than an arm-joint, the others not so long. No comb above the base of the arm."

Distribution. Both sides of the North Atlantic, 466–570 fms.

Prof. *Verrill's* full description is as follows:—

"Disk large, swollen, nearly round, with small notches, destitute of papillæ, at the bases of the five arms; dorsal surface covered by very numerous small, imbricated scales, partially concealed by a soft skin; in the central area they are crowdedly arranged around one or more larger central plates; the marginal interradial scales are larger and thicker, with a median radial row of two or three still larger ones; ventral scales convex, unequal, imbricated. Radial shields convex, irregularly subtriangular, with rounded corners and outer edge, as broad as long, separated by a group of three or more imbricated disk-scales. Mouth-shields shorter than broad, with an obtuse inner angle, a nearly straight outer edge, and short, notched, lateral edges. Side mouth-shields long and rather broad oblong, meeting within. Mouth-papillæ very small and irregular, 7 to 9 on each side of each angle, those next to the teeth longer and pointed. Teeth slender, acute. Innermost tentacle-pores large, bordered on the outside by about six small flat scales, on the inner by about four. Arms somewhat rigid, rather short and stout, not

seen entire; arm-spines three, the upper one rather long and stout, tapered, the others successively shorter and smaller; two tentacle-scales. Lower arm-plates rather small, transversely rhomboidal, with rounded lateral angles, the four sides concave, and the distal angle prominent; near the base of the arms the plates are in contact to a small extent, but farther out they are separated by the lateral plates. Upper arm-plates large, thickened, trapezoidal, toward the base of the arms broader than long, broadest distally, the proximal and distal edges nearly straight; farther out they become longer than broad, and much narrowed proximally.

"Colour, in life, bright orange; in alcohol, white. Diameter of disk 18 mm.; its height 7 mm.; length of arms (minus tips) from centre of disk 45 mm.

"Off Martha's Vineyard, 192 to 310 fms.

"Specimens of this singular species were sent to Mr. Lyman for examination last year. He considered it an undescribed species. It has no allies on our coast."

2. OPHIOCTEN.

OphiocTen, *Littk. Vid. Medd.* 1854 (1855), p. 97; *id. Dansk. Selsk. Skrift.* v. (1859) p. 51; *Lyman, Ill. Cat. M. C. Z.* (1865) p. 53; *id. Chall. Rep. Oph.* (1882) p. 78.

No tooth-papillæ; teeth; mouth-papillæ not numerous. Disk not notched; radial shields partly obscured by characteristic scaling of disk. Arm-spines solid, smooth, short, not stout. Bursal slits not very extensive.

Allied to *Ophiura*, but more delicate.

1. OphiocTen sericeum. (Plate XIII. figs. 1 & 2.)

Ophiura sericea, *Forbes, Sutherl. Voy.* (1852) ii. p. ccxv.

OphiocTen kroyeri, *Littk. Vid. Medd.* 1854 (1855), p. 102; *id. Dansk. Selsk. Skrift.* v. (1859) p. 52, pl. i. fig. 5; *Lym. Ill. Cat. M. C. Z.* (1865) p. 53; *Ljungman, Öfv. Vet.-Akad. Förh.* 1864 (1865), p. 360; *id. op. cit.* 1866 (1867), p. 307; *Marenz. Denk. Ak. Wien*, xxxv. (1878) p. 382.

OphiocTen sericeum, *Lym. Bull. M. C. Z.* v. (1879) p. 102; *Dunc. & Slad. Greenl. Ech.* (1881) p. 65, pl. iv. figs. 8-10 & 14; *Lym. Chall. Rep. Oph.* (1882) p. 79; *Hoyle, Proc. Roy. Soc. Ed.* xii. (1885) p. 720.

A small and delicate species.

The disk flattened, with a sharp edge, and covered for the most part with a scaling which renders indistinct the underlying plates, but a central circular plate with larger primary plates around it may be made out. Three to five distinct, proportionately well-developed mouth-papillæ; rather large, irregularly oval, mouth-shields; elongated side mouth-plates. Arms flat, rather long; a comb on either side of the base of about seven short spines, and a

few papilliform spines on the most proximal upper arm-plate. Three arm-spines, the uppermost the longest; the ventral plates are small, with a convex distal or, generally, a straight proximal edge. Arms seven to ten times diameter of disk.

$$r = 5.$$

Colour white or more mottled with darker.

Distribution. North Atlantic (east side); Arctic Sea; ? off Marion Island. 50–2435 fms.

<i>a-n.</i> 59° 26' N., 8° 23' W., 705 fms.	'Porcupine' Exp. (St. 88).
<i>o-s.</i> 60° 34' N., 4° 40' W., 560 fms.	'Porcupine' Exp. (St. 77).
<i>t.</i> 47° 38' N., 12° 8' W., 2435 fms.	'Porcupine' Exp. (St. 37).
<i>u, v.</i> 47° 38' N., 12° 8' W., 400 fms.	G. C. Bourne, Esq.

Incertæ sedis.

3. OPHIOCHITON.

Ophiichiton, *Lyman, Bull. M. C. Z.* v. (1878) p. 132; *id. Chall. Rep. Oph.* (1882) p. 176.

Disk with fine imbricated scales. Radial shields small. Mouth-papillæ numerous; no tooth-papillæ; teeth present.

1. Ophiichiton ternispinis.

Ophiichiton ternispinus, *Lyman, Bull. M. C. Z.* x. (1883) p. 255.

Ophiichiton tenuispinus*, *id. t. c.* pp. 228 & 285; *Hoyle, Proc. Roy. Soc. Ed.* xii. (1884) p. 709, & *Proc. Roy. Phys. Soc. Ed.* viii. (1885) p. 144.

“*Special Marks.* One tentacle-scale. Three slender, rather long arm-spines.

“*Description of an Individual.* Diameter of disc 12 mm. Length of arm 60 mm. Width of arm near disc 2 mm. Twelve mouth-papillæ to each angle, whereof the four inner ones, on either side, are short, pointed and spaced, while the two outer ones are flattened and crowded. Teeth stout, flat, and shaped like a blunt spear-head. Mouth-shields regular pointed heart-shaped, with a small rounded lobe without. Length to breadth, 2 : 1.3. Side mouth-shields very narrow within, where they barely meet; but spreading widely without, where they bound a part of the inner end of the genital opening. First under arm-plate rounded and small, not larger than the neighbouring mouth-papillæ. The plates beyond are much narrower than the arm; they are about as broad as long, much wider without than within, with an outer curve, reentering curves on the sides, and a truncated angle within. They are somewhat swollen, but have no ridge. Side arm-plates even, slightly flaring, nearly

* As will be seen, the original namer of the species has, I suspect by a printer's error, given two forms to his specific name.

meeting above and below. Upper arm-plates narrower than the arm, much longer than wide, bounded on all sides by gentle curves. Disc covered with thin, irregular, overlapping scales, and having in the centre a group of much larger rounded primary plates, 1 mm. in diameter. Below the scaling is similar but finer. Radial shields narrow oblong, or egg-shaped, small, separated by a narrow wedge of fine scales; length to breadth, 2:1. Genital openings large and long, extending from mouth-shield to margin of disc. Three smooth, slender, tapering arm-spines, whereof the uppermost may be as long as two joints. Lengths, to that of an under arm-plate, 2.5, 1.2, 1.2, : 1. One oval tentacle-scale of moderate size.

“Colour in alcohol, nearly white.

“‘Porcupine’ Expedition, 1869, Station 42, south-west of Ireland, 862 fathoms, water 4°3 Cent.; 1 specimen.”

I have never seen this species, of which I quote Mr. Lyman’s original description.

AMPHIURIDÆ (see p. 25).

1. OPHIOMUSIUM.

Ophiomusium, *Lyman*, *Bull. M. C. Z.* i. (1869) p. 322; *id.* *Chall. Rep. Oph.* (1882) p. 83.

No tooth-papillæ; teeth; mouth-papillæ confluent. Very large radial shields with intermediate plates form a stout covering to the disk; upper and lower arm-plates reduced or absent; side-plates meet above and below; arm-spines very small. Tentacle-pores confined to area of disk.

1. *Ophiomusium lymani*.

Ophiomusium lymani, *Thoms. Depths of the Sea*, (1873) p. 174, figs. 32 & 33; *Lyman, Chall. Rep. Oph.* (1882) p. 90; *Hoyle, Proc. Roy. Phys. Soc. Ed.* viii. (1885) p. 151.

Inner half of the disk occupied by five or six circlets of small irregular plates set round a single central and circular plate. Radial shields irregularly triangular, large, each member of a pair separated from its fellow, and from the adjoining pair by bands of about equal length formed by a few well-sized but not constantly regular plates. Five teeth; there are signs of the mouth-papillæ, when separate, having been seven in number. Mouth-plate shield-shaped, much wider behind them near the mouth, where it is pointed; side-shields united in front of the mouth, longer than broad, irregularly oblong. Bursal slits rather short; the free part of the adjoining scale with a sharp edge. Two large, irregularly quadrate plates outside the mouth-shield. The lower marginal plates swollen, few in number. Under arm-plates and single tentacle-scales on the first two arm-joints only. Upper arm-plates convex forwards, small, getting smaller, and disappearing altogether at about the

20th arm-joint. Arm-spines 7-9, very short, and quite insignificant. Colour in spirit yellowish white.

Found by 'Porcupine' at St. 45 a (51° 1' N., 10° 2' W.), 180 fms.; specimens apparently lost.

Distribution. North and South Atlantic, N. and S. Pacific (with some variations, *vide Lyman*). 180 to 1825 fms.

2. OPHIOCNIDA.

Ophiocnida, *Lyman, Ill. Cat. M. C. Z. i.* (1865) p. 133; *id. Chall. Rep.*

Oph. (1882) p. 152.

Ophiocoma, *Forbes, Brit. Starf.* 1840, p. 30 (pars).

Ophiolepis, *M. Tr. Syst. Ast.* (1842) p. 89 (pars).

No tooth-papillæ; teeth; mouth-papillæ not numerous. Disk small, with naked radial shields and fine scales; arms long and slender; arm-spines short, stout and solid. Plates of disk spiny or granular.

1. Ophiocnida brachiata. (Plate XIII. figs. 3-5.)

Asterias brachiata, *Montagu, Trans. Linn. Soc.* vii. (1804) p. 84.

Ophiura brachiata, *Leach, Zool. Misc.* ii. (1815) p. 57; *Flem. Brit. An.* (1828) p. 488.

Ophiocoma brachiata, *Forbes, Brit. Starf.* (1840) p. 45; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 437.

Ophiolepis (Ophiopholis) brachiata, *M. Tr. Syst. Ast.* (1842) p. 96.

Ophiopholis brachiata, *Gray, Cat. Brit. Rad.* (1848) p. 25.

Amphiura neapolitana, *Sars, Nyt Mag.* x. (1859) p. 35 (pl. i. figs. 11-15).

Ophiocnida brachiata, *Lyman, Cat. Mus. C. Z. i.* (1865) p. 12; *Ljungman, Öfv. Vet.-Akad. Förh.* 1866 (1867), p. 317; *Fischer, Actes Soc. Bord.* xxvii. (1869) p. 362; *Ljungman, Öfv. Vet.-Akad. Förh.* 1871 (1872), p. 642; *Ludwig, Mitth. zool. Stat. Neap.* i. (1879) p. 550; *Lyman, Chall. Rep. Oph.* (1882) p. 155; *Leslie & Herdman, Proc. R. Phys. Soc.* vi. (1881) p. 89; *Hoyle, op. cit.* viii. (1885) p. 145; *Carus, Favn. Med.* (1884) p. 95.

Ophiocnida neapolitana, *Lyman, Cat. Mus. C. Z. i.* (1865) p. 137.

Amphiura brachiata, *Norm. Ann. & Mag.* xv. (1865) p. 109.

Arms fifteen to twenty times as long as the radius of the disk. Disk pentangular; covering-scales small, closely packed, imbricating, with a free edge near the periphery and forming at it spinous processes. Radial shields small, triangular. The very long arms have about eight flattened short spines; upper arm-plates nearly twice as broad as long, lower nearly square; two tentacle-scales at base of arm, and one elsewhere.

$$R = 110 \text{ (about); } r = 6.5.$$

$$R = 100 \text{ (about); } r = 6.$$

The arms are often a good deal twisted or curved.

Colour, dry, various shades of yellow or grey; "when alive purplish brown and sometimes bluish ash-colour" (*Montagu*).

Distribution. North Atlantic (east side); Mediterranean. To 20 fms.

- a, b.* Kenmare River. Sir P. Egerton.
c. Dundrum, co. Down, August 1836. Belfast Nat. Hist. Soc.
d. Tenby.
e. Old British Collection.
f-j. No history.

3. AMPHIURA.

Amphiura, Forbes, *Linn. Trans.* xix. (1845) p. 149; *Lützk. K. Dansk. Selsk. Skrift.* v. (1859) p. 54; *Norm. Ann. & Mag.* xv. (1865) p. 107; *Lyman, Ill. Cat. M. C. Z.* i. (1865) p. 115; *id. Chall. Rep. Oph.* (1882) p. 122.

No tooth-papillæ; teeth; mouth-papillæ small, not numerous. Disk small, with naked radial shields and imbricating scales. Arms long, sometimes very long; arm-spines short, stout and solid.

Key to the Species.

- A. Two mouth-papillæ on each side.
 i. Two tentacle-scales.
 5-8 arm-spines 1. *A. chiajii*.
 4 arm-spines 6. *A. bellis*.
 ii. No tentacle-scales.
 Arms very long 2. *A. filiformis*.
 Arms not long 5. *A. borealis*.
 B. Three mouth-papillæ on each side.
 i. Two tentacle-scales 3. *A. elegans*.
 ii. No tentacle-scales 4. *A. securigera*.

1. *Amphiura chiajii*.

Asterias filiformis, *Delle Chiaje, Mem. An. Nap.* ii. (1825) p. 359 (*non Asterias filiformis, O. F. M.*).

Amphiura chiajii, Forbes, *Trans. Linn. Soc.* xix. (1843) p. 151, pl. xiv. figs. 14-18; *Lützk. Vid. Medd.* 1856 (1857), p. 109; *Sars, Nyt Mag.* x. (1859) p. 30, pl. i. figs. 8-10; *Lützk. Vid. Selsk. Skrif. Kjöbenh.* v. (1859) pl. 57, pl. ii. figs. 12 *a* & *b*; *Sars, Norg. Ech.* (1861) p. 17; *Duj. & Hupé, Echin.* (1862) p. 253; *Heller, SB. Akad. Wien*, xlvi. (1863) pp. 425 & 444; *Lyman, Ill. Cat. Mus. C. Z.* i. (1865) p. 119; *Norman, Ann. & Mag.* xv. (1865) p. 107; *Ljungman, Öfv. Vet.-Akad. Förh.* 1866 (1867), p. 318; *Heller, Zooph. u. Echin. Adriat.* 1868, p. 61; *Lyman, Ill. Cat. Mus. C. Z.* viii. (1875) pl. v. fig. 61; *Möbius & Bütschli, JB. Comm. deutsch. Meer.* ii. & iii. (1875) p. 145; *Ludwig, Mitth. zool. Stat. Neap.* i. (1879) p. 550; *Lyman, Chall. Rep. Oph.* (1882) p. 123; *Hoyle, Proc. R. Soc. Ed.* xii. (1884) pp. 709, 711, 715; *id. Proc. R. Phys. Soc.* viii. (1884) p. 139; *Bell, Ann. N. H.* xx. (1887) p. 411; *Fjelstrup, Zool. Dan. Pigh.* (1890) p. 27, pl. iii. fig. 2.

Amphiura florifera, Forbes, *Trans. Linn. Soc.* xix. (1843) pl. xiv. figs. 14-18; *Duj. & Hupé, Echin.* (1862) p. 235; *Lyman, Ill. Cat. M. C. Z.* i. (1865) p. 12.

Ophiolepis florifera, *M. Tr. Arch. f. Nat.* 1844.

Ophiolepis sundevalli, *J. Müller, Abh. Ak. Berl.* 1851 (1852), p. 56
(*non O. sundevalli, M. Tr.*).

Amphiura stepanovii [n. n.], *Czerniavsky, Protocol. (Zool.) Mosk. Naturf. Versamml.* 1869 (1870), p. xlv (*teste Lyman*).

Arms eight times or more the radius of the disk. Disk quinquelobate; covering-scales small, regularly imbricating, smaller below than above, not forming spines. Radial shields rather small, quite or almost touching externally, separated internally, where they are not so wide. The longish, delicate, flattened arms carry from four to six not stout spines; two tentacle-scales; lower arm-plates longitudinally sulcate, almost quadrate, sometimes with a shallow notch in their distal edge. Two mouth-papillæ, one at the side and one at the angle. A central plate with a rosette of five on the dorsal surface of the disk.

This is a species which exhibits very great variation, not only in the proportional length of the arms, but the forms of the disk, the distinctness of the central rosette-plates, the extent of the calcification of the under arm-plates, and the colour.

Colour, in spirit, whitish to brownish.

R=69; $r=4\cdot5$.

R=65; $r=4$.

R=56; $r=4$.

R=52; $r=4\cdot2$.

R=55; $r=3\cdot8$.

R=32; $r=4$.

R=25; $r=2\cdot5$.

Distribution. Eastern side of North Atlantic; Mediterranean (including Adriatic). 0-120 fms.

<i>a-j</i> . The Minch.	'Porcupine' Exp. (Thomson Coll.)
<i>k, l</i> . The Minch.	J. Murray, Esq.
<i>m-q</i> . Loch Sunart, 40 fms.	J. Murray, Esq.
<i>r-t</i> . Loch Sunart, 45-50 fms. 5/9/87.	J. Murray, Esq.
<i>u-z</i> . Loch Aber, 70-80 fms.	J. Murray, Esq.
<i>a'</i> . Loch Duich, 60 fms.	J. Murray, Esq.
<i>b'</i> . Loch Hourn, 70 fms.	J. Murray, Esq.
<i>c'-l'</i> . Upper Loch Etive, 30-50 fms.	J. Murray, Esq.
<i>m'</i> . Loch Etive, 70 fms.	J. Murray, Esq.
<i>n'-z'</i> . Loch Etive, 20-30 fms.	J. Murray, Esq.
<i>a''</i> . Firth of Lorn, 50-111 fms.	J. Murray, Esq.
(A mass attached to a <i>Cerianthus</i> -tube.)	
<i>b''-f''</i> . Firth of Lorn, 50 fms.	J. Murray, Esq.
<i>g''</i> . Firth of Lorn, 50 fms.	J. Murray, Esq.
<i>h''</i> . Mull of Cantyre, 49 fms.	J. Murray, Esq.
<i>i''-z''</i> . West coast of Scotland.	J. Murray, Esq.
<i>a'''-e'''</i> . Killary, Bangor, co. Down.	Belfast Nat. Hist. Soc.

2. *Amphiura filiformis*.

- Asterias filiformis*, O. F. Müll. *Prod. Zool. Dan.* (1776) p. 235, no. 2843; *id.* *Zool. Dan.* ii. (1788) p. 24, pl. lix.
Ophiura filiformis, Nilss. *Coll. Zool. Scan.* (1817) p. 15.
Ophiocoma filiformis, Forbes, *Brit. Starf.* (1840) p. 40; Thompson, *Nat. Hist. Irel.* iv. (1856) p. 437.
Ophiolepis filiformis, M. Tr. *Syst. Ast.* (1842) p. 94; Gray, *Brit. Rad.* (1848) p. 24.
Amphiura filiformis, Forbes, *Tr. Linn. Soc. Lond.* xix. (1843) p. 151; Sars, *Nyt Mag.* x. (1859) p. 28; Lütke, *Vid. Selsk. Skrift.* v. (1859) p. 56, pl. ii. fig. 11; Duj. & Hup. *Echin.* (1862) p. 254; Lyman, *Ill. Cat. Mus. C. Z.* i. (1865) p. 115; Norman, *Ann. & Mag.* xv. (1865) p. 107; Ljungman, *Öfv. K. Vet.-Akad. Förh.* 1866 (1867), p. 321; Heller, *Zoophyt. u. Echin. Adriat.* 1868, p. 60; Lyman, *Bull. Mus. C. Z.* viii. (1875) pl. v. fig. 63; Ludwig, *Mitth. zool. Stat. Neapel*, i. (1879) p. 548; Carus, *Prod. Faun. Med.* (1884) p. 94; Fjelstrup, *Zool. Dan. Pigh.* (1890) p. 27, pl. iii. fig. 1.

A species often confounded with *A. chiajii*, but distinguished from it by the softness of the ventral surface of the disk, owing to the reduction or absence of the scales, and by the absence of tentacle-scales. Further, there is never a prominent rosette of a central and five other scales, and some of the arm-spines sometimes have a minute cross-piece. The arms are longer, and the radial plates are narrower and set more parallel to one another.

Colour, when dry, brownish.

Much more difficult to preserve satisfactorily than *A. chiajii*.

Variation probably considerable.

Distribution. Eastern side of North Atlantic; Mediterranean. 0-120 fms.

<i>a, b.</i> Loch Etive.	John Murray, Esq.
<i>c.</i> Firth of Clyde.	Prof. E. Forbes.
<i>d, e.</i> Kenmare River.	Sir P. Egerton.
<i>f.</i> Scotland.	Dr. Melvill.
<i>g.</i> ———?	Prof. E. Forbes.

3. *Amphiura elegans*.

- Ophiura elegans*, Leach, *Zool. Misc.* ii. (1815) p. 57.
Asterias squamata, Delle Chiaje, *Mem. An. Nap.* iii. (1828) p. 77, pl. xxxiv. fig. 1.
Ophiura neglecta, Johnston, *Mag. Nat. Hist.* viii. (1835) p. 467; Forbes, *Mem. Wern. Soc.* viii. (1839) p. 126; *id.* *Brit. Starf.* (1840) p. 30; Thompson, *Nat. Hist. Ireland*, iv. (1856) p. 437.
Ophiulepis squamata, M. Tr. *Arch. f. Nat.* vi. (1840) p. 328; *id.* *Syst. Ast.* (1842) p. 92; Sars, *Nyt Mag.* x. (1859) p. 28.
Amphiura neglecta, Forbes, *Tr. Linn. Soc.* xix. (1843) p. 150; Herdman, *Proc. R. Phys. Soc. Ed.* v. (1880) p. 201.
Ophiulepis tenuis, Ayres, *Proc. Bost. Soc. N. H.* iv. (1851 [4]) p. 133.
Amphiura tenuis, Lyman, *op. cit.* vii. (1860 [1]) p. 194.
Amphiura squamata, Sars, *Norg. Ech.* (1861) p. 21; Lyman, *Ill. Cat. M. C. Z.* i. (1865) p. 121; Jarzynsky, *Trans. Petersb. Soc. Nat.* i. (1870) p. 318; Panceri, *Att. Acc. Sci. Nap.* vii. (1878)

- no. 1, p. 17 [phosphorescence]; *Leslie & Herdman, Proc. R. Phys. Soc. Ed.* vi. (1881) p. 88; *Lyman, Chall. Rep. Oph.* (1882) p. 136; *Barrois, Rev. Biol.* i. (1889) p. 73; *Fjelstrup, Zool. Dan. Pigh.* (1890) p. 26, pl. ii. fig. 6.
- Amphiura elegans*, *Norm. Ann. & Mag.* xv. (1865) p. 109; *Hoyle, Proc. R. Phys. Soc. Ed.* viii. (1885) p. 141.
- Amphiura tenera*, *Lütke. Dansk. Vid. Selsk. Skrift.* v. (1859) p. 226; *Lyman, Ill. Cat. M. C. Z.* i. (1865) p. 123.
- Amphipolis squamata*, *Ljungman, Öfv. Vet.-Ak. Förh.* 1871 (1872), p. 645.
- Amphipolis tenera*, *id. ibid.*
- Amphipolis tenuis*, *id. t. c.* p. 646.
- Amphipolis lineata*, *id. t. c.* p. 634.
- Amphipolis kinbergi*, *id. t. c.* p. 646.
- Amphipolis elegans*, *id. ibid.*
- Amphipolis appressa*, *id. t. c.* p. 647.
- Ophiura moniliformis*, *Grube, Actin. &c. Meer.* (1840) p. 18.
- Asterias noctiluca* (?), *Viviani, Phosph. Mar.* (1805) p. 5.

A small species, not more than an inch or an inch and a half in spread. Arms five to nine times the radius of the disk. Disk rounded; covering-scales small and imbricating; radial shields in contact along the whole of their inner edge. The delicate flattened arms have three or four fine spines; two tentacle-scales; ventral shields irregularly pentagonal. Three mouth-papillæ on either side, and often the outermost the largest.

Colour, when dried, light or darker yellow. In life greyish.

R.	r.
13	2.
16	2·3.
18	3.

Distribution. North Atlantic, Arctic Ocean, West Indies, Cape, S.E. of Australia. To 120 fms.

<i>a-c.</i> Coast of Down.	Belfast Nat. Hist. Soc.
<i>d, e.</i> 50° 24' 45" N., 10° 07' 30" W., 70 fms.	G. C. Bourne, Esq.
<i>f-h.</i> Liverpool.	
<i>i, j.</i> Aberdeen.	G. Sim, Esq.

4. *Amphiura securigera*.

- Ophiopeltis securigera*, *Düb. & Kor. Vet. Akad. Handlg.* 1844 (1846), p. 236, pl. vi. figs. 3-6; *Sars, Norg. Ech.* (1861) p. 14; *Norman, Ann. & Mag. N. H.* xv. (1865) p. 111; *Wyv. Thomson, Depths of the Sea*, (1873) p. 124.
- Amphiura securigera*, *Lyman, Chall. Rep. Oph.* (1882) p. 148; *Hoyle, Proc. Roy. Phys. Soc. Ed.* viii. (1885) p. 141.

Mr. Norman writes of this species, which I have never seen:—

“Disk having the radiating scales long, narrow, and parallel. Arms extremely long and very slender; upper scales triangular, lower cordate; lateral scales bearing three spines, of which the upper and lower are simple, but the middle is much swollen in the centre, and apically produced into an anchor- or, rather, axe-formed semicircular head, having a jagged edge.

“Disk greyish; arms bright orange.

“A single specimen of this most interesting addition to our fauna was dredged in 1861, by Mr. Jeffreys and myself, on the haddock-ground about six miles to the north of the Walsey Lighthouse, Shetland, in 40–50 fathoms. The species had, previously to the date just mentioned, been inserted as British in the ‘List of British Marine Invertebrate Fauna’ published by the British Association; but, as far as we can learn, at that time it had not been taken in our seas; and it would seem that the name was inserted by mistake for *A. chiajii*.

“The arms of these species are more flexible than those of any other Echinoderm with which we are acquainted.

“They are commonly coiled upon themselves in many complete circles.”

Allied to *A. squamata*, but with more slender and longer arm-spines, coarser disk-scales, and longer arm-plates. Perhaps only a variety.

Distribution. Both sides of North Atlantic.

5. *Amphiura borealis*.

Ophiopeltis borealis, *G. O. Sars, Förh. Vid. Selsk. Christ.* 1871 (1872), p. 16.

Amphiura borealis, *Lyman, Chall. Rep. Oph.* (1882) p. 144; *Hoyle, Proc. Roy. Phys. Soc. Ed.* viii. (1885) p. 139.

A small species, with arms more than twelve times the radius of the disk; scaling of disk distinct on dorsal surface only; radial shields divergent internally; three or four short arm-spines, one of which is considerably thickened at its free end. No tentacle-scales. Two mouth-papillæ, one at the side and one at the angle.

Faeroe Channel; 203 fms. (fide *Hoyle*).

Distribution. Lofoten, coast of Norway. 80–400 fms.

6. *Amphiura bellis*, var. *tritonis*.

Amphiura bellis, *Lyman, Chall. Rep. Oph.* (1882) p. 127.

Amphiura bellis, var. *tritonis*, *Hoyle, Proc. Roy. Soc. Ed.* xii. p. 716 (pl. vii. figs. 1–3).

Mr. Hoyle gives the following account of the single specimen of this variety known:—

“Diameter of disk, 12 mm. Arms long and slender, 11 cm. Width of arm close to disk, without spines, 2 mm. Two mouth-papillæ on either side; one large, trapezoidal, at the apex of the mouth-angle, one of its sides coinciding with the corresponding margin of its fellow, the ten papillæ almost enclosing the circle of the mouth; the other mouth-papilla is at the commencement of the oral process, is acutely pointed and triangular, and is succeeded immediately by a diamond-shaped scale, which covers the opening of the first tentacle. A supplementary scale was noticed at one mouth-angle.

“Mouth-shields heart-shaped, one subpentagonal. Side mouth-shields appear to be triangular; they do not project inwards beyond the median shields, and they meet each other in the position usually occupied by the first under arm-plate, which is absent. The other arm-plates are rectangular, with the inner and outer margins somewhat rounded; farther out on the arms they form an angle so that the plate is hexagonal; the lateral margins straight and coincident with the attached margin of one of the tentacle-scales. Side arm-plates slightly prominent where the spines are attached, and meeting in the middle line either above or below.

“Upper arm-plates transversely oval, but the proximal margin instead of being evenly curved forms an angle.

“Disk flat, thin, covered with small swollen overlapping scales, which are coarser and radially elongated near the radial shields. Radial shields wedge-shaped, very long, about four times as long as wide, pointed at the proximal extremity, truncated distally, completely separated from each other, except perhaps at the extreme outer end, by a median and one or two lateral rows of elongated scales. Interbrachial spaces in the under surface covered with similar small scales; three, or sometimes at the proximal end of the arm four, straight, tapering, bluntly-pointed arm-spines.

“Two tentacle-scales, one towards the axis of the arm, elongated, semi-oval, one on the proximal margin of the aperture, shorter and more nearly circular.

“Colour yellowish grey, with five rather indefinite radial markings on the dorsal surface of the disk.

“The typical *Amphiura bellis* differs from this in having one short stout blunt papilla on either side of the base of the mouth-angle. It has also subtriangular mouth-shields, and the lateral mouth-shields do not meet each other in the middle line.

“The mouth-papillæ are of a different shape. A first under arm-bone is present, and the tentacle-scales of the first pair are spiniform and rather conspicuous.

“This single specimen is worthy of special notice, because the species has been only known hitherto from specimens collected by the ‘Challenger’ at Stations 174, near the Fiji Islands, and 232 and 236, off Japan. It is interesting to notice that *Asteromyx loveni* is also common to the North European seas and those of Japan, and a relation has been traced by Drs. Gwyn Jeffreys and Günther between the Mollusca and fishes of Japan and the North Atlantic and Mediterranean.”

Dredged at 59° 40' N., 7° 21' W., 516 fms., during the cruise of H.M.S. ‘Triton.’

4. OPHIACTIS.

Ophiactis, *Lütke Vid. Medd.* 1856 (1857), p. 12; *Lyman, Ill. Cat. M. C. Z.* i. (1865) p. 105; *id. Chall. Rep. Oph.* (1882) p. 112.
Ophiolepis, *M. Tr. Syst. Ast.* (1842) p. 89 (pars).

No tooth-papillæ; teeth; mouth-papillæ few and small. Radial

shields moderate; covering-plates of disk stout, numerous, imbricating. Arms stout, never long, with strong, solid, smooth spines.

Key to the Species.

Two mouth-papillæ.	1. <i>O. abyssicola.</i>
One mouth-papilla	2. <i>O. balli.</i>

1. *Ophiactis abyssicola.*

Amphiura abyssicola, Sars, *Norg. Ech.* (1861) p. 18, pl. ii. figs. 7-12.
Ophiocnida abyssicola, Lyman, *Ill. Cat. Mus. C. Z.* i. (1865) p. 12.
Ophiactis abyssicola, Ljungman, *Efv. Vet.-Akad. Förh.* 1866 (1867), p. 324; Lyman, *Chall. Rep. Oph.* (1882) p. 122; *id. Proc. R. Soc. Ed.* xi. (1882) p. 707; Hoyle, *op. cit.* xii. (1884) pp. 710, 715, 718; *id. Proc. R. Phys. Soc. Ed.* viii. (1884) p. 143.

A rather small species, with stout scales and rather stronger arms. Disk-scales very unequal in size, thickened; many of them carry stout spines. Radial shields rather large, separated each from its fellow by three or four small plates; they have an irregularly straight inner and a convex outer edge. Two mouth-papillæ. Three or four stoutish arm-spines, the uppermost the longest and as long as the upper arm-plates; the side-plates encroach considerably on the upper and lower plates, both of which are much wider distally than proximally; the upper arm-plate is very narrow proximally.

Colour, in spirit, white: "laete carneus seu aurantiacus, in medio dorso subfusco-carneus, spinis pallidioribus" (Sars).

$$r=4.5-2.5; R=22-30.$$

Distribution. Coasts of Norway. 64-767 fms.

<i>a, b.</i> Faeroe Channel, 542 fms.	'Porcupine' Exp. (St. 47 A).
<i>c-f.</i> Faeroe Channel, 440 fms.	'Porcupine' Exp. (St. 51).
<i>g-p.</i> Faeroe Channel, 384 fms.	'Porcupine' Exp. (St. 52).
<i>q.</i> Faeroe Channel, 345 fms.	'Porcupine' Exp. (St. 65).
<i>r-w.</i> Faeroe Channel, 458 fms.	'Porcupine' Exp. (St. 90).
<i>x.</i> East of Shetland, 203 fms.*	'Porcupine' Exp. (St. 74).
<i>y, z, a'-c'.</i> No loc.	Wyv. Thomson Coll.

2. *Ophiactis balli.*

Ophiocoma ballii, Thompson, *Ann. & Mag.* v. (1840) p. 99; Forbes, *Brit. Starf.* (1840) p. 35; Thompson, *Nat. Hist. Irel.* (1856) p. 437.

Ophiocoma goodsiri, Forbes, *t. c.* p. 57.

Ophiolepis ballii, M. Tr. *Syst. Ast.* (1842) p. 97.

Ophiolepis goodsiri, *id. ibid.*

Ophiopholis ballii, Gray, *Cat. Brit. Rad.* (1848) p. 25.

* Mr. Lyman, who named these specimens, notes that they have few or no disk-spines, and have thick scales.

Ophiopholis goodsiri, *id. ibid.*

Amphiura ballii, *Sars, Nyt Mag.* x. (1859) p. 42; *id. Norg. Ech.* (1861) p. 17, pl. 2. figs. 1-6; *Norman, Ann. & Mag.* xv. (1865) p. 109.

Ophiocnida ballii, *Lyman, Cat. Mus. C. Z.* i. (1865) p. 12.

Ophiactis ballii, *Lyman, Chall. Rep.* (1882) p. 121; *Hoyle, Proc. Roy. Soc. Ed.* xii. (1884) p. 718; *id. Proc. R. Phys. Soc. Ed.* viii. (1885) p. 143.

A small species, with fairly stout, moderately long arms. Disk-scales subequal, regularly imbricating, sometimes spiny. Radial shields small, wider without than within; the inner apices widely separated from one another. A single mouth-papilla. Four or five arm-spines, two of which may be a little longer than the length of the side-plate; the side-plates nearly meet in the middle line above, and the upper arm-plates are therefore very much wider along their distal than their proximal edge; lower arm-plates cordiform, with a rounded proximal edge.

Colour, in spirit, white. "Disk yellowish or red, often mottled with these two colours; arms banded with red" (*Norman*).

$$R=20 \text{ (about)}; r=3.$$

Distribution. North Atlantic.

- a.* East of Shetland Is., 203 fms. 'Porcupine' Exp. (St. 74).
b, c. Dalkey Sound. Belfast Nat. Hist. Society.
d. Giants' Causeway (adherent to *Pinna*). Belfast Nat. Hist. Society.

Dr. Norman states that "it lives on hard ground, in deep water, and has a peculiar habit, delighting to nestle in hollows and crevices of stones, squeezing its disk and twisting its arms so as to conform to all the irregularities of the surface to which it attaches itself." To 203 fms.

5. OPHIOPUS.

Ophiopus, *Ljungman, Öfv. Vet.-Akad. Förh.* 1866 (1867), p. 309; *Lyman, Chall. Rep. Oph.* (1882) p. 156.

Ophiaregma, *Sars, Forh. Vid. Selsk. Christ.* 1872 (1873), p. 112.

Very near *Ophiactis*, but distinguished by the absence of bursal clefts.

1. *Ophiopus arcticus*.

Ophiopus arcticus, *Ljungman, Öfv. Vet.-Akad. Förh.* 1866 (1867), p. 309; *Lyman, Chall. Rep. Oph.* (1882) p. 156; *Hoyle, Proc. Roy. Soc. Ed.* xii. (1884) p. 720.

Ophiaregma abyssorum, *Sars, Forh. Vid. Selsk. Christ.* 1872 (1873), p. 112.

Disk pentagonal, with large central and five primary plates well marked; radial shields very obscure. Arms delicate, about seven times the radius of the disk; three or four short arm-spines, the

uppermost the longest; the under arm-plates irregularly pentagonal, with one or, near the base, two ambulacral papillæ.

Colour, in spirit, whitish.

$$R = 4; r = 2.$$

Distribution. Norway, Spitzbergen, Greenland; the specimen in our collection bears no locality. Reported by Hoyle from Faeroe Channel. 400 fms.

6. OPHIOPHOLIS.

Ophiopholis, *Lütken, Danske Selsk. Skrift.* v. (1859) p. 59 (*ex M. Tr. Syst. Ast.* (1842) p. 96); *Lyman, Ill. Cat. M. C. Z.* (1865) p. 96; *Norm. Ann. & Mag.* xv. (1865) p. 111; *Lyman, Chall. Rep. Oph.* (1882) p. 110.

No tooth-papillæ; teeth; mouth-papillæ not numerous. Radial shields naked, not large. Disk-scales more or less ornamented with prominent granules, which may become spines. Arm-spines smooth, stout, of moderate length. Upper arm-plates surrounded by smaller supernumerary plates. Bursal slits deep.

1. *Ophiopholis aculeata.*

- Asterias aculeata*, *Linn. Syst. Nat.* ed. xii. (1766) p. 1101; *O. F. Müll. Prod. Z. D.* (1776) p. 235; *Retz. Vet.-Ak. Hdlg.* iv. (1783) p. 240; *L. Gmel. S. N.* xiii. (1789); *Abilg. Zool. Dan.* iii. (1789) p. 29, pl. xcix.; *Retz. Diss. Spec. Ast.* (1805) p. 32.
- Asterias ophiura*, *Fabr. Faun. Grœnl.* (1780) p. 371.
- Ophiura aculeata*, *Nilss. Coll. Zool. Scan.* (1817) p. 14.
- Ophiura ammothea*, *Leach, Zool. Misc.* (1817) p. 55.
- Ophiura flemingii*, *id. t. c.* p. 56.
- Ophiura bellis*, *Fleming, Brit. An.* (1828) p. 488; *Johnst. Mag. Nat. Hist.* viii. (1835) p. 595.
- Ophiocoma bellis*, *Forbes, Mem. Wern. Soc.* viii. (1839) p. 126; *id. Brit. Starf.* (1840) p. 53; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 438; *Peach, Proc. Phys. Soc. Edinb.* ii. (1859-62) p. 382, pl. xx.; *Maitl. Faun. Belg. sept.* (1851) p. 86.
- Ophiolepis aculeata*, *M. Tr. Arch.f. Nat.* 1840, p. 328.
- Ophiolepis* (*Ophiopholis*) *scolopendrica*, *id. Syst. Ast.* (1842) p. 96 (*non O. scolopendrina, apud Duj. & Hup. Echin.* p. 241); *Gray, Brit. Rad.* (1848) p. 25.
- Ophiopholis aculeata*, *Lütk. Dansk. Vid. Selsk. Skrift.* v. (1859) p. 60, pl. ii. figs. 15 & 16; *Norm. Ann. & Mag.* xv. (1865) p. 112; *Jarzynsky, Trans. Petersb. Soc. Nat.* i. (1870) p. 318; *Marenz. Denk. Ak. Wien*, xxxv. (1878) p. 383; *Lyman, Chall. Rep. Oph.* (1882) p. 112; *Hoyle, Proc. R. Soc. Ed.* xii. (1884) p. 720; *Ludw. Zool. Jahrb.* i. (1886) p. 285; *Fjelstrup, Zool. Dan. Pigh.* (1890) p. 28, pl. iii. fig. 3.
- Ophiopholis bellis*, *Lyman, Ill. Cat. M. C. Z.* i. (1865) p. 66, pl. i. figs. 4-6; *Herdman, Proc. R. Phys. Soc. Ed.* v. (1880) p. 201; *Leslie & Herdm. op. cit.* vi. p. 87.

A rather small but stout species. The disk is rather elegantly ornamented with clumps of granules, which become closely packed

spines at the sides and below; the granules are pretty thick on the outer side of each radial shield. As many as twelve teeth in a row; three mouth-papillæ on either side. Mouth-plate irregularly lenticular, wider than long; side mouth-plates of moderate size. The spines of interbrachial area below confined to the middle, so that the edges of the bursal slits are free of them. Form of disk and depth of arm-notch very variable. Arms wide, flat. Seven short, very stout arm-spines, the two lowest the most delicate. The small plates surrounding the distal and outer edges of the upper arm-plates disappear towards the tip of the arm, becoming gradually smaller as the neighbourhood of the disk is left. Lower arm-plates irregularly quadrate, separated by notches, the single tentacle-scale very distinct.

This species presents great variations in form, colour, and extent of spinulation; the ordinary colour is a hue of purplish red, deeper in parts, mottled or spotted, and it is much better retained in dried specimens than is the case with most Ophiurids.

$$R=78; 77 \text{ (about)}; 68; 41.$$

$$r=9; 11; 10; 6.$$

Distribution. Both sides of North Atlantic, as far south as Cape Cod on the west and Great Britain on the east. 0-300 fms.

<i>a-c.</i> Faeroe Channel, 345 fms.	'Porcupine' Exp. (St. 65).
<i>d.</i> Faeroe Channel, 114 fms.	'Porcupine' Exp. (St. 61).
<i>e-n.</i> Faeroe Channel, 312 fms.	'Porcupine' Exp. (St. 82).
<i>o.</i> Faeroe Channel, 560 fms.	'Porcupine' Exp. (St. 77).
<i>p.</i> East of Shetland, 64 fms.	'Porcupine' Exp. (St. 67).
<i>q.</i> East of Shetland, 75 fms.	'Porcupine' Exp. (St. 68).
<i>r.</i> East of Shetland, 203 fms.	'Porcupine' Exp. (St. 74).
<i>s-v.</i> East of Shetland, 290 fms.	'Porcupine' Exp. (St. 78).
<i>w, x.</i> Upper Loch Torridon, 30-40 fms.	John Murray, Esq.
<i>y, z.</i> Between Plocton and Loch Reraig, 8-24 fms. 21/9/91.	John Murray, Esq.
<i>a'.</i> Mouth of Sound of Mull, 68 fms.	John Murray, Esq.
<i>b'-d'.</i> Firth of Lorn, 50 fms.	John Murray, Esq.
<i>e'-i'.</i> Loch Etive, 15-20 fms.	John Murray, Esq.
<i>j'-l'.</i> West Scotland.	John Murray, Esq.
<i>m'-o'.</i> West Ireland.	'Porcupine' Exp. (St. 17).
<i>p', q'.</i> 50° 24' 45" N., 10° 07' 30" W., 200 fms.	G. C. Bourne, Esq.
<i>r'.</i> Courtmasherry.	Belfast Nat. Hist. Soc.
<i>s', t'.</i> Isle of Man.	Prof. E. Forbes.
<i>u', v'.</i> Off Liverpool.	
<i>w'-δ''.</i> Montrose, June 24, July 3, 4, 6, 10, and Aug. 3, 1889.	W. Duncan, Esq.
<i>c''-i''.</i> Montrose, 3/9/89.	W. Duncan, Esq.
<i>j''.</i> Aberdeen.	G. Sim, Esq.
<i>k'', l''.</i> Shetland.	
<i>m'', n''.</i> Orkney.	

7. OPHIACANTHA.

Ophiacantha, *M. Tr. Syst. Ast.* (1842) p. 106; *Littk. Danske Selsk. Skrift.* v. (1859) p. 65; *Lyman, Ill. Cat. M. C. Z. i.* (1865) p. 93; *id. Chall. Rep. Oph.* (1882) p. 178.

No tooth-papillæ; teeth; mouth-papillæ numerous. Radial shields elongated, often obscured. Disk spiny or thorny. Arm-spines hollow, often rough and elongated. Long bursal slits.

Key to the Species.

Arm-spines slightly thorny.....	1. <i>O. bidentata.</i>
Arm-spines not thorny ..	2. <i>O. spectabilis.</i>
Arm-spines translucent	3. <i>O. abyssicola.</i>

1. *Ophiacantha bidentata.*

Asterias bidentata, *Retzius, Diss. Ast.* (1805) p. 33.

Ophiura retzii, *Nilsson, Coll. Zool. Scan.* (1817) p. 15.

Ophiacantha spinulosa, *M. Tr. Syst. Ast.* (1842) p. 107; *Sars, Norg. Echin.* (1861) p. 13; *Lyman, Ill. Cat. Mus. C. Z. i.* (1865) p. 93; *Jarzynsky, Trans. Petersb. Soc. Nat. i.* (1870) p. 318; *Marenzell. Denkschr. Ak. Wien, xxxv.* (1878) p. 382; *Dunc. & Slad. Mem. Echin. Greenl.* (1881) p. 68.

Ophiocoma arctica, *M. Tr. Syst. Ast.* (1842) p. 103.

Ophiacantha groenlandica, *M. Tr. Arch. f. Nat.* 1844, p. 183.

Ophiocoma echinulata, *Forbes, Sutherland's Voy.* (1852) ii. p. ccxv.

Ophiacantha bidentata, *Ljn. Œfv. K. Vet.-Akad. Förh.* 1871, p. 652; *Lyman, Chall. Rep. Oph.* (1882) p. 186; *id. Bull. Mus. C. Z. x.* (1883) p. 260; *Hoyle, Proc. R. Soc. Ed.* xii. (1884) pp. 709, 710, 712; *id. Proc. R. Phys. Soc. Ed.* viii. (1884) p. 142.

A moderately-sized species, with projecting lateral arm-plates. Disk covered with very short spines. Arm-spines finely serrated, rather long, not transparent. Arms five or six, most remarkable for the prominent ridges formed by the lateral arm-plates on each side; these plates meet in a suture above and below. Arm-spines six or seven, the uppermost the longest, and as much as 5.5 mm. long. The mouth-papillæ not numerous, but inconstant in number, and to some extent in position, as is the mouth-shield in form. Except at base of arm a single tentacle-scale. Diameter of disk 13 mm.; arms very fragile.

Colour, in spirit, whitish.

A very variable species and one exhibiting great changes during growth.

Distribution. Both sides of North Atlantic, as far south as Cape Cod on the west, but not south of Faeroe on the east; Arctic Ocean. 20-2335 fms.

a, b. Faeroe Channel, 440 fms.

'Porcupine' Exp. (St. 51).

c. Faeroe Channel, 384 fms.

'Porcupine' Exp. (St. 52).

2. *Ophiacantha spectabilis*.

Ophiacantha spectabilis, G. O. Sars, *Forh. Vid.-Selsk. Christ.* 1871 (1872), p. 10; *Lyman, Chall. Rep. Oph.* (1882) p. 198; *Hoyle, Proc. R. Soc. Ed.* xii. (1884) p. 714.

A rather large species. Disk pretty thickly covered with more or less short spines. Arm-spines smooth, seven or eight in number, radiating in all directions, and some as much as 5 mm. long; the uppermost have sharp, the lower blunt ends. Mouth-papillæ from four to eight; mouth-shields rounded triangular, wider than long; side mouth-plates rather large. A single tentacle-scale on all but the most distal joints, where there may be two. Diameter of disk 14 mm.: R is said to be = 4 r.

Colour, in spirit, whitish; "uniformiter fulvus vel castaneus, nullas maculas vel fascias obscuriores ostendens" (*Sars*).

Reported by Hoyle from the Faeroe Channel.

Distribution. Norway; 80-433 fms.

3. *Ophiacantha abyssicola*.

Ophiacantha abyssicola, G. O. Sars, *Forh. Vid.-Selsk. Christ.* 1871 (1872), p. 8; *Lyman, Chall. Rep. Oph.* (1882) p. 199; *Hoyle, Proc. R. Soc. Ed.* xii. (1884) pp. 711-713.

A small species, with the arm-joints so constricted as to give them a knotted appearance. Disk almost smooth. Arm-spines smooth, seven near base, fewer more distally, the longest the uppermost, gradually but considerably diminishing in size to the lowermost; the longest as much as 2 mm. The arms most remarkable for their moniliform appearance, each arm-joint being much wider along its distal than its proximal edge. Three or four mouth-papillæ very prominent and distinct. Mouth-shield constricted in its outer half by the invasion of the bursal slits. A single tentacle-scale. Diameter of disk 9 mm. R is said to be = 10 r.

Colour, in spirit, white; "uniformiter pallide ferrugineus, brachiis interdum fasciis obscurioribus transversis indistincte ornatis" (*Sars*).

Distribution. Northern parts of East Atlantic, and Arctic Circle. 20-312 fms.

a, b. Faeroe Channel, 312 fms.

'Porcupine' Exp. (St. 82).

c-f. Faeroe Channel, 290 fms.

'Porcupine' Exp. (St. 78).

OPHIOCOMIDÆ (see p. 26).

1. OPHIOCOMA.

Ophiocoma, *Ag. Mém. Soc. Neuchât.* i. (1836) p. 192; *M. Tr. Syst. Ast.* (1842) p. 98; *Lyman, Ill. Cat. M. C. Z.* i. (1865) p. 70; *Norm. Ann. & Mag.* xv. (1865) p. 111; *Lyman, Chall. Rep. Oph.* (1882) p. 167.

Teeth, tooth- and mouth-papillæ; tooth-papillæ very numerous. Disk granulated and radial shields hidden. Spines smooth, not numerous.

1. *Ophiocoma nigra*.

- Asterias nigra*, *Abilg. apud O. F. Müller, Zool. Dan.* iii. (1789) p. 20, pl. xciii.; *L. Gmel. S. N.* xiii. (1789) p. 3168; *Retz. Diss. Spec. Ast.* (1805) p. 31.
Ophiura granulata, *Flem. Brit. An.* (1828) p. 488; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 438.
Ophiocoma nigra, *M. Tr. Arch. f. Nat.* 1840, p. 328; *id. Syst. Ast.* (1842) p. 100; *Düb. & Kor. Vet.-Ak. Hdlg.* 1844 (1846), p. 234; *Gray, Brit. Rad.* (1848) p. 26; *Herdman, Proc. R. Phys. Soc. Ed.* v. (1880) p. 201; *Leslie & Herdm. op. cit.* vi. (1881) p. 87; *Barrois, Rev. Biol.* i. (1888) p. 73; *Fjelstrup, Zool. Dan. Pigh.* (1890) p. 29, pl. iii. fig. 4.
Ophiocoma granulata, *Forbes, Mem. Wern. Soc.* viii. (1839) p. 127; *id. Brit. Starf.* (1840) p. 50.
Asterias tricolor, *Abilg. Zool. Dan.* iii. (1789) p. 28, pl. xcvii.; *Retz. Diss. Spec. Ast.* (1805) p. 31.
Ophiura sphærulata, *Nilss. Coll. Zool. Scan.* (1817) p. 16.
Ophiocoma nilssoni, *M. Tr. Syst. Ast.* (1842) p. 100.

A moderately sized stout species.

Disk rounded, covered with a fine granulation, which ceases only near the bursal slits; arms fairly stout, seven or eight times the radius of the disk. About ten teeth, a number of small tooth-papillæ; mouth-shield irregular in form, but often lens-like and broader than long; four upstanding mouth-papillæ on either side. Upper arm-plates wider than long, but soon encroached on by the side arm-plates, which carry five or six rather long, sharp spines. Two tentacle-scales to very far out in the arm, then only one.

Colour black or dark brown, the arms lighter than the disk; sometimes lighter, and sometimes spotted.

R.	r.
95	11
76	10
56	8·5
50	8·5
40	4·5

Distribution. Scandinavian Seas; Barents Sea. To 87 fms.

- | | |
|--|-------------------|
| <i>a, b.</i> Between Plocton and Loch Reraig,
21/9/91. | John Murray, Esq. |
| <i>c.</i> Sound of Mull, 70 fms., 5/9/87. | John Murray, Esq. |
| <i>d, e.</i> Loch Leven, 25 fms., 27/8/87. | John Murray, Esq. |
| <i>f, g.</i> Firth of Lorn, 50 fms. | John Murray, Esq. |
| <i>h, i.</i> Near Trench and Kilbrennan Sound,
10-14 fms. | John Murray, Esq. |
| <i>j-l.</i> Kilbrennan Sound. | John Murray, Esq. |
| <i>m.</i> 4 miles S.E. of Sanda, 30-38 fms. | John Murray, Esq. |
| <i>n, o.</i> West coast of Scotland. | John Murray, Esq. |

<i>p-r</i> . Kilkierran Bay, 4-80 fms., 6/7/90.	R. Irish Acad.
<i>s-u</i> . Portaferry and Strangford Lough.	Belfast Nat. Hist. & Phil. Soc.
<i>v-x</i> . Off Liverpool.	
<i>y-d'</i> . Devonshire.	
<i>e'</i> . Falmouth.	W. P. Cocks, Esq.
<i>f', g'</i> . Plymouth Sound.	
<i>h'</i> . ? Plymouth Sound.	
<i>i'-k'</i> . E. coast of Ross-shire.	Dr. Sutherland.
<i>l'-n'</i> . Shetland.	E. M. Nelson, Esq.
<i>o', p'</i> . Old British Coll.	

2. OPHIOPSILA.

Ophiopsila, *Forbes, Trans. Linn. Soc.* xix. (1845) p. 149; *Lütken, Danske Selsk. Skrift.* v. (1859) p. 235; *Lyman, Ill. Cat. M. C. Z.* (1865) p. 149; *id. Chall. Rep. Oph.* (1882) p. 159.

Disk with very minute overlapping scales nearly or altogether covering the radial shields. Arm-spines short and flattened, from six to twelve. Lowest tentacle-scale elongated, spatula- or dagger-shaped; the tentacle-scales lie in a longitudinal groove.

1. Ophiopsila annulosa.

Ophianoplus annulosus, *Sars, Nyt Mag.* x. (1859) p. 23, pl. i. figs. 2-7; *Brady & Robertson, Ann. & Mag.* iii. (1869) p. 355, pl. xxii. figs. 1-6.

Ophiopsila annulosa, *Lütken, Danske Vid. Selsk. Skrift.* v. (1859) p. 258; *Ludw. Mitth. zool. Stat. Neap.* i. (1879) p. 551; *Carus, Faun. Med.* (1884) p. 95; *Hoyle, Proc. R. Phys. Soc. Ed.* viii. (1885) p. 152.

This species, which I have never seen, is defined by Sars thus:—"Disco supra fusco annulis albis; spinis brachiorum xii." It has been recognized by Dr. Norman among specimens collected on the west coast of Ireland, but is otherwise only known from the Mediterranean; 40-50 fms.

OPHIOTHRICIDÆ (see p. 26).

OPHIOTHRIX.

Ophiotrix, *M. Tr. Arch. f. Nat.* vi. (1840) p. 328; *id. Syst. Ast.* (1842) p. 109; *Lyman, Ill. Cat. M. C. Z.* (1865) p. 153; *Norman, Ann. & Mag.* xv. (1865) p. 107; *Lyman, Chall. Rep. Oph.* (1882) p. 213.

Tooth-papillæ numerous; teeth; no mouth-papillæ; the mouth-frames united in their proximal half only so that there is a pore in the hinder part. Radial shields long. Disk spiny or granulated or both. Arm-spines rather long and numerous, notched at their sides, generally glassy.

Key to the Species.

Sides of the interbrachial spaces spiny	1. <i>O. fragilis</i> .
Sides of the interbrachial spaces bare	2. <i>O. luetkeni</i> .

1. *Ophiothrix fragilis*.

Asterias fragilis, *Abilg. apud O. F. Müller, Zool. Dan.* iii. (1789) p. 28, pl. xcvi. ; *Retz. Diss. Spec. Ast.* (1805) p. 30; *Nilss. Coll. Zool. Scan.* (1817) p. 16.

Ophiura fragilis, *Lamk. An. s. Vert.* ii. (1816) p. 546.

Ophiothrix fragilis, *M. Tr. Syst. Ast.* (1842) p. 110, pl. ix. fig. 2; *Gray, Brit. Rad.* (1848) p. 26; *Sars, Nyt Mag.* x. (1859) p. 18; *id. Norg. Ech.* (1861) p. 12; *Norm. Ann. & Mag.* xv. (1865) p. 107; *Heller, Zooph. u. Ech. Adriat.* (1868) p. 62; *Lütke. Dansk. Vid. Selsk. Skrift.* viii. (1870) p. 52; *Lyman, Bull. M. C. Z.* iii. (1874) p. 249; *Ludw. Mitth. zool. Stat. Neap.* i. (1879) p. 551; *Carus, Prod. Faun. Med.* (1884) p. 95; *Fjelstrup, Zool. Dan. Pigh.* (1890) p. 25, pl. ii. fig. 5; *Bell, Ann. & Mag.* viii. (1891) p. 338.

Asterias pentaphylla, *Penn. Brit. Zool.* iv. (1777) p. 54; *Turton, Brit. Faun.* (1807) p. 141.

Ophiothrix pentaphyllum, *Ljungman, Öfv. Vet.-Ak. Förh.* 1871, p. 622; *Lyman, Bull. M. C. Z.* iii. (1874) p. 249; *id. Proc. Roy. Soc. Ed.* xi. (1882) p. 707.

Ophiothrix rammelsbergii, *M. Tr. Syst. Ast.* (1842) p. 113, pl. viii. fig. 3.

Ophiocoma rosula, *Forb. Brit. Starf.* (1840) p. 60; *Peach, Proc. R. Phys. Soc. Edinb.* ii. (1859-62) p. 63; *Herdman, Proc. Roy. Phys. Soc. Ed.* v. (1880) p. 200; *Leslie & Herdm. op. cit.* vi. (1881) p. 89; *Tregelles, Rep. & Trans. Penzance Nat. Hist. Soc.* 1887-88, p. 371.

Asterias varia, *Penn. Brit. Zool.* iv. (1777) p. 54.

Asterias radiata, *id. ibid.*

Asterias hastata, *id. t. c.* p. 55.

Asterias fissa, *id. ibid.*

Asterias nigra *, *id. ibid.*

A species which exhibits the greatest variations in colour and marking, and in the presence or absence of spines on the disk; of moderate size.

Arms very fragile, about eight to ten times as long as the radius of the disk. The scales on the upper surface of the disk often form projecting spinules, but may be almost completely hidden by elongated, delicate spines. The triangular radial shields are of large size and are bare except for a few spines which may be present on the inner side of their base. Each is separated from its fellow by a few laterally compressed scales on which are spinous granules or short spines.

The teeth-papillæ are exceedingly numerous and beneath the clump are seven teeth. The arms are rather delicate; the upper

* Pennant's descriptions are not sufficient, but Borlase's figures, to which he refers, easily enables us to recognize these forms; all these five but *radiata* are cited by Turton, *Brit. Faun.* (1807) p. 141.

arm-plates have a concave proximal and a strongly curved distal edge; the upper surface is carinate and the distal end of the keel is knobbed. The side arm-plates intrude considerably on the proximal part of these plates and carry about seven spines, of which the uppermost is shorter than the next three or four, but not so short as the lowermost two or three. The under arm-plates have the distal edge wider than the proximal, and often concave outwards. One tentacle-scale.

Colour very variable, sometimes very dark, often banded and spotted with brick-red; sometimes a deep brown is the very prevailing hue, sometimes grey, slate, or bluish.

It is difficult to give a satisfactory account of the length of the arms; in the four here given the total length of the arm is nearly correct for the last only.

R.	r.
76	8
55	5.5
41	4.5
28	3.7

Distribution. Norway to Mediterranean—often very abundant. 0-52 fms.

<i>a-e.</i> Faeroe Bank.	'Porcupine' Exp.
<i>f-h.</i> 59° 35' N., 9° 11' W., 767 fms.	'Porcupine' Exp.
<i>i.</i> The Minch.	'Porcupine' Exp.
<i>j-z.</i> Sound of Mull, Tobermory, 30 fms.	John Murray, Esq.
<i>a'</i> . Sound of Mull, Tobermory, 70 fms.	John Murray, Esq.
<i>b'</i> . Sound of Mull, Tobermory, 5/9/87.	John Murray, Esq.
<i>c'</i> . Loch Leven, 25 fms., 27/8/87.	John Murray, Esq.
<i>d'-h'</i> . Firth of Lorn.	John Murray, Esq.
<i>i'-m'</i> . Loch Etive.	John Murray, Esq.
<i>n'</i> . Great Cumbrae and Wemyss Ground.	John Murray, Esq.
<i>o', p'</i> . West coast of Scotland.	John Murray, Esq.
<i>q'</i> . 20 miles off Achill Head, 126 fms.	R. Irish Acad.
<i>r', s'</i> . 40 miles off Achill Head, 220 fms.	R. Irish Acad.
<i>t', u'</i> . Blacksod Bay, 5-6 fms., 21/4/91.	R. Irish Acad.
<i>v'</i> . Blacksod Bay.	Dr. Grenfell.
<i>w'-z'</i> . Kenmare River.	
<i>a'', b''.</i> Portaferry, Aug. 1837, and Strangford, 11/10/34.	Belfast Phil. & Nat. Hist. Soc.
<i>c''-e''.</i> Off Liverpool.	
<i>f''-k''.</i> Falmouth.	W. P. Cocks, Esq.
<i>l''.</i> Falmouth Harbour.	W. P. Cocks, Esq.
<i>m''-o''.</i> Falmouth.	
<i>p''-r''.</i> Plymouth.	
<i>s''-w''.</i> Torbay.	
<i>x''-b³.</i> Weymouth, Oct. 1880.	E. A. Smith, Esq.
<i>c³-e³.</i> Herm.	R. L. Spencer, Esq.
<i>f³.</i> Herm, Sept. 1889.	Prof. Bell.
<i>g³.</i> Channel Isles.	R. L. Spencer, Esq.
<i>h³, i³.</i> Lulworth, July 1889.	F. J. B. Beckford, Esq.
<i>j³-l³.</i> Lobster Patch, Poole, 5½ fms.	F. J. B. Beckford, Esq.

m^3 . Poole, $2\frac{1}{2}$ fms., July 1889.	F. J. B. Beckford, Esq.
n^3 . Firth of Forth.	
o^3 - z^3 Montrose, 22/6, 27/6, 3/7, 4/7, 6/7, 1889.	W. Duncan, Esq.
a^4 . Aberdeen.	G. Sim, Esq.
b^4 . E. coast of Ross-shire.	Dr. Sutherland.
c^4 , d^4 . Moussa (Shetland).	E. M. Nelson, Esq.
e^4 . Orkney.	Haslar Coll.

2. *Ophiothrix luetkeni*.

Ophiothrix luetkeni, *Wyv. Thoms. Depths of the Sea*, (1872) p. 100 [n. n.]; *Lyman, Bull. M. C. Z.* iii. (1874) p. 248; *id. Chall. Rep. Oph.* (1882) p. 218; *Bell, Ann. & Mag.* viii. (1891) p. 329.
Ophiothrix pentaphyllum, *Bell, Ann. & Mag.* iv. (1889) p. 436; *id. J. Mar. Biol. Assoc.* i. (1890) p. 325.

A stout well-grown species. Arms about ten times as long as the radius of the disk. The scales on the disk not unlike those of *O. fragilis* and, as in it, they may or may not be covered with spines. The interbrachial spaces have the middle third occupied by fine spines, which are sometimes only poorly developed, while the sides are bare. The triangular shields differ chiefly from those of *O. fragilis* in not having their spines or spinous granules confined to one angle.

Teeth-papillæ coarse. Arms broad, flat, strong. The upper arm-plates somewhat variable in form, but always with a few fine spines on their surface; they are hardly at all carinate, and have pretty even proximal and distal edges. Spines coarser and rather shorter than in *O. fragilis*, about seven in number. The lower arm-plates may have a distal concavity, but this is not very obvious in full-grown specimens. One tentacle-scale.

Colour white or banded, or spotted with red or purple.

R.	r.
100 (arm broken)	11.5
150 (arm broken)	13
(arms much broken)	15

Distribution. A young specimen reported by Lyman from the Azores. 90–315 fms.

a . 40 miles off Bolus Head, 115 fms.	R. Irish Acad.
b . 50 miles off Bolus Head, 200 fms.	R. Irish Acad.
c , d . $50^{\circ} 50' 15''$ N., $11^{\circ} 12' 30''$ W., 200 fms.	G. C. Bourne, Esq.
e . $48^{\circ} 39' 42''$ N., $10^{\circ} 07' 27''$ W., 90 fms.	G. C. Bourne, Esq.
f . S.W. coast of Ireland, 200 fms.	'Flying Fox' Exp.
g . S.W. coast of Ireland, 250 or 315 fms.	'Flying Fox' Exp.
h - j . — ?	'Porcupine' Exp.

STREPTOPHIURÆ (see p. 26).1. **OPHIOSCOLEX.**

Ophioscolex, *M. Tr. Syst. Ast.* (1842) p. 109; *Lyman, Chall. Rep. Oph.* (1882) p. 232.

Teeth and mouth-papillæ; tooth-papillæ present or absent. No upper arm-plates. A thick naked skin covers all the disk and extends on to the arms and spines. Tentacle-scales present or absent.

Key to the Species.

Mouth-papillæ seven to ten	1. <i>O. glacialis.</i>
Mouth-papillæ ten or more	2. <i>O. purpurea.</i>

1. **Ophioscolex glacialis.**

Ophioscolex glacialis, *M. Tr. Syst. Ast.* (1842) p. 109; *Barr. & M'Andrew, Ann. & Mag.* xx. (1857) p. 46; *Sars, Norg. Ech.* (1861) pp. 7 & 12; *Lyman, Bull. M. C. Z.* x. (1883) p. 268; *Hoyle, Proc. R. Soc. Edinb.* xii. (1884) p. 720.

Disk nearly circular; arms seven to nine times as long as radius of disk, flattened, tapering rather rapidly. All the parts of the disk are obscured by the thick wrinkled skin, except the seven to ten somewhat irregularly arranged delicate mouth-papillæ. Three delicate arm-spines about as long as the arm is broad. No tentacle-scale.

Colour, in spirit, yellowish white.

$R=65; 42.$ $r=7; 6.$

Distribution. Both sides of North Atlantic, as far south as $38^{\circ} 21' 50''$ N., $73^{\circ} 32'$ W. (West Indies?) on the west, from Faeroe to Spitzbergen on the east. 100–300 fms.

Some semi-macerated fragments, determined by Mr. Lyman, from $60^{\circ} 0'$ N., $5^{\circ} 13'$ W., 312 fms. 'Porcupine' Exp.

2. **Ophioscolex purpurea.**

Ophioscolex purpurea, *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 235, pl. vi. fig. 2; *Sars, Norg. Ech.* (1861) p. 8.

Ophioscolex purpureus, *Lyman, Bull. C. M. Z.* v. (1878) p. 233 *id. Chall. Rep. Oph.* (1882) p. 234; *Hoyle, Proc. Roy. Soc. Ed.* xii. (1884) p. 720.

Disk pentangular; arms about eight times as long as the radius of the disk, flattened, do not taper very rapidly. Mouth-papillæ more numerous (ten or more), stouter, and more regularly arranged

than in *O. glacialis*. Three arm-spines rather shorter than in the preceding species. One tentacle-scale.

Colour said to be "intense purpureus," but in spirit quite white.

$$R=34; 32. \quad r=4.5; 4.$$

Distribution. Both sides of the North Atlantic, as far south as 23° 1' N., 83° 14' W., 190 fms.; Norway, 64–767 fms.

<i>a.</i> 59° 56' N., 6° 27' W., 363 fms.	'Porcupine' Exp. (St. 54).
<i>b, c.</i> 60° 14' N., 6° 17' W., 632 fms.	'Porcupine' Exp. (St. 57).
<i>d, e.</i> 60° 39' N., 3° 9' W., 203 fms.	'Porcupine' Exp. (St. 74).
<i>f.</i> 60° 0' N., 5° 13' W., 312 fms.	'Porcupine' Exp. (St. 82).

2. OPHIOBYRSA.

Ophiobyrsa, *Lyman, Bull. M. C. Z.* v. (1878) p. 131; *id. Chall. Rep. Oph.* (1882) p. 243.

Mouth-armature consists of a set of spines at the angles, with a spine scattered here and there on the sides of the jaws. Disk covered with thick integument on which spines or spinous granules are feebly developed. Upper arm-plates reduced or absent; side arm-plates project and carry slightly roughened spines. No tentacle-scales. Very large bursal slits.

1. Ophiobyrsa hystricis.

Ophiobyrsa hystricis, *Lyman, Bull. Mus. C. Z.* x. (1883) p. 272, pl. viii. figs. 120–122; *Hoyle, Proc. Roy. Soc. Ed.* xii. (1884) p. 711; *Bell, J. Mar. Biol. Assoc.* i. (1890) p. 326; *id. P. Z. S.* 1892, p. 183, pl. xii. figs. 2 & 3.

A very large Ophiurid, *Wyv. Thomson, Depths of the Sea*, (1874) p. 123.

A large fine species, not unlike an *Ophiomyxa*.

Disk and arms flattened; skin of disk alone beset with spines, which are best marked on the radial shields; no spines on dorsal surface of arms. Radial shields narrow, wider without than within. Upper arm-plates represented by two vestigial plates, which do not meet in the middle line or touch their neighbours in front or behind. Five feebly roughened arm-spines, the uppermost the longest. Lower arm-plates tend to be square. The prominent bursal slit looks both downwards and outwards, and the outer portion is marked by a strongly curved lip.

During life or in spirit the details are much obscured by the thick skin, which extends even on to the spines; the skin in drying is apt to contort the specimen.

Colour, in spirit, white; dry, disk dark, arms lighter.

R.	r.
185	12
250 (or more)	16

- a. North-west of Shetland, 345 fms. 'Porcupine' Exp. (St. 63).
 b. Off S.W. coast of Ireland, 315 fms. 'Flying Fox' Exp.
 c. Off S.W. coast of Ireland, 400 fms. G. C. Bourne, Esq.

Distribution. These are the only known habitats.

3. OPHIOMYXA.

Ophiomyxa, *M. Tr. Syst. Ast.* (1842) p. 108; *Lyman, Chall. Rep. Oph.* (1882) p. 244.

Disk and arms covered by a thick skin. Mouth-papillæ and teeth flattened lobes, with serrate edges. No tentacle-scales. Arm-spines jagged at tip.

1. Ophiomyxa serpentaria.

Ophiomyxa serpentaria, *Lyman, Bull. M. C. Z.* x. (1883) p. 274; *Hoyle, Proc. Roy. Soc. Ed.* xii. (1884) p. 710.

A single specimen, reported by Lyman from 363 fms. in Faeroe Channel, and distinguished by the absence of upper arm-plates, three short arm-spines, and three small mouth-papillæ; radial shields small*.

CLADOPHIURÆ (see p. 26).

ASTRONYXINÆ (see p. 27).

ASTRONYX.

Asteronyx, *M. Tr. Syst. Ast.* (1842) p. 119; *Norman, Ann. & Mag.* xv. (1865) p. 105.
 Astronyx, *Lyman, Chall. Rep. Oph.* (1882) p. 285.

Disk pentagonal, arched, sharply separated from the narrow arms; radial shields in the form of elongated rods, but broken into several pieces. Papillæ on the angles of the mouth large; mouth-shields hidden and small, as is the madreporite. Basal clefts set in a depression, very short, and in the interbrachial angle only. Some of the arm-spines hooked.

1. Astronyx loveni.

Asteronyx loveni, *M. Tr. Syst. Ast.* (1842) p. 119; *Sars, Norg. Ech.* (1861) p. 5, pl. i. figs. 1-5; *Stewart, P. Z. S.* 1861, p. 96 (fig.); *Norm. Ann. & Mag.* xv. (1865) p. 106; *Jarzynsky, Trans. Petersb. Soc. Nat.* i. (1870) p. 318; *Lyman, Chall. Rep. Oph.* (1882) p. 137; *Sim, Zoologist*, xl. (1882) p. 24; *Hoyle, Proc. R. Phys. Soc. Ed.* viii. (1884) p. 137; *id. Proc. Roy. Soc. Ed.* xii. (1884) p. 713.

Arms very long, slender, convex above, flattened below, very fine

* No specimen is in the British Museum.

at tip; one of the arm-spines very much longer than the rest, and almost as long as the arm is wide. Skin both of disk and arms without any hard deposit; no tentacle-scale; about six mouth-papillæ.

Colour, in spirit, creamy white.

Sometimes found clasping the axes of living specimens of *Funiculina quadrangularis*. Arms not naturally extended, but when so drawn out may give a spread of 800 mm.

R.	r.
380 (ca.)	15
360 (ca.)	20
175 (ca.)	10
125 (ca.)	8

Distribution. Circumpolar: North Sea, eastern side of North Atlantic, Japan. To 350 fms.

a. The Minch.	'Porcupine' Exp.
b. Loch Torridon.	J. A. Stewart, Esq.
c-g. Loch Hourn, 70 fms., 29/8/87.	John Murray, Esq.
h. Firth of Lorn.	John Murray, Esq.
i, j. Firth of Lorn (embracing <i>Funiculina quadrangularis</i>).	John Murray, Esq.
k, l. Aberdeen.	Geo. Sim, Esq.

GORGONOCEPHALINÆ (see p. 27).

GORGONOCEPHALUS.

Gorgonocephalus (pars), *Leach, Zool. Misc.* ii. (1815) p. 51; (sens. emend.) *Lyman, Chall. Rep. Oph.* (1882) p. 258.

Euryale (pars), *Lamk. An. s. Vert.* ii. (1816) p. 535; *Ag. Mém. Soc. Neuch.* ii. (1839), *Notice, &c.* p. 1.

Astrophyton (pars), *Forbes, Brit. Starf.* (1840) p. 67; *M. Tr. Syst. Ast.* (1842) p. 121; *Lyman, Ill. Cat. Mus. C. Z.* i. (1865) p. 180; *Norm. Ann. & Mag.* xv. (1865) p. 105.

Disk rounded or with slight re-entering curves, thick; arms narrow at the base and not dividing so frequently as in *Astrophyton*. Radial shields elongated, diverge considerably. Upper arm-plates represented by a mosaic of thin irregular plates.

Key to the Species.

Dorsal surface of disk spiny	1. <i>G. lincki</i> .
Dorsal surface of disk not spiny	2. <i>G. eucnemis</i> .

1. *Gorgonocephalus lincki*.

? *Astrophyton arborescens*, *Penn. Brit. Zool.* iv. (1777) p. 56 (non *M. Tr.*).

? *Asterias caput-medusæ*, *Turt. Brit. Faun.* (1801) p. 140.

? *Astrophyton scutatum*, *Flem. Brit. An.* (1827) p. 489; *Couch, Corn. Faun.* i. (1838) p. 84.

- ‡ *Euryale scutatum*, *De Bl. Actin.* (1834) p. 246 (non *Gould, Invert. Mass.* (1841) p. 345).
Astrophyton scutatum, *Forbes, Brit. Starf.* (1840) p. 67 (non *Agassiz, Mém. Soc. Neuch.* ii. (1839), *Notice &c.* p. 11).
Astrophyton linckii, *M. Tr. Syst. Ast.* (1842) p. 122; *Lyman, Ill. Cat. M. C. Z. i.* (1865) p. 190; *Norman, Ann. & Mag.* xv. (1865) p. 105.
Gorgonocephalus linckii, *Lyman, Chall. Rep. Oph.* (1882) p. 264; *Hoyle, Proc. R. Phys. Soc. Ed.* viii. (1885) p. 138.

Disk with a single madreporite at one of the angles of the rays, equally covered on the whole of the dorsal surface with strong spinous cylinders or cones, the longest near or on the margin; unequal and irregular development of spines on the ventral surface. No tubercles on the arms, but on the ventral side a median band of large granules; papillæ well developed, three and then four in a row.

Distribution. North Atlantic (eastern side).

No specimen from British area in the collection of the British Museum.

2. *Gorgonocephalus eucnemis*.

- ? *Asterias caput-medusæ*, *Fabr. Faun. Grænl.* (1780) p. 372, no. 367; *Dewhurst, Nat. Hist. Cetacea*, (1834) p. 279.
Astrophyton eucnemis, *M. Tr. Syst. Ast.* (1842) p. 123; *Lütke, K. Dansk. Vid. Selsk. Skrift.* v. (1859) p. 70, pl. ii. figs. 9-19; *Sars, Norg. Ech.* (1861) p. 4; *Lyman, Ill. Cat. M. C. Z. i.* (1865) p. 181; *Marenzeller, Denks. Ak. Wien*, xxxv. (1878) p. 383.
Gorgonocephalus eucnemis, *Lyman, Chall. Rep. Oph.* (1882) p. 263; *Hoyle, Proc. R. Phys. Soc. Ed.* viii. (1884) p. 137.

Disk with a single madreporite at one of the angles of the rays. Surface of disk with thin integument, through which the elongated radial shields stand out very prominently; the surface of the shields loosely covered with granules, but there are no spines or tubercles; skin in interbrachial areas smooth, as are, too, the under surfaces of the arms; three, four, or five papillæ.

Colour yellowish brown.

Distribution. Northern parts of Atlantic (east and west).

ECHINOIDEA (*see* p. 27).CIDARIDÆ (*see* p. 29).

CIDARIS.

- Cidaris, *Leske* (*ex Klein*), *Addit.* (1778) p. 42 (pars); *Gray*, *Ann. Philos.* xxvi. (1825) p. 426; *Ag. & Des. Ann. Sc. Nat.* vi. (1846) p. 325; *J. Müll. Abhl. k. Ak. Wiss. Berl.* 1853 (1854) p. 123; *Desor, Syn. Ech. foss.* p. 3; *Stewart, Q. J. M. S.* xi. (1871) p. 51; *A. Ag. Rev. Ech.* (1872-4) p. 252; *id. Chall. Rep.* 1881, p. 33; *Loven, Bih. K. Svensk. Vet.-Akad. Hdlg.* xiii. (1887[8]) iv. no. 5, p. 138; *Duncan, J. Linn. Soc.* xxiii. (1889) p. 27.
- Cidarites, *Lamk. An. s. Vert.* iii. (1816) p. 52.
- Eocidaris, *Desor, Syn. Ech. foss.* (1858) p. 155.
- Rabdocidaris, *id. op. cit.* p. 39; *Rhabdocidaris, De Loriol, Mém. Soc. Phys. Genève*, xxviii. no. 8 (1883) p. 7.
- Leiocidaris, *id. op. cit.* p. 48.
- Porocidaris, *id. op. cit.* p. 46; *Wyv. Thoms. Phil. Trans.* clxiv. (1874) p. 726.
- Phyllacanthus (subg.), *Brandt, Prodr. descr. Anim.* (1835) p. 67.
- Gymnocidaris, *A. Ag. Bull. M. C. Z.* i. (1863) p. 17.
- Orthocidaris, *id. ibid.*
- Temnocidaris, *id. t. c.* p. 18.
- Prionocidaris, *id. ibid.*
- Stephanocidaris, *id. ibid.*
- Chondrocidaris, *id. ibid.*
- Dorocidaris (subg.), *id. Rev. Ech.* (1872) p. 254.
- Schleinitzia, *Studer, MB. Ak. Berl.* 1876, p. 463.
- Discocidaris (subg.), *Döderlein, Arch. f. Naturg.* 1885, p. 82.

Test stout, turban-shaped, flattened above and below; ambulacral areae slightly sinuous, about one-fourth the breadth of the interambulacral areae; the plates of the latter are not numerous, and each has its centre occupied by a large primary tubercle. This is frequently perforated at its tip, but it may not be, and the base may or may not be crenulated.

A large number of generic forms have been quite unnecessarily distinguished, as the synonymy of the genus shows.

Key to the Species.

- | | |
|---|--------------------------|
| Peristome nearly as large as calycinal area | 1. <i>C. papillata</i> . |
| Peristome much smaller than calycinal area | 2. <i>C. purpurata</i> . |
| Doubtful species | 3. <i>C. gracilis</i> . |

1. *Cidaris papillata*.

- Cidaris papillata*, *Leske, Addit.* (1778) p. 61, pl. xxxix. fig. 2; *Flem. Brit. An.* (1828) p. 477; *Forbes, Brit. Starf.* (1841) p. 146; *Philippi, Arch. f. Nat.* 1845, p. 353; *Düb. & Kor. Vet.-Ak. Hdlg.* 1844 (1846), p. 255, pl. ix. figs. 25-30; *Ag. Ann. Sci. Nat.* vi. (1846) p. 324; *Gray, Brit. Rad.* (1848) p. 2; *Sars, Norg. Ech.* (1861) p. 93; *Lovén, Vet.-Ak. Hdlg.* xi. 7. (1874) pl. xx.; *Wyv. Thoms. Phil. Trans.* clxiv. (1874) p. 722, pl. lix. figs. 1-13.
- Echinus cidaris*, ? var. *a*, *Sowerby, Brit. Misc.* (1805) p. 89, pl. 44.
- Cidarites papillata*, *Desmoul. Syn. Ech.* (1837) p. 320.

- Leiocidaris papillata*, *Duj. & Hup. Ech.* (1862) p. 485; *Perr. Ann. Sci. Nat.* xiii. (1870) p. 24.
- Orthocidaris papillata*, *A. Ag. Bull. Mus. C. Z.* i. (1863) p. 17.
- Dorocidaris papillata*, *A. Ag. Rev. Ech.* (1872-3) pp. 105 & 254, pls. i., i. b, ii. a. figs. 1-13, ii. b. figs. 1-5, ii. c. figs. 7-12; *id. Bull. Mus. C. Z.* viii. (1878) p. 70; *Ludwig, Mitth. zool. Stat. Neap.* i. (1879) p. 554; *Stewart, Trans. Linn. Soc.* i. (1880) p. 569, pl. 70. figs. 1-5; *A. Ag. Chall. Rep. Ech.* (1880) p. 40; *Ludw. Zeits. f. w. Zool.* xxxiv. (1882) p. 85, pl. iii. figs. 8-10; *Verrill, Am. J. Sci.* xxiii. (1882) p. 133; *A. Ag. Proc. Roy. Soc. Ed.* vi. (1883) p. 697; *Koehler, Ann. Mus. Marseill.* i. 3. (1883) p. 113, pl. iii. fig. 17; *Rathbun, Proc. U.S. Nat. Mus.* viii. (1885) p. 611; *Prouho, C. R.* cii. (1886) p. 1403; *id. Arch. Zool. expér.* v. (1887) p. 217, pls. 14-21, 23-25.
- Cidarites hystrix*, *Lamk. Anim. s. Vert.* (1816) iii. p. 55; *id. op. cit.* (1840) iii. p. 379; *Desm. Etudes* (1831) p. 320.
- Cidarites (Phyllacanthus) hystrix*, *Brandt, Prodr. descr. Anim.* (1836) p. 68.
- Cidaris hystrix*, *De Blainv. Actinol.* (1832) p. 231, pl. xx. bis, fig. 5; *Phil. Arch. f. Nat.* xi. (1845) p. 353; *Ag. Ann. Sci. Nat.* vi. (1846) p. 32; *Sars, Nyt Mag.* x. (1859) p. 53; *Lovén, op. cit.* p. 29, pl. xx.; *Heller, Zoophyt. u. Echinod. adriat. Meer.* (1863) p. 69.
- Leiocidaris hystrix*, *Duj. & Hupé, Hist. nat. Echin.* (1862) p. 484.
- Orthocidaris hystrix*, *A. Ag. Bull. Mus. C. Z.* i. (1863) p. 17.
- Dorocidaris hystrix*, *A. Ag. Rev. Echin.* (1872) p. 105.
- Dorocidaris abyssicola*, *id. Bull. Mus. C. Z.* i. (1869) p. 253.
- Cidaris borealis*, *Düben & Koren, Öfv. Vet.-Ak. Förh.* 1844 (1845), p. 114.
- Cidaris affinis*, *Phil. Arch. f. Nat.* x. (1845) p. 353; *Sars, Nyt Mag.* x. (1859) p. 54; *Wyv. Thomson, Phil. Trans.* clxiv. (1874) p. 726, pl. lx.
- Cidaris stokesi*, *Ag. Ann. Sci. Nat.* vi. (1846) p. 32; *Heller, Zoophyt. u. Echinod. adriat. Meer.* (1868) p. 69; *Perrier, Ann. Sci. Nat.* xiii. (1870) p. 26, pl. ii. fig. 6.
- Rhabdocidaris hystrix*, *De Loriol, Mém. Soc. Phys. et d'Hist. nat. Genève*, xxviii. (1883) no. 8, p. 7.

Primary spines are few in number, vary in colour from pale straw to reddish brown, may be twice as long as the diameter of the test, but are shorter above and below the ambitus, vary somewhat in thickness and in the extent to which they are compressed at the tip; the serration of the spines, caused by the granules on their surface, is scarcely ever pronounced. There is generally a delicate pink band at the base of the spine. Round the tubercle to which the spine is attached are set a number of spatulate spines, light yellow to dark brown in colour, often darkest in the middle line or at the tip. The ambulacral spines are less numerous and smaller than the interambulacral secondaries, while those on the apical area may be like either, and those on the buccal membrane are like the former.

The test is flat above, circular in outline; ambulacra slightly sinuous, not wide; there is no groove connecting the members of each pair of pores, but there is a transverse ridge along the upper side of the perforate portion of each ambulacral plate. The interambulacral area is covered by two regular rows of tubercles and two more internal and more irregular rows. There are eight or nine

interambulacral plates in each row; the areole round each primary tubercle is wide and deep; the tubercle is perforated, but its base is not crenulated; the remaining portion of each plate is closely covered with miliaries; as a rule the circlet of tubercles is complete, but it sometimes happens that only one row of tubercles divides one areola from one of its neighbours.

In the calycinal area the periproct has a pentagonal form, and the angles of the pentagon are produced along the lines of the radii, a triangular plate separating each of the radials and touching the interradiial by its pointed apex; the interradials are kidney-shaped in form, with the long axis at right angles to the line of the ray; the radials vary a good deal in contour, but are always wider along their inner than their outer edge, and are generally notched at the sides.

Peristome rather large, about the same size as the calycinal area.

Diam. of test.	Height of test.	Diameter of			Length of spines.
		Mouth.	Calycinal area.	Periproct.	
43	29	15	17.5	..	83, 42, 20
44	27	16	19	10.5	..
33	19.5	11	14		54, 22, 15

Distribution. Very wide. "We dredged it in from 100 to 400 fathoms wherever there was a gravelly or sandy or in any way a hard bottom, in one continuous belt from the Faeroe Islands to Gibraltar. In some localities the number of individuals was quite surprising. In the Shetland Sea, and at some stations off the South and West of Ireland, the dredge-bag was almost choked with them" (Wyv. Thomson, *Phil. Trans.* 1874, p. 725). Prof. A. Agassiz has himself (Chall. Rep. Ech. p. 38) thrown doubt on his correct identification of Pacific forms as belonging to this species. 0-874 fms.

a.	Off coast of Kerry, 100-200 fms.	Royal Irish Academy.
b.	Off S.W. coast of Ireland, 250 fms.	'Flying Fox' Exp.
c-n.	Off S.W. coast of Ireland, 150-315 fms.	'Flying Fox' Exp.
o.	Off S.W. coast of Ireland (young).	'Flying Fox' Exp.
p.	Off Wexford, 30-40 fms.	'Porcupine' Exp.
q, r.	49° & 50° N., 11° W., 200-400 fms.	G. C. Bourne, Esq.
s, t.	40 miles off Achill Head, 144 & 220 fms.	R. Dublin Soc.
u.	45 miles off Blackrock, 500 fms., 12/5/91.	R. Dublin Soc.
v.	45 miles off Blackrock, 250 fms., 12/5/91.	R. Dublin Soc.

2. *Cidaris purpurata*.

Porocidaris purpurata, *Wyv. Thoms. Phil. Trans.* clxiy. (1874) p. 728, pl. lix. figs. 14, 15, pl. lxi.

Cidaris purpurata, *Duncan, J. Linn. Soc.* xxiii. (1889) p. 32.

Some of the primary spines are swollen in their basal half, which is coloured purple. A few of the spines are a little longer * than the diameter of the test; some are almost smooth, others a good deal serrated; those around the mouth are flattened and spatulate.

* Twice and more as long, *teste* Wyv. Thomson.

The remaining, smaller, spines of a uniform light brown colour. The secondaries form a definite circlet around each areola and are flattened and blunted; the tertiaries are finer and more pointed.

As large as the smaller of these are the large bivalved pedicellariæ, which are most numerous in the apical region. The buccal membrane is crowded with small spines.

The test is somewhat flattened, subpentagonal rather than circular; ambulacra about as wide as in *C. papillata*; around each pair of pores a groove; the pore-areas are nearly as wide as the area between them, in which there are two regular rows of miliaries, with a few smaller tubercles scattered between them. There are eight or nine plates in each interambulacral series. The areolæ are not as deep as in *C. papillata*; they frequently are only separated from one another by a single row of granules; the tubercles are perforated or faintly crenulated; the granules which closely cover the plates are more equal in size than in *C. papillata*.

The extensive calycinal area differs in the two sexes, for in the female the genital pores are of enormous size, and intrude even on the upper ambulacral plates. The radials are very regularly heart-shaped; the interradials are large, with a nearly straight inner edge, with sides slightly curved, and the outer edge complete in ♂, but deeply notched in ♀.

Peristome rather small, considerably smaller than calycinal area.

	Diam. of test.	Height of test.	Diameter of			Spines.
			Peri-stome.	Calycinal area.	Periproct.	
a. ♂	50	32	13	22.5	11	45, 55, 62
b. ♀	47.5	33	7.5	23.5	11	

a, b. North of the Hebrides.

'Porcupine' Exp.

The two specimens in the Museum are said to be Sir W. Thomson's types; they were taken "about 100 miles to the north of the Hebrides," and are by Prof. Agassiz said to have come from a depth of 542 fms.

3. *Cidaris gracilis*.

Porocidaris gracilis, Sladen, *Proc. R. Irish Acad.* i. (1891) p. 699, pl. xxix.

Under this name Mr. Sladen has described a single specimen, "probably immature," from 51° 1' N., 11° 50' W., and depth 750 fms. Perhaps when a mature specimen is found it will be seen to be only *C. purpurata*.

ECHINOTHURIIDÆ (see p. 29).

Key to the Genera of Echinothuriidæ.

Vertical muscles divide the cœlom into chambers.	1. ASTHENOSOMA,
No vertical muscles dividing the cœlom into chambers.	[p. 143.
.....	2. PHORMOSOMA,
.....	[p. 144.

1. ASTHENOSOMA.

Asthenosoma, *Grube, JB. schles. Ges.* xlv. (1868) p. 42; *A. Ag. Rev. Ech.* (1872) p. 272; *Ludwig, Zeitsch. f. wiss. Zool.* xxxiv. (1880) p. 70; *Duncan, J. Linn. Soc.* xxiii. (1889) p. 43.
 Calveria, *Wyv. Thoms. Phil. Trans.* clxiv. (1874) p. 737.

An Echinothurid in which the imbrication of the coronal plates is very marked, and the ambulacral plates very wide; the tubercles that bear the primary spines form prominent bosses. The calcareous deposit in the coronal plates may be greatly reduced, and the cœlom is divided into separate chambers by vertically disposed muscular bands. The organs of Stewart appear, in some species, to be well developed.

1. *Asthenosoma hystrix*.

Calveria hystrix, *Wyv. Thoms. Proc. Roy. Soc. Lond.* xx. (1872) p. 494; *Phil. Trans.* clxiv. (1874) p. 738 (non *Proc. Roy. Soc.* xviii. (1869) p. 445), pls. lxiv. & lxv.
Asthenosoma hystrix, *A. Ag. Rev. Ech.* (1872) pp. 93 & 273, pl. ii. figs. 1-5; *id. Bull. Mus. C. Z.* viii. (1880) p. 74; *id. Mem. C. Z.* x. (1883) p. 29, pls. xiii. & xiv.; *Rathbun, Proc. U.S. Nat. Mus.* ix. (1886) p. 267; *Bell, Proc. Roy. Dubl. Soc.* vii. (1892) p. 526, pls. xxiv. & xxv.
Asthenosoma reynoldsii, *A. Ag. t. c.* (1880) p. 75.
Calveria fenestrata, *Wyv. Thoms. Phil. Trans.* clxiv. (1874) p. 741, pl. lxiii. figs. 9 & 9 a, & pls. lxvi. & lxvii.
Asthenosoma fenestratum, *A. Ag. Rev. Ech.* (1872) p. 210.

Varying considerably in one of the chief characters that distinguish the genus—the extent to which the plates of the corona are calcified, so that the membranous interspaces may be very marked or nearly obsolete; varying also in the size of the genital pores, but this perhaps is sexual. Varying from pale grey to brilliant pink; the bands or patches of colour varying considerably in intensity. In each interambulacrum a row of primary tubercles is well developed; these diminish in size from the ambitus towards the mouth and are set very regularly on every plate; above the ambitus they are not always present on every successive plate, and they cease about eight plates from the apical area; in addition there may be a few scattered primary tubercles; there are no prominent tubercles in the ambulacra. Both ambulacral and interambulacral plates are low from above downwards. The anal plates are very numerous, and nearly all bear a distinct tubercle. The madreporite is irregularly triangular and somewhat variable in size. The peristomial plates are thickly covered with tubercles. None of the spines are long, and all but the primaries are delicate and almost silky.

The diameter of the test may be as much as 200 mm.; one measuring 110 mm. across has been extended as much as possible, and its vertical axis was found to measure 50 mm. Specimens in all kinds of distension, and, if dried, of distortion, may be observed.

Distribution. Both sides of N. Atlantic from W. Indies to Rockall. 103-547 fms.

- a-k.* 45 miles off Blackrock, 500 fms. Royal Dublin Society.
l, m. 45 miles off Blackrock, 500 fms. Royal Irish Academy.
n. A dried fragment, marked "type of *Calveria hystrix*." 'Porcupine' Exp.
o. Two dried fragments, marked "Sp. 1, fenestrated." 'Porcupine' Exp.

2. PHORMOSOMA.

Phormosoma, *Wyv. Thoms. Phil. Trans.* clxiv. (1874) p. 732; *Duncan, J. L. S.* xxiii. (1889) pp. 42 & 310; *Bell, Ann. & Mag.* iv. (1889) p. 437.

An Echinothurid in which the coronal plates imbricate slightly, and the ambulacral plates are narrow; the areolæ of the tubercles that bear the primary spines are deeply sunken, and their impress may be seen on the internal surface of the test. The calcareous deposit in the coronal plates is greater than in *Asthenosoma*, and there are no vertical muscular bands dividing the cœlom into separate chambers. The organs of Stewart are not known to be ever well developed.

1. Phormosoma placenta.

Phormosoma placenta, *Wyv. Thoms. Phil. Trans.* clxiv. (1874) p. 732, pls. lxii. & lxiii. figs. 1-8; *A. Ag. Bull. M. C. Z.* x. (1883) p. 301, pls. xii. & xv. figs. 3-19; *id. Proc. Roy. Soc. Ed.* xi. (1883) p. 697; *Rathbun, Proc. U. S. Nat. Mus.* ix. (1886) p. 267; *Bell, Ann. & Mag.* iv. (1889) p. 436.
 Phormosoma sigsbei, *A. Ag. Bull. M. C. Z.* viii. (1880) p. 75.

A species with very large primary tubercles, which are more numerous developed on the oral than the aboral surface; they have well marked areolæ, and from what is known as to their spines it is probable that they are rather long and have a stout calcareous cap: these tubercles are both ambulacral and interambulacral in position. There are but few other tubercles on the surface above the ambitus, but below, and especially near the mouth, there are a number of tubercles, which are also developed on the transversely elongated peristomial plates. Organs of Stewart vestigial.

Colour deep purple below, grey above, with spots and patches of purple.

Diam. of test.	Diam. of mouth.	Diam. of calyc. area.
125	36	20
110	34	18
100	32	18
95	24.5	15.5
80	21	14.5

Distribution. Both sides of Atlantic, as far south as the Lesser

Antilles, and as far north as the Faeroe Channel. From 150–1242 fms.

- a-e.* Off S.W. coast of Ireland, 1000 fms. 'Flying Fox' Exp.
f. Off S.W. coast of Ireland, 500 fms. Royal Dublin Soc.
g. Three fragments, marked "*Calveria Phormosoma*. Types of Porcupine."

2. *Phormosoma uranus*.

Phormosoma uranus, *Wyv. Thoms. Voyage of 'Challenger' (The Atlantic)* (1877), i. p. 146, figs. 33 & 34; *A. Ag. Chall. Rep.* (1881) p. 103, pl. xviii. c. fig. 12; *id. Mem. Mus. C. Z. x.* (1883) p. 35, pls. x. & xi.; *id. Proc. Roy. Soc. Ed.* xi. (1883) p. 697; *Rathbun, Proc. U.S. Nat. Mus.* ix. (1886) p. 268; *Sladen, Proc. R. Irish Acad.* i. (1891) p. 701.

Phormosoma petersii, *A. Ag. Bull. Mus. C. Z.* viii. (1880) p. 76.

Test very thin; large primary tubercles not greatly developed till a late period of growth, and then "not closely packed but irregularly arranged" and limited to region near the ambitus. When collected of a brilliant claret colour.

Distribution. Both sides of Atlantic from Lesser Antilles to Faeroe Channel. 399–1742 fms.

A specimen dredged by H.M.S. 'Knight Errant' from 555 fms., N.W. of Lewis, was referred to this species by Prof. Agassiz.

ECHINIDÆ (see p. 30).

Key to the Genera of Echinidæ.

- | | |
|--|--------------------------|
| A. Three pairs of pores in an arc..... | 1. ECHINUS, p. 145. |
| B. More than three pairs of pores in an arc. | [p. 155. |
| i. With moderate gill-cuts | 2. STRONGYLOCENTROTUS, |
| ii. With deep gill-cuts | 3. SPHÆRECHINUS, p. 158. |

1. ECHINUS.

Echinus, *Linn. Syst. Nat.* ed. x. (1758) p. 663 (pars); *Ag. in Val. Anat. Echin.* (1841) p. ii; *Desor, Syn. Ech. foss.* (1858) p. 123; *A. Ag. Rev. Ech.* (1872) pp. 121, 293; *Carus, Prod. Faun. Med.* (1884) p. 100; *Dunc. J. Linn. Soc.* xxiii. (1889) p. 126.

Heliocidaris (pars), *Desml. cf. Ag. & Des. Ann. Sci. Nat.* (2) vi. p. 371.

Sphærechinus (pars), *Duj. & Hupé, Echinod.* (1862) p. 529.

Psammechinus, *Ag. et Des. t. c.* p. 368 (subg.); *Desor, Syn. Ech. foss.* (1858) p. 118; *Lütken, Vid. Medd.* 1863 (1864), p. 140.

Test varies greatly in size and shape, often swollen at ambitus; ambulacra rather narrow, arcs of pores more or less vertical; primary tubercles subequal in all parts of the test, more closely packed below than above the ambitus. Peristome moderate or small, slits slight; membrane sometimes covered by secondary calcareous plates in addition to the five pairs of small radial plates. Spines never long, acutely pointed, sometimes quite sharp.

Key to the Species.

- A. Primary spines very much longer than secondary.
 I. Mouth of moderate size.
 a. No red patches near periproct 1. *E. acutus*.
 β. Red patches near periproct 2. *E. norvegicus*.
 II. Mouth very small 3. *E. microstoma*.
 B. Primary spines short.
 a. With purple tips 4. *E. miliaris*.
 β. With tips not purple 5. *E. esculentus*.
 C. Primary spines moderate 6. *E. elegans*.

1. *Echinus acutus*.

- Echinus acutus*, Lamk. *An. s. Vert.* iii. (1816) p. 45; *de Bl. Dict. Sci. Nat.* xxxvii. (1825) p. 78; *Desmoulins, Syn. Ech.* (1837) p. 270; *Ag. & Desor, Ann. Sci. Nat.* vi. (1846) p. 365; *Aradas, Atti Ac. Gioenia*, viii. (1853) p. 276; *A. Ag. Rev. Ech.* (1872) p. 121, & (1873) p. 489; *Ludwig, Mitth. zool. Stat. Neap.* i. (1879) p. 558; *Koehler, Ann. Mus. Marseille*, i. 3. (1883) p. 121; *Carus, Prod. Faun. Mediterr.* (1884) p. 100; *Bell, Ann. & Mag.* iv. (1889) p. 439; *Prouho, C. R.* cii. (1886) p. 444.
Echinus miliaris, *Flem. Mem. Wern. Soc.* ii. (1818) p. 246; *Brit. Anim.* (1828) p. 478 [non auctt.].
Echinus flemingii, *Forbes, Brit. Starf.* (1841) p. 164; *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 266; *Ag. & Desor, Ann. Sci. Nat.* vi. (1846) p. 365; *Gray, Brit. Rad.* (1848) p. 3; *Sars, Nyt Mag.* x. (1859) p. 55; *Grube, Insel Lussin*, (1864) p. 101; *Wyp. Thomson, Phil. Trans.* clxiv. (1874) p. 744, pl. 68, fig. 14.

Primary spines much larger and longer than secondary, more or less pointed at their tip; pale yellow in colour, but rather darker at the base; shorter, blunter, and more closely packed below than above the ambitus. Secondary spines much more numerous, much shorter and finer than the primary; the smallest exceedingly fine. Pedicellariæ very numerous, of various sizes, as much as 3 mm. in length. The spines of the adult are proportionately shorter than those of younger specimens.

Test of full-grown form conical above, almost flat below, small mouth, moderately sized apical area; neither primary nor secondary tubercles are very numerous above the ambitus; below, however, the plates are well covered. Apical area pentangular; periproct rather large, all the radials shut off from it; the madreporite is not prominent, and the tubercles on the interradials are rather small. In the interambulacra there about fifty plates, each of which may, above the ambitus, carry one large primary tubercle; this may be very prominent or less well marked or absent; below the ambitus there are three or four subequal primary tubercles, and these diminish in size and number as the mouth is approached. The number of secondary tubercles is not large, and the miliaries are not closely packed. The number of compound ambulacral plates may be nearly fifty; each of these has a large primary tubercle set about the middle of each plate, but the ambulacral present the same kind of variations as the interambulacral tubercles; above the ambitus secondary tubercles are very rare, so that in both ambulacral and interambulacral areas the middle line is almost

completely bare. Below the ambitus the secondary tubercles are more numerous, and the miliaries are very well developed. The peristome is pentagonal and the gill-cuts slight. A bright red line extends along the twenty lines of the primary tubercles above the ambitus and give a very characteristic appearance to the test.

A very considerable amount of variation is exhibited by:—

(a) The form of the test. This is always much flatter in younger than older specimens, but the former vary in the extent to which they are respectively conical; the latter are sometimes more rounded than is typically the case, and the sharpness of the apical pole is sometimes a good deal blunted.

(b) The length of the spines. The younger examples usually have the spines proportionately longer than the adult, but the latter vary very considerably among themselves. When the spines are short, they are sometimes more than ordinarily stout.

(c) In many cases the bases of the spines are green, but they are sometimes red.

Diam. of test.	Height.	Diameter of			Longest spine.
		Peristome.	Calyc. area.	Periproct.	
115	66	27	.	.	29
115	60	27	20·5	9	36
110	78	24·5	18·5	9	.
50	30	18·5	12	5·5	.
50	27	17	.	.	28
42	28	14	.	4·5	26
38	22	12	10	4·5	24
30	12·5	10	..	.	21
23	11	9	.	.	21

Distribution. Atlantic from Norway and Halifax to Ascension; North Sea; Mediterranean; off Kermadec Island. To 1350 fms.

a. Off Tenby.	Prof. W. N. Parker.
b-d. S.W. Ireland.	
e-m. S.W. Ireland, 55 fms.	'Flying Fox' Exp.
n. S.W. Ireland, 110 fms.	'Flying Fox' Exp.
o. S.W. Ireland, 150 fms.	'Flying Fox' Exp.
p. Galway Bay.	Royal Dublin Soc.
q. 20 miles off Achill Head, 20 fms.	Royal Dublin Soc.
s-u. Falmouth.	W. P. Cocks, Esq.
v-z. { Weymouth.	
a'-c'. {	
d'. Tynemouth.	

2. *Echinus norvegicus*.

Echinus norvegicus, *Diib. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 268, pl. ix. figs. 33-39; *Sars, Norg. Ech.* (1861) p. 94; *A. Ag. Rev. Ech.* (1872) pp. 125 & 296, pl. vi a. fig. 4; *Wyv. Thoms. Phil. Trans.* clxiv. (1874) p. 744; *Möb. & Bütschli, JB. Comm. Kiel*, ii. & iii. (1875) p. 149; *A. Ag. Chall. Rep. Ech.* (1880) p. 117; *id. Bull. Mus. C. Z.* viii. (1880) p. 77.

Echinus (*Psammechinus*) *norvegicus*, *Ag. & Desor, Ann. Sci. Nat.* vi. (1846) p. 368.

Psammechinus norvegicus, *Duj. & Hup. Echin.* (1862) p. 526.

Echinus flemingii, *A. Ag. Bull. Mus. C. Z.* i. (1862) p. 262.

Echinus depressus, *G. O. Sars, Vid.-Selsk. Forh.* 1871 (1872), p. 23.

Echinus elegans, *Bell, Journ. Linn. Soc.* xvii. (1884) p. 102*.

All the specimens in the Collection known to come from the British area belong to the small form of this species, which it will be sufficient to describe in detail.

The test is conspicuous by a reddish, much more rarely greenish, patch in the middle of each ambulacral and interambulacral area. In the latter the patch may be wide and extend to the ambitus; in the former it may be wedge-shaped. In many dried tests the latter and in some the former also may completely fade away. The test is more or less depressed or conical, flat beneath, with rather large peristome, calycinal area and periproct, all of which are or may be juvenile characters, but are in this case found in a form which has been shown to have matured gonads.

Primary spines white, sometimes red at base, often rather long and delicate, nearly the diameter of the test, not very numerous, sometimes a good deal shorter and then rather stouter and yellower or greenish in hue. A moderate number of well-developed smaller spines, most numerous below the ambitus. Pedicellariæ pretty numerous, some with the three valves very thick at their base, though not so fleshy as in *E. microstoma*.

Ten or eleven plates in each row of the interambulacra, with a single, central, large primary tubercle; below the ambitus the secondaries are pretty numerous, above it they are much more sparse. The interambulacra are wide owing to the width of the poriferous zones; these are the most noticeable when there is an intermediate reddish wedge-shaped patch above the ambitus, above which the large primaries are not developed, and only a few scattered secondaries are to be found. The size and number of the tubercles is, however, subject to some considerable variation.

The calycinal area is often remarkably prominent, either because of the coloration of the area or the raising up of its constituent plates; the radials are all shut out from the periproct, the inter-radials are rather large, and there are three or four granules along the inner edge; the number of granules on the interradials is inconstant. The peristome is large and nearly circular, its membrane is remarkable for the large quantity, small amount, or absence of calcareous plates.

Diam. of test.	Height of test.	Diameter of		
		Peristome.	Calyc. area.	Periproct.
15	6.5	5.5	5.5	2.5
15	8	5	5.7	2.7
14	7	5.2	.	..
12	7	5	4.8	2
10	5.25	4.3	4	2
10	4.75	3.25	3.75	2

* *Echinus rarispina* of Thomson (*Phil. Trans.* clxiv. p. 744) and of Hoyle (*Proc. R. Phys. Soc.* Ed. x. p. 417) are references to a MSS. species of Sars.

The longest primary spines of specimens of this size vary from 8.4 to 4 mm.

Distribution. Both sides of North Atlantic, from Norway to Valentia, and Halifax, U.S., to Florida; off Japan; off Patagonia. Littoral to 2435 fms.

a. Zetland. R. M'Andrew, Esq.
b-k. 52° 25' N., 11° 40' W., 80-110 fms. 'Porcupine' Exp.
l, m. 50° 29' 26" N., 11° 4° W., 400 fms. G. C. Bourne, Esq.

3. *Echinus microstoma.* (Plate XIV. figs. 1 & 2.)

Echinus microstoma, *Wyv. Thoms. Phil. Trans.* clxiv. (1874) p. 744, pl. lxxviii, figs. 1-10; *Norman, Ann. & Mag.* vi. (1880) p. 435; *Bell, Ann. & Mag.* iv. (1889) p. 440, pl. xix, fig. 1.

Primary spines not numerous, of moderate length, fairly stout, taper very gradually or end bluntly; white, straw-coloured, or crimson; shorter, blunter, and more closely packed above than below the ambitus; rather finely striated. Secondary spines very fine and rather sparse above the ambitus, below which they are stouter and more numerous. Pedicellariæ not abundant.

Test very thin, somewhat flattened above, tumid below; small peristome, a little depressed; calycinal area of moderate size; both primary and secondary tubercles rather rare above the ambitus, but much more numerous below. Calycinal area with rather large periproct, from which all the radials are shut off; madreporite not very prominent; the tubercles on the interradials are confined to the inner half, where they are closely packed. In the interambulacra there are about twenty plates, each with a prominent central primary tubercle; these diminish in size more markedly as they approach the peristome than the periproct, above the ambitus they are surrounded by a few secondary and miliary tubercles, which are more numerous and definitely arranged below it. There are rather less than thirty compound pore-plates; these bear distinct primary tubercles at and below the ambitus only; above it only an occasional plate here and there carries a largish tubercle. The number of smaller tubercles is also scanty above, and not very large below the ambitus. The peristome is small and depressed, and the gill-cuts are not well marked. The surface of the test is a brilliant brick- or salmon-red, with which a little yellow is sometimes combined.

The bright-red colour, the thin test, and the proportionately small peristome easily distinguish this species, which is very common in deep water. Its range of variation does not seem to be as marked as that of some other members of the genus.

Diam. of test.	Height.	Peristome.	Periproct.
68	34	.	14
50	25	12	5
47	20	13	5
43	19.5	11.5	5
40	21	10.5	4.5

The spines vary somewhat, but a length of about 12 mm. is probably common among the primary spines of average-sized examples.

Distribution. Bay of Biscay, West coasts of Ireland and Scotland.

<i>a-c.</i> 28 miles W., $\frac{1}{2}$ S. of Dursley Head, 108 fms.	Royal Irish Academy.
<i>d-f.</i> 45 miles of Blackrock, 500 fms.	Royal Dublin Soc.
<i>g-j.</i> S.W. coast of Ireland, 110 fms.	'Flying Fox' Exp.
<i>k-p.</i> S.W. coast of Ireland, 180 fms.	'Flying Fox' Exp.
<i>q.</i> S.W. coast of Ireland, 500 fms.	'Flying Fox' Exp.

4. *Echinus miliaris.*

Echinus miliaris *, *L., Gmel. Syst. Nat.* xiii. (1778) p. 3169; *Lamk. An. s. Vert.* iii. (1816) p. 49; *de Bl. Dict. Sci. Nat.* xxxvii. (1825) p. 80; *Desmoul. Etudes* (1837) p. 272; *Ag. in Val. Anat. Echin.* (1841) p. vi; *Forbes, Brit. Starf.* (1841) p. 161; *Gray, Brit. Rad.* (1848) p. 3; *Maitland, Faun. Belg.* (1851) p. 94; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 441; *Sars, Norg. Ech.* (1861) p. 94; *A. Ag. Rev. Ech.* (1872-74) pp. 125 & 495; *Möb. & Bütschli, JB. Comm. Kiel*, ii. & iii. (1875) p. 149.

Echinus (Psammechinus) miliaris, Ag. & Desor, An. Sci. Nat. vi. (1846) p. 368.

Psammechinus miliaris, Desor, Syn. Ech. foss. (1855) p. 119, pl. xviii. fig. 5; *Duj. & Hup. Ech.* (1862) p. 526; *Perr. Ann. Sci. Nat.* xiii. (1870) p. 41; *Fischer, Act. Soc. Linn. Bordeaux*, xxviii. (1869) p. 370; *Barr. Cat. Crust.* (1882) p. 44.

Echinus saxatilis, O. F. Müll. Zool. Dan. Prod. (1776) p. 235 (non *Linn., nec Fabr.*).

Cidaris saxatilis, Leske, Addit. (1778) p. 18.

Echinus pustulatus, Ag. in Val. Anat. Ech. (1841) p. vi.

Psammechinus pustulatus, Duj. & Hup. Echin. (1862) p. 527.

Echinus virens, Düb. & Kor. Vet.-Akad. Hdlg. 1844 (1846), p. 274, pl. x. figs. 43-45.

Echinus (Psammechinus) koreni, Ag. & Desor, Ann. Sci. Nat. vi. (1846) p. 368.

Primary spines rather short, longest at the ambitus, pretty numerous, slightly tapering, finely ribbed, and often purple at the tip. A considerable number of secondary spines, similar to but smaller than the primary.

Test stout, with a quantity of tubercles, markedly pentangular, but more so in adults than young, more or less depressed above, never at all high; peristome rather large, pentagonal in adult, its membrane armed with a number of small scales. Calycinal area moderate, all the radials excluded from the rather large periproct; the pores in both radials and interradials well marked; madreporite sometimes a good deal swollen.

In the interambulacra there are about twenty plates, each of which, both below and above the ambitus, carries a distinct primary

* The references by A. Agassiz (*Rev. Ech.* p. 125) to "Müll. 1771, Knorr, Del.," and by Hoyle (*Proc. R. Phys. Soc. Ed.* x. p. 417), "P. L. S. Müller in Knorr, *Delic. Nat. Select. pl. D*" [for which read *D. ii. 5, p. 108*], appear to be to a *nomen nudum*.

tubercle, and the rows formed by them are quite well marked. At the ambitus there are on the outer side of this primary tubercle two or three secondary tubercles, and on the inner side one or two; these disappear very regularly as either pole is approached; there may be two rows of these secondary tubercles on each plate, or the second row may be replaced by one made up of a larger number of miliaries; with these, at any rate, the rest of each plate is closely packed.

On the ambulacral plates, of which there are about thirty in each row, a prominent primary tubercle is also to be noticed; this is placed just inside the rather wide poriferous zone; between the two rows are a number of secondary and miliary tubercles, but they are not so closely packed as in the interambulacral area; a few miliaries are scattered over the poriferous zone. The distribution of tubercles on the calycinal plates is not constant, but it frequently happens that the interradials have three or four largish tubercles on the edge nearest the periproct.

Colour: the tips of the spines may be light or pinkish, but are more frequently purple; the test, when dry, may be dark grey-brown with pink bands, or have a more general pinkish or reddish hue.

On the whole this is perhaps the species of *Echinus* which presents less striking variations than any other found in our seas; even the differences due to age are slighter than is often the case.

Diam. of test.	Height.	Diameter of			Longest spine.
		Peristome.	Calyc. area.	Periproct.	
34	17	13	8.5	4.5	..
27	13	11.5	7	3.5	..
19	10	8	5.5	3	7.5
16	9	8	4	2	

Distribution. The species extends northwards to Iceland and southwards into the Mediterranean; North Sea. To 45 fms.

<i>a-c.</i> Between Loch Reraig and Plocton, 8-24 fms., 21/9/91.	John Murray, Esq.
<i>d-f.</i> Loch Goil, 45 fms. (February).	John Murray, Esq.
<i>g.</i> Kilbrennan Sound, 10-20 fms. (March).	John Murray, Esq.
<i>h.</i> Whiting Bay, Arran.	Rev. D. Lansborough.
<i>i.</i> Kenmare River (July 1889).	
<i>j-n.</i> Lough Hoyle (July 1889).	
<i>o.</i> Ballywater.	Belfast Nat. Hist. & Phil. Soc.
<i>p.</i> Strangford Lough, 5 fms., 8/9/51.	Belfast Nat. Hist. & Phil. Soc.
<i>q-s.</i> Isle of Man.	Prof. E. Forbes.
<i>t-v.</i> Off Liverpool.	
<i>w, x.</i> Low water near Tenby (March 1889).	
<i>y, z.</i> Falmouth.	W. P. Cocks, Esq.
<i>a'</i> Plymouth.	
<i>b', c'.</i> Plymouth.	
<i>d'-f'</i> Weymouth (October).	Edgar A. Smith, Esq.

<i>g', h'</i> . St. Leonards (August).	R. I. Pocock, Esq.
<i>i', j'</i> . Lobster Patch, Poole, 5½ fms., July 1889.	F. J. B. Beckford, Esq.
<i>k', l'</i> , S. England.	B. B. Woodward, Esq.
<i>m'-s'</i> . Firth of Forth.	R. McAndrew, Esq.
<i>t'</i> . Zetland.	

5. *Echinus esculentus*.

Echinus esculentus, *Linn. Syst. Nat.* x. (1758) p. 663; *id. Faun. Suec.* ed. ii. (1761) p. 513, no. 2116; *id. M. L. U.* (1764) p. 705; *id. Syst. Nat.* xii. (1766) p. 1102; *Penn. Brit. Zool.* (1777) iv. p. 57, pl. 34; *id. op. cit.* (1812) iv. p. 137, pl. xxxvi.; *Flem. Brit. An.* (1828) p. 478; *Desm. Syn. Ech.* (1837) p. 278; *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 264; *Ag. & Desor, Ann. Sci. Nat.* vi. (1846) p. 365; *Gray, Brit. Rad.* (1848) p. 3; *Lütke. Vid. Medd.* 1856, p. 72; *id. op. cit.* 1871, p. 306; *Sars, Norg. Ech.* (1861) p. 93; *Jarzynsky, Trans. Petersb. Soc. Nat.* i. (1870) p. 319; *Al. Ag. Rev. Ech.* (1872) pp. 122, 491, pl. vii. a. fig. 7; *Wyv. Thoms. Phil. Trans.* clxiv. (1874) p. 744; *Möb. & Bütsch. JB. Comm. Kiel*, ii. & iii. (1875) p. 149; *Bell, J. L. S.* xvii. (1883) p. 103; *Herdman, Liverp. M. B. C.* i. (1886) p. 136; *Scott, Ann. Scot. Nat. Hist.* i. (1892) p. 49.

Sphærechinus esculentus, *Duj. & Hup. Echin.* (1862) p. 529; *Perr. Ann. Sci. Nat.* xii. (1870) p. 151.

Echinus sphaera, *O. F. Müll. Zool. Dan. Prod.* p. 235, no. 2845; *Nilsson, Coll. Zool. Scan.* (1817) p. 4; *Forbes, Brit. Starf.* (1841) p. 149; *Ag. in Val. Anat. Echin.* (1841) p. ii; *Maitland, Faun. Belg.* (1851) p. 93; *Gosse, Tenby*, (1856) p. 240, pls. xii. & xiii.; *Thompson, Nat. Hist. Irel.* (1856) iv. p. 441; *Stewart, Tr. L. S.* xxv. (1866) pl. 1. fig. 2 a; *Romanes & Ewart, Phil. Trans.* clxxii. (1881) p. 831 (general physiology); *Geddes & Beddard, Tr. R. Soc. Ed.* xxx. (1883) p. 383, pls. xix.-xxi. (pedicellariæ).

Echinus globiformis, *Lamk. An. s. Vert.* iii. (1816) p. 44; *de Bl. Dict. Sci. Nat.* xxxvii. (1825) p. 79; *Desm. Etud.* (1837) p. 270.

Echinus subangulosus, *de Bl. t. c.* p. 78; *Desm. t. c.* p. 270.

Echinus pseudomelo, *de Bl. t. c.* p. 77; *Desm. t. c.* p. 270.

Echinus aurantiacus, *de Bl. t. c.* p. 79; *Desm. t. c.* p. 272.

Echinus quinqueangulatus, *de Bl. t. c.* p. 79; *Desm. t. c.* p. 270.

Echinus violaceus, *de Bl. t. c.* p. 80; *Desm. t. c.* p. 272.

Primary spines numerous, short, not sharply pointed; whitish or pinkish in colour, often violet at the tip or for their whole extent; longest at the ambitus. So closely packed are they that the secondary spines are with difficulty detected; these are fine and short. Pedicellariæ very numerous, of various sizes, but not so large as in *E. acutus*. Spines not much shorter proportionately in old than young specimens, sometimes not at all so.

Test of adult well rounded, often not flattened in any way, except of course on the oral surface, and there not abruptly, but sometimes quite pentagonal, occasionally subconical, sometimes rather depressed; mouth of moderate size, apical area not large, madreporite rather prominent. Large numbers of primary tubercles, which are larger at and below than above the ambitus. Apical area irregularly pentagonal; periproct not large, all the radials generally,

but not always, shut off from it ; three large tubercles often on inner edge of each interradial. In the interambulacra there may be as many as seventy plates, and on these a tendency may sometimes be observed to carry alternately one and two large primary tubercles ; there is typically a regular row of primary tubercles from pole to pole fringing the poriferous zone, but with increase of size several of them may become absorbed. The tubercles are rather larger and more closely packed below than above the ambitus ; there are a moderate number of secondary and miliary tubercles. The number of compound ambulacral plates is about thirty, and they are covered by a number of primary tubercles, of which there may be as many as six in a rather irregular row ; there may be two irregular rows, and the irregularity may be further increased by absorption of some of the tubercles. No median bare space in either ambulacra or interambulacra, except in rare cases. Peristome rounded or pentagonal, the membrane closely covered with plates bearing fine spines ; near the mouth the spines are much stouter, and a large number of pedicellariæ are scattered among them.

Distribution. East side of North Atlantic, North Sea, Mediterranean ; Port Natal and John Adams Bank (Brazil). To 110 fms.

<i>a.</i> Loch Etive, 15-20 fms.	John Murray, Esq.
<i>b.</i> Tobermory, 30 fms.	John Murray, Esq.
<i>c.</i> 4 miles S.E. of Sanda, 30-38 fms.	John Murray, Esq.
<i>d, e.</i> Between Sanda and Ailsa Craig, 24 fms.	John Murray, Esq.
<i>f-h.</i> Kilbrennan Sound, 10-20 fms.	John Murray, Esq.
<i>i, j.</i> Loch Fyne, 80 fms.	John Murray, Esq.
<i>k, l.</i> Between Great Cumbrae and Wemyss Ground.	John Murray, Esq.
<i>m.</i> West coast of Scotland.	
<i>n.</i> Belfast Bay, 20 fms.	Belfast Nat. Hist. & Phil. Soc.
<i>o.</i> S.W. coast of Ireland, 50-60 fms.	
<i>p.</i> S.W. coast of Ireland, 110 fms.	
<i>q-t.</i> ? Galway Bay.	Royal Dublin Soc.
<i>u.</i> Turbary, S. Ireland.	Dr. Grenfell.
<i>v, w.</i> Off Liverpool.	
<i>x.</i> Fishing-ground off Lundy.	
<i>y.</i> Off Tenby.	
<i>z.</i> Off Tenby.	Dr. Bowerbank.
<i>a'.</i> Ilfracombe.	Dr. Gray.
<i>b'.</i> Polperro.	
<i>c'.</i> Falmouth.	W. P. Cocks, Esq.
<i>d'.</i> Plymouth.	C. Stewart, Esq.
<i>e'-h'.</i> Plymouth.	
<i>i', j'.</i> Poole, 2½ fms., July 1889.	F. J. B. Beckford, Esq.
<i>k'.</i> Outside Portland Breakwater.	Rev. S. O. Ridley.
<i>l'.</i> Herm.	T. H. Powell, Esq.
<i>m'-p'.</i> Fern Islands.	W. Thorburn, Esq.
<i>q'-s'.</i> Firth of Forth.	Dr. Leach.
<i>t'.</i> Firth of Forth.	E. Forbes, Esq.
<i>u'-j'.</i> Montrose.	W. Duncan, Esq.
<i>k'-m'.</i> Cromarty and Moray Firths.	Dr. A. Sutherland.
<i>n'-w'.</i> Moussa, Shetland.	E. M. Nelson, Esq.

x'. English Channel.
y'. British Seas.
z'-*d*³. British Seas.

Miss Buckland.
 Coll. Mantell.

6. *Echinus elegans*. (Plate XIV. figs. 3 & 4.)

Echinus elegans, *Düb. & Kor. Vet.-Ak. Hdlg.* 1844 (1846), p. 272, pl. x. figs. 40-42; *Ag. & Desor, Ann. Sci. Nat.* vi. (1846) p. 365; *Sars, Norg. Ech.* (1861) p. 94; *Duj. & Hupé, Hist. Nat. Ech.* (1862) p. 524; *A. Ag. Rev. Ech.* (1872-3) pp. 122 & 491, pl. vii. a. fig. 4; *Wyv. Thoms. Phil. Trans.* clxiv. (1874) p. 744, pl. lxxviii. figs. 11-13; *Al. Ag. Bull. Mus. C. Z.* viii. (1880) p. 77; *id. Chall. Rep.* (1881) p. 115.

Test rather stout and rather high, sloping somewhat rapidly from apex to ambitus, flattened below. Primary spines of moderate length, often with the appearance of being broken at their tips, much shorter below than above the ambitus, red in colour, except at the tip which is white; below the ambitus as much as or more than half the length of the spine may be white. Secondary spines of the same colour, numerous, rather delicate. Pedicellariæ numerous, large, valves as much as 2.5 mm. long. Spines proportionately much longer in young than old forms.

Peristome moderate, calycinal area not large, but madreporite very large and conspicuous. Primary tubercles more widely separated above than below the ambitus, and the secondaries much more numerous below than above it.

In both ambulacral and interambulacral areas there is a conspicuous median space devoid of all but small tubercles and bearing only small spines. About twenty-five plates in each interambulacral row; the primary tubercle which occupies its centre is very conspicuous, has a wide spreading base, and stands well up; there are only a few secondary tubercles on these plates. The primary tubercles on the interambulacral plates diminish more rapidly in size towards the calycinal than the peristomial area; at the ambitus they are quite prominent.

All the radial plates are shut out from the periproct; there may be one, two, or three largish tubercles on the inner border of each interradial plate.

Colour: the denuded test has a pinkish hue, of not so deep a red as in *E. microstoma*, and not so patchy as in *E. norvegicus*.

Diam. of test.	Height of test.	Diameter of			Longest spine.
		Peristome.	Calyc. area.	Periproct.	
19	8.5	7.75	5.5	3	
19	9	7.5	6	2.5	..
15	8	5.5		2	12
12.5	5.5	6	..	2	11
9	4	3.75	3	1.5	10
8.5	4		2.75	1.5	..

In drawing up this diagnosis much use has been necessarily

made of a well-grown specimen from Hardangerfjord, as the Collection contains but few specimens and all small. According to Sars this species is very rare. It has been sometimes thought to be a variety of *E. norvegicus*; with the small number at my disposal I am quite able to see the points of difference.

Distribution. Both sides of Atlantic; Mediterranean; Admiralty Islands. Down to 1350 fms.

<i>a-d.</i> St. 47 <i>a</i> *	'Porcupine Exp.,' 1868.
<i>e-h.</i> S.W. Ireland, 250 fms.	'Flying Fox' Exp.
<i>i, j.</i> 54 miles off Achill Head, 500 fms.	Royal Dublin Society.
<i>k, l.</i> 45 miles off Blackrock, 500 fms.	Royal Dublin Society.

Echinus melo, Lamk.

I cannot inscribe this species in the list of British specimens on the present record; Forbes (Rep. Brit. Assoc. 1850 (1851), p. 123) speaks of an *Echinus* which "appears to be identical with the *Echinus melo* of the Mediterranean," as having been found by Mr. Peach on the coast of Cornwall. In his 'Revision' Prof. Alex. Agassiz makes no reference to this, but in the Proc. Roy. Soc. Edinb. xi. (1882), p. 697, he reports *E. melo* from off North Rona, after saying "there is nothing new."

2. STRONGYLOCENTROTUS.

Echinus (pars), O. F. Müller, *Prod. Zool. Dan.* (1776) p. 235; *Molina, Stor. nat. Chili*, (1782) p. 348.

Echinus (*Toxopneustes*) (pars), *Ag. & Des. Ann. Sci. Nat.* vi. (1846) p. 367.

Strongylocentrotus, *Brandt, Prodr. descr. Anim.* (1835) p. 63; *Gray, Proc. Zool. Soc.* 1855, p. 37; *A. Agass. Rev. Ech.* (1872) pp. 161 & 276; *Carus, Prod. Faun. Med.* (1884) p. 99; *Duncan, J. Linn. Soc.* xxiii. (1889) p. 121.

Heliocidaris (pars), *Ag. & Des. Ann. Sci. Nat.* vi. (1846) p. 371.

Echinometra, *Gray, Brit. Rad.* (1848) p. 4.

Loxechinus, *Desor, Syn. Ech. foss.* (1858) p. 136.

Psammechinus (pars), *Duj. & Hup. Ech.* (1862) p. 525.

Sphærechinus (pars), *iid. t. c.* p. 529.

Anthocidaris, *Lütke. Vid. Medd.* 1863 (1864), p. 164.

Euryechinus, *Verrill, Proc. Bost. Soc. Nat. Hist.* x. (1866) p. 341.

An echinine Echinid in which the secondary plates are formed of more than three primary plates. Test circular or subpentagonal; gill-slits well marked.

Key to the Species.

Primary spines hardly larger than secondaries .	1. <i>S. droebachiensis</i> .
Primary spines distinctly larger than secondaries.	2. <i>S. lividus</i> .

* No Station "47 *a*" is given in the Report of the Voyage published in the Proc. Roy. Soc. 1869-70; Stat. 47 was at 59° 34' N., 7° 18' W., depth 542 fms.

1. *Strongylocentrotus droebachiensis*. (Plate XV. fig. 1.)

- Echinus droebachiensis*, O. F. Müll. *Prodr. Zool. Dan.* (1776) p. 235, no. 2846; L., *Gmel. S. N.* xiii. (1778) p. 3169; *Lützk. Vid. Medd. Kjöbenh.* 1856, p. 91, and 1857, p. 24; C. Stewart, *Tr. L. S.* xxv. (1865) pl. 1. fig. 3; Jarzynsky, *Trans. Petersb. Soc. Nat.* i. (1870) p. 318; Stuxberg, *Cefv. Vet.-Ak. Förh.* 1878, no. 3, p. 29.
- Echinus saxatilis*, Fabr. *Faun. Grænl.* (1780) no. 368; Nilss. *Coll. Zool. Scan.* (1817) p. 9 (non Linn. nec O. F. Müll.).
- Echinus* (*Toxopneustes*) *droebachiensis*, Ag. & Des. *Ann. Sci. Nat.* vi. (1846) p. 367; Sars, *Nyt Mag.* x. (1859) p. 58; *id. Norg. Echin.* (1861) p. 95.
- Toxopneustes droebachiensis*, Duj. & Hupé, *Hist. Nat. Echin.* (1862) p. 532; *Lützk. Vid. Medd.* 1863 (1864), p. 143; *Al. Ag. Proc. Bost. Soc. N. H.* 1863, p. 191; *id. Proc. A. N. S. Philad.* 1863, p. 357; *id. Sea-side Studies*, (1865) p. 101, figs. 131-135, 173-181 (Pluteus); Packard, *Canad. Nat. & Geol.* viii. (1863) p. 405; Wyv. Thoms. *Phil. Trans.* cxiv. (1874) p. 745; Levinsen, *Dijmphna Togt.* (1887) p. 391.
- Echinometra droebachensis*, Gray, *Brit. Rad.* (1848) p. 4.
- Euryechinus droebachiensis*, Verr. *Proc. Bost. Soc. N. H.* 1866, pp. 340 & 352.
- Echinus neglectus*, Lamk. *An. s. Vert.* iii. (1816) p. 49, & iii. (1840) p. 366; Forbes, *Brit. Starf.* (1841) p. 172 (fig.); Düb. & Kor. *Vet.-Ak. Hdlg.* 1844 (1846), p. 277; Maitland, *Faun. Belg.* (1851) p. 93; Forbes in *Sutherl. Voy.* (1852) p. ccxiv.
- Echinus* (*Toxopneustes*) *neglectus*, Ag. & Des. *Ann. Sc. Nat.* vi. (1846) p. 367; Brandt in *Middend. Sibir. Reise*, (1851) ii. 1. p. 34.
- Toxopneustes neglectus*, Desor, *Synops.* (1858) p. 135, pl. xvii. bis figs. 1 & 2.
- Echinus subangularis*, Flem. *Brit. An.* (1828) p. 479 (non Leske).
- Strongylocentrotus chlorocentrotus*, Brandt, *Prod. desc. Anim.* (1835) p. 64.
- Echinus chlorocentrotus*, Stimps. *Bost. J. N. H.* vi. (1857) p. 526.
- Echinus granularis*, Say, *J. A. N. S. Philad.* v. (1827) p. 225 (non Lamk.).
- Echinus granulatus*, Gould, *Inv. Mass.* (1841) p. 344.
- Euryechinus granulatus*, Verrill, *P. Bost. Soc. N. H.* x. (1866) pp. 340 & 352.
- Strongylocentrotus droebachiensis*, A. Ag. *Rev. Ech.* (1872-73) pp. 162, 277, pls. iv. a. figs. 2, 3, 6, pl. vi. fig. 9, pls. ix. & x.; *id. Bull. Mus. C. Z.* viii. p. 76; *id. Mem. Mus. C. Z.* ix. no. 2, pl. x.; Möb. & Bütsch. *JB. Comm. Kiel*, ii. & iii. (1875) p. 149; Marenz. *Denk. Ak. Wien*, xxxv. (1877) pp. 359 & 385; Dunc. & Slad. *Echinod. Arct. Sea*, (1881) p. 19; Bell, *P. Z. S.* 1881, p. 427; *id. in Markham's Polar Reconnaiss.* (1881) p. 346, and *J. Linn. Soc.* xvii. (1883) p. 103; Leslie & Herdm. *Pr. Phys. Soc. Ed.* vi. (1881) p. 93; Hoffmann, *Nied. Arch. Zool., Suppl. Bd.* (1881) p. 14; Murdoch, *Exp. to Port Barrow, Alaska*, (1885) p. 158; Fischer, *Intern. Polarforsch.* iii. (1886) p. 38; Rathbun, *Proc. U. S. Nat. Mus.* ix. (1886) pp. 271 & 275; Ludw. *Zool. Jahrb.* i. (1886) p. 281; Pfeffer, *JB. Hamb.* iii. (1886) p. 49; Stuxberg, *Vega Exped.* v. (1887) p. 155; Whiteaves, *Tr. R. Soc. Canada*, iv. 4. (1887) p. 117; Scott, *Ann. Scott. Nat. Hist.* i. (1892) p. 49.
- Echinus* (*Toxopneustes*) *dubeni*, Ag. *Ann. Sci. Nat.* vi. (1846) p. 368.

- Toxopneustes dubeni*, *Duj. & Hupé, Hist. Nat. Echin.* (1862) p. 532.
Toxopneustes carnosus, *Al. Ag. Proc. A. N. S. Philad.* (1853) p. 357.
Toxopneustes pictus, *Norm. Rep. Brit. Assoc.* 1868 (1869), p. 314.
Toxopneustes pallidus, *G. O. Sars, Forh. Vid.-Selsk. Christ.* 1871, p. 25.
Toxopneustes droebachiensis, *Lovén, Vet.-Akad. Hdlg.* xi. no. 7 (1874) pl. xvii.

Test never large. Primary spines rather short, numerous, rather sharp, white, brick-red, bright red, purple, yellowish green, or green throughout, or with the tip lighter or darker than the rest. Secondary spines numerous, not obscured by the primaries; pedicellariæ numerous.

Test pentagonal in outline, rather depressed; pretty stout, with twenty prominent rows of primary tubercles, large peristome; calycinal area compact, prominent madreporite, moderate periproct.

About fourteen plates in each interambulacral series, those at the ambitus twice as wide as deep, with a single large primary tubercle occupying the middle of the plate; on either side there is a smaller primary tubercle, and on the outer side there are sometimes two, one above the other; these are larger and more definitely arranged below and at than above the ambitus; the rest of the plate is occupied by smaller miliary tubercles. The primaries of the ambulacral plates are somewhat smaller than those of the interambulacral, but the primary tubercle which occupies the middle of each plate is quite distinct; between the two rows are a few miliaries, and in the midst of each arc there is one small tubercle, occasionally there are two, and very rarely there are three.

Distribution. Circumpolar, extending as far south as north coast of France, Massachusetts Bay, Vancouver's Island, Sea of Okhotsk. 0-640 fms.

- | | |
|----------------------------|--------------------|
| a. Shetland. | E. Forbes, Esq. |
| b. Sandwich Bay, Shetland. | E. M. Nelson, Esq. |
| c. Cromarty Frith. | Dr. A. Sutherland. |
| d-x. Montrose. | W. Duncan, Esq. |

2. *Strongylocentrotus lividus*.

- Echinus lividus*, *Lamk. An. s. Vert.* iii. (1816) p. 50; *de Bl. Dict. Sci. Nat.* xxxvii. (1825) p. 88; *Desmoulins, Syn. Ech.* (1837) p. 282; *Forbes, Brit. Starf.* (1841) p. 167; *Valentin. Anat. Echin.* (1841) p. 1; *Cuvier (Masson's ed.)*, pl. 11. figs. 2-4; *J. Müller, Abh. Ak. Berl.* 1850 (1852), p. 49, with numerous figs. of larvæ, as also in *Metschnikoff, Mém. Ac. St. Pétersb.* xiv. (1869) no. 8, pls. vii. & viii.; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 441; *Caillaud, Cat. Rad. Loire Inf.* (1865) p. 21; *John, Arch. f. Nat.* lv. (1889) pp. 299-301; *Fewkes, Amer. Nat.* xxiv. (1890) p. 1.
Echinus lithophagus, *Leach, Tilloch's Phil. Mag.* xxxix. (1812) p. 151; *id. Mem. Wern. Soc.* ii. (1818) p. 647.
Echinus sp., *E. T. Bennett, Trans. Linn. Soc.* xv. (1827) p. 74.
Echinus (Toxopneustes) lividus, *Ag. & Des. Ann. Sci. Nat.* vi. (1846) p. 367.

- Toxopneustes lividus*, *Sars, Nyt Mag.* x. (1859) p. 52; *Bronn, Kl. u. Ordn.* ii (1859) p. 333, and numerous figs.
Euryechinus lividus, *Verr. Proc. Boston Soc. Nat. Hist.* x. (1866) p. 341.
Echinus vulgaris, *de Bl. Dict. Sci. Nat.* xxxvii. (1825) p. 341; *Desmoulins, Syn. Ech.* (1837) p. 278; *Gray, Cat. Brit. Rad.* (1848) p. 4.
Echinus purpureus, *Risso, Eur. Mérid.* v. (1846) p. 277.
Toxopneustes concavus, *Ag. & Des. Ann. Sci. Nat.* vi. (1846) p. 367.
Toxopneustes complanatus, *Ag. & Des. ibid.*
Strongylocentrotus lividus, *A. Ag. Rev. Ech.* (1872) p. 164, & (1873) p. 446; *Gauthier, Compt. Rend.* lxxix. (1874) p. 402; *Koehler, Ann. Mus. Marseille*, i. 3. (1883) p. 123; *Carus, Prod. Faun. Med.* (1884) p. 99; *Korschelt, Zool. Jahrb.* iii. (anat.) (1889) p. 653 (development); *Barrois, Rev. Biol.* i. (1888) p. 75.

Distribution. Atlantic, from British Channel to Canaries; Brazil; Mediterranean. 0-2 fms.

- a.* Ilfracombe.
b-f. Ireland. Earl of Enniskillen.
g-j. Ireland.
k. Cork. J. Humphrey, Esq.
l. Guernsey. R. L. Spencer, Esq.
m. Jersey.

3. SPHÆRECHINUS.

- Echinus* (pars), *Lamk. An. s. Vert.* iii. (1816) p. 38.
Toxopneustes (pars), *Ag. & Des. Ann. Sci. Nat.* vi. (1846) p. 367.
Sphærechinus, *Desor, Syn. Ech. foss.* (1858) p. 134; *A. Ag. Rev. Ech.* (1872) pp. 159 & 451; *Bell, P. Z. S.* 1881, p. 430; *Carus, Prod. Faun. Med.* (1884) p. 100; *Duncan, J. Linn. Soc.* xxiii. (1889) p. 122.

Closely allied to *Strongylocentrotus*, but distinguished by deeper gill-slits, several sets of ossicles on buccal membrane, and widely diverging free ends of radius in Lantern of Aristotle.

1. *Sphærechinus granularis*. (Plate XV figs. 2 & 3.)

- Echinus granularis*, *Lamk. An. s. Vert.* iii. (1816) p. 44.
Echinus (*Toxopneustes*) *granularis*, *Ag. & Des. Ann. Sci. Nat.* vi. (1846) p. 367.
Sphærechinus granularis, *A. Ag. Bull. M. C. Z.* i. (1863) p. 23; *Lütke, Vid. Medd.* 1863 (1864), p. 143; *Fischer, Actes Soc. Linn. Bordeaux*, xxvii. (1869) p. 368; *A. Ag. Rev. Ech.* (1872) p. 159, & (1873) p. 452; *Ludwig, Mitth. zool. Stat. Neap.* i. (1879) p. 557; *Koehler, Ann. Mus. Marseille*, i. 3. (1883) p. 125; *Carus, Prod. Faun. Mediter.* (1884) p. 100; *Barrois, Rev. Biol.* i. (1889) p. 109.
Echinus brevispinosus, *Risso, Eur. Mérid.* v. (1826) p. 277.
Echinus (*Toxopneustes*) *brevispinosus*, *Ag. & Des. Ann. Sci. Nat.* vi. (1846) p. 367; *Sars, Nyt Mag.* x. (1859) p. 56.
Toxopneustes brevispinosus, *Bronn, Kl. u. Ordn.* ii. (1860) p. 337; *Dohrn, Zeits. f. wiss. Zool.* xxxv. (1875) p. 471 [mode of feeding].

- Sphærechinus brevispinosus, *Desor, Syn. Ech. foss.* (1858) p. 134.
 Echinus esculentus, *de Bl. Dict. Sci. Nat.* xxxvii. (1825) p. 86.
 Sphærechinus esculentus, *Bronn, Kl. u. Ordñ.* ii. (1860) pl. xxxvii.
 figs. 1-3 & 5-14, pl. xxxix. figs. 6 & 8.
 Echinus equituberculatus, *de Bl. Dict. Sci. Nat.* xxxvii. (1825) p. 86
 (not p. 76).
 Echinus æquituberculatus, *Desmoulins, Syn. Echin.* (1837) p. 280.
 Echinus subglobiformis, *de Bl. Dict. Sci. Nat.* xxxvii. (1825) p. 89;
Desmoulins, Syn. Ech. (1837) p. 282.
 Echinus dubius, *de Bl. op. cit.* p. 87; *Desm. op. cit.* p. 280.
 Echinus (*Toxopneustes*) albidus, *Ag. & Des. Ann. Sci. Nat.* vi. (1846)
 p. 367.

Test may attain some size. Primary spines short, very numerous, rather blunt, white, purple, purple tipped with white, pink, red or brown; secondary spines inconspicuous; pedicellariæ globiferæ enormous.

Test hemispherical or slightly conical, not often depressed; stout, thickly covered with primary tubercles. Small peristome, compact calycinal area, rather large periproct.

In a typical specimen there are rather more than thirty plates in each interambulacral series, and those at the ambitus are about three times as wide as deep; they there bear six primary tubercles each, and this number only slowly decreases as either pole of the test is reached; the primary tubercles are not very prominent, but their large number gives a special facies to the test; scattered around and between them are small miliaries. The primaries of the ambulacral plates are somewhat smaller than those of the interambulacral; there are, at the ambitus, two on either plate, and the inner of these disappears somewhat more rapidly above than below the ambitus, so that a narrow, almost bare space is left near the apex of the test; near the line of suture one of the secondary tubercles is often rather prominent. The poriferous zones vary somewhat in breadth, the arrangement of the pairs of pores in arcs being inconstant. Each compound pore-plate may carry five or six pairs of pores, and on each there is one rather large tubercle.

The plates of the calycinal area form a narrow ring, and even the madreporite is not very prominent: the tuberculation is inconstant; two of the radials touch the periproct, which is of an elongated oval form. The vent is excentric; round it are some very small plates, but the rest of the circumanal plates are rather large.

The test may be of a purplish or pinkish hue; the poriferous zones are generally of a lighter hue than the rest of the test, but appear to be somewhat depressed in consequence of the smaller size of the tubercles on than those to either side of them.

Diameter of test.	Height of test.	Diameter of		
		Peristome.	Calyc. area.	Periproct.
82	57	24	15	9
66·5	40	21	11·5	8
58	36	20·5	9	5
48	30	18·5	8·5	5

Specimens about 70 mm. in diameter have the longest spines between 9 and 10 mm. long; but the spines are little, if at all, shorter in examples with a diameter of 50 mm. The spines vary more in colour than in their other characters.

Within the British area this species is only found in the Channel Islands.

Distribution. Coasts of France, Spain, and Portugal; Mediterranean. 0-37 fms.

a. Herm.

T. H. Powell, Esq.

b. Herm.

R. L. Spencer, Esq.

CLYPEASTRIDÆ (see p. 31).

ECHINOCYAMUS.

- Echinocyamus*, *Van Phelsum* (1774), *Brief aan C. Nozeman*, (1774) p. 131, pls. 1 & 2; *Ag. Mon. Scut.* (1841) p. 125; *A. Ag. Rev. Ech.* (1872) pp. 111 & 304; *Dunc. J. Linn. Soc.* xxiii. (1889) p. 144.
Spatagus, *O. F. Müll. Prod. Zool. Dan.* (1776) p. 236 (pars).
Echinus, *L., Gmelin, Syst. Nat.* (1789) p. 3168 (pars).
Fibularia, *Lamk. An. s. Vert.* (1816) p. 16 (pars).

Test small, rather thick; ambulacra short, wider than the interambulacra; anus round, midway between mouth and hinder margin; tubercles small, set in depressions.

1. *Echinocyamus pusillus*. (Plate XVI. figs. 8 & 9.)

- Spatagus pusillus*, *O. F. Müll. Prod. Zool. Dan.* (1776) p. 236; *Abilg. Zool. Dan.* iii. (1789) p. 18, pl. xci. figs. 5 & 6.
Echinocyamus angulosus, *Leske, Add.* p. 151; *Ag. Mon. Scut.* (1841) p. 130, pl. 27. figs. 14-18; *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 279; *Ag. & Des. Ann. Sci. Nat.* vii. (1847) p. 140; *Sars, Norg. Ech.* (1861) p. 95; *Duj. & Hup. Echin.* (1862) p. 556.
Echinus pulvinulus, *Penn. Brit. Zool.* iv. (1812) p. 140.
Echinocyamus pusillus, *Gray, Ann. Phil.* xxvi. (1825) p. 428; *Flem. Brit. An.* (1828) p. 481; *Ag. Mon. Scut.* (1841) p. 128, pl. 27. figs. 1-8; *Forbes, Brit. Starf.* (1841) p. 175; *Phil. Arch. f. Nat.* 1845, i. p. 356 [on its variation]; *Gray, Brit. Rad.* (1848) p. 5; *Gray, Cat. Rec. Ech.* (1855) p. 28; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 441; *Sars, Nyt Mag.* x. (1859) p. 60; *Heller, Zooph. & Echin. Adriat.* (1868) p. 66; *Hodge, Tr. North. & Durh.* iv. (1872) p. 140; *Al. Ag. Rev. Ech.* (1872) pp. 111 & 304; *Möb. & Bütsch. JB. Comm. Kiel*, ii. & iii. (1876) p. 149; *Ludwig, Mitth. zool. Stat. Neap.* i. (1879) p. 559; *Kochler, Ann. Mus. Marseille*, i. 3. (1885) p. 127; *Carus, Prod. Faun. Mediter.* (1884) p. 101.
Fibularia tarentina, *Lamk. An. s. Vert.* iii. (1816) p. 17; *Risso, Eur. Mérid.* v. (1826) p. 283.
Clypeaster pulvinulus, *Van den Ende, Nat. Verh. Hollandsche Muatsch.* xvi. 2. (1828) p. 301.
Fibularia pusillus, *Maitland, Faun. Belg. septent.* (1851) p. 92.

Echinocyamus angulatus, *Wyv. Thoms. Phil. Trans.* clxiv. (1874) p. 747.

Test always small, very variable in form. Spines short, greenish or yellowish, fading to white; some about twice as long as the rest and rather longer, more or less club-shaped; a few longer than the rest around the mouth; the finer spines are thickest at their free end.

The test has generally an elongated oval form, but sometimes, and more particularly with smaller specimens, it is rounded; the lower surface is often flattened, but sometimes is more or less tumid; the upper is flattish or slightly arched. The tubercles are large and are set in deep areolæ, which in full-grown specimens give a characteristic deep-pitted appearance to the surface of the test. The ambulacra are wider than the interambulacral areas; there are six or seven pairs of pores, the distal more widely separated from one another than the proximal. Mouth rather large, circular or suboval in form; anus about half as far from the edge of the test as from the mouth.

Length.	Breadth.	Height.
6	4.6	2.5
6	5	3
5	4	2
3.5	3	2

Quite unlike any other British Echinoid; generally distributed, but not well represented in collections.

Distribution. Both sides of North Atlantic (from Azores to Norway; Florida); Mediterranean. 0-325 fms.

<i>a-d.</i> Mouth of Sound of Mull.	J. Murray, Esq.
<i>e, f.</i> Arran.	Rev. D. Landsborough.
<i>g-k.</i> Castle Chichester, 6-10 fms. (Aug. 26th, 1844).	Belfast Nat. Hist. Soc.
<i>l.</i> Portmarnock.	Belfast Nat. Hist. Soc.
<i>m, n.</i> Near Tenby (May 1888).	
<i>o-z.</i> Kent.	
<i>a', b'.</i> Berwick-on-Tweed.	Dr. G. Johnston.
<i>c'-f'.</i> Montrose.	W. Duncan, Esq.
<i>g'-l'.</i> Sandwich Bay, Shetland.	E. M. Nelson, Esq.

Arachnoides placenta.

Echinarachnius placenta, *Gmelin*; *Forbes, Brit. Starf.* (1841) p. 178, fig.

This species, confined, so far as is known, to the Indian and Pacific Oceans, is stated by Forbes to have been dredged by Jameson in deep water off Foula. The specimen is not now to be found in either the Museum of Science and Art or the University Museum at Edinburgh, and it is impossible to say what the error is or whence it arose.

SPATANGIDÆ (see p. 31).

Key to the Genera of Spatangidæ.

- A. Peristome nearly central 1. NEOLAMPAS, p. 162.
 B. Peristome excentric.
 i. No subanal fasciole 2. SCHIZASTER, p. 163.
 ii. A subanal fasciole.
 a. Some of the tubercles much larger
 than the rest 3. SPATANGUS, p. 164.
 β. Tubercles subequal.
 i. Test highest behind 4. ECHINOCARDIUM, p. 168.
 ii. Test not highest behind 5. BRISSOPSIS, p. 172.

1. NEOLAMPAS.

Neolampas, *A. Ag. Bull. Mus. C. Z.* i. (1869) p. 271; *id. Rev. Ech.* (1872) pp. 147 & 340; *Wyv. Thoms. Phil. Trans.* clxiv. (1874) p. 745; *Duncan, J. Linn. Soc.* xxiii. (1889) p. 195.

Test prolonged posteriorly into a short blunt rostrum, and arching nearly uniformly from before backwards. Ambulacra flush with the surface of the test, and formed of a uniform double row of single pores. Well-developed bourrelets and floscelles.

1. *Neolampas rostellata*.

Neolampas rostellatus, *Al. Ag. Bull. Mus. C. Z.* i. (1869) p. 271.
Neolampas rostellata, *Al. Ag. Rev. Ech.* pp. 147 & 340, pl. xvii.
 figs. 1-12; *Wyv. Thoms. Phil. Trans.* clxiv. (1874) p. 745, pl. lxix.

“The single specimen procured in the ‘Porcupine’ Expedition, which was dredged living in 690 fathoms at the mouth of the English Channel, is 20 millims. in length, 16 millims. in extreme width across the ambitus, and 7 millims. in height. The outline from above is not quite symmetrically oval or pyriform, the shell bulging on either side somewhat irregularly towards the posterior extremity. In profile, the anterior end of the test is the thinnest; the outline rises to the apex and then sinks gradually to the truncated posterior rostrum, along the top of which it coincides with a slight longitudinal ridge. The oral surface of the test also rises slightly from the anterior border to produce the depression in which the mouth is placed, and from the mouth it sinks towards the truncated extremity forming the floor of the rostrum. This truncated end is occupied by a deep inversion, deepest above, at the bottom of which the anal orifice opens. The periproct is oval, large, and plated with small scales. In one specimen there is no trace of the exerted anal tube described by Prof. A. Agassiz as occurring in the specimens dredged by Count Pourtales in the Strait of Florida.

“The ambulacra have all precisely the same character. Those of the bivium are apparently in slight depressions. This is, however, only an effect produced by the slight projection of the sides of the posterior rostrum. The ambulacra are not very easily seen, the pores are so minute; by holding the shell up to the light, however, they become sufficiently apparent as rows of simple pores passing

between irregularly hexagonal plates, in double series, from the apex to the mouth. The ambulacral areae widen somewhat from the apex to the ambitus, and become slightly narrower from the ambitus towards the mouth; they are about 4 millims. in width at the widest point, the lateral ambulacral spaces being 12 millims. At the mouth the ambulacra expand into a very distinct floscelle, and the interambulacral areae end in bourrelets crowded with tubercles and bearing combs of long spatulate spines. The plates of the apical disk are so compacted and fused together, that it is difficult to trace their outline. Eight holes, nearly of equal size, surround a central madreporic tubercle; of these, five terminate the ambulacra, and are the pits for the sense-organs, the other three are ovarial. The posterior and the right anterior ovaries and ducts are undeveloped.

"The surface of the test is crowded with minute tubercles for the articulation of the larger spines and many small granules. The tubercles are imperforate, with a smooth mammillary boss; they are placed in circular scrobicular depressions, but they project somewhat above these and above the surface of the test. The larger spines, articulated to the tubercles, are cylindrical, fenestrated, with slight asperities on the longitudinal calcareous shafts. The small spines which, attached to the minute granules, form a close under-felting all over the test are fenestrated and slightly roughened, and expand at the end into a rosette of pointed tubercles. The pedicellariæ articulated to some of the granules are three-valved; they are very small and of a somewhat peculiar form, though resembling generally the smallest pedicellariæ in *Echinus*.

"The bases of the valves are wider, the valves themselves are rounder and more arched and toothed round the edge. Round the mouth there are groups of three and four very small pedicellariæ, differing in form somewhat from the others, and with the bases of the valves apparently fused together."

I have not been able to trace this specimen, the account of which as here given, is copied from Sir Wyville Thomson's description in the 'Philosophical Transactions.'

The species has been found at various depths between 100 and 229 fms. off the coasts of Florida.

2. SCHIZASTER.

Echinus (pars), *Linn. Syst. Nat.* x. (1758) p. 663.

Spatangus (pars), *Lamk. An. s. Vert.* iii. (1816) p. 27.

Ova, *Gray, Ann. Phil.* x. (1825) p. 431.

Micraster (pars), *Ag. Mém. Soc. Neuch.* i. (1836) p. 184.

Schizaster, *id. t. c.* p. 185; *id. & Des. Ann. Sci. Nat.* viii. (1847) p. 20;

Al. Ag. Rev. Ech. (1872) pp. 157 & 363; *Carus, Prod. Faun.*

Medit. (1884) p. 104; *Duncan, J. Linn. Soc.* xxiii. (1889) p. 234.

Periaster (pars), *D'Orb. Pal. Franç.* vi. (1854) p. 269.

Test thin, generally longer than wide, highest posteriorly; the paired ambulacra sunken, and the anterior longer than the posterior, the median in a deep groove; two or three genital pores.

1. *Schizaster fragilis*.

- Brissus fragilis*, *Düb. & Kor. Vet.-Ak. Hdlg.* 1844 (1846), p. 280, pl. x. figs. 47-49.
- Schizaster fragilis*, *Ag. & Des. Ann. Sci. Nat.* viii. (1847) p. 22; *Lüth. Vid. Medd.* 1863 (1864), p. 175; *Al. Ag. Rev. Ech.* (1872) pp. 157 & 363; *Möb. & Bütschli, JB. Comm. Kiel*, ii. & iii. (1875) p. 150; *Al. Ag. Bull. Mus. C. Z.* (1880) p. 85; *id. Chall. Rep.* (1881) p. 201; *id. Mem. Mus. C. Z.* x. (1883) p. 74, pl. xxviii. figs. 8-14; *Rathbun, Proc. U.S. Nat. Mus.* ix. (1886) p. 291.
- Schizaster (Brisaster) fragilis*, *Gray, Cat. Ech.* (1855) p. 61.
- Tripylus fragilis*, *Sars, Norg. Ech.* (1861) p. 96; *Wyp. Thoms. Phil. Trans.* clxiv. (1874) p. 750.
- Periaster fragilis*, *D'Orbigny, Pal. Franç.* vi. (1854) p. 270; *Duj. & Hup. Ech.* (1862) p. 598.
- Schizaster cubensis*, *Al. Ag. (non D'Orb.) Bull. Mus. C. Z.* i. (1865) p. 278.

Anterior ambulacrum not very deep; antero-lateral ambulacra about three times as long as the postero-lateral. Highest point of test in hinder third of body, whence there is a steep slope forwards and a very slight slope backwards. Mouth very far in front. General coloration of test in spirit brownish with lighter-coloured spines.

Length	45	53	51
Greatest breadth	40	47	51
Height	24	29	27
Length of anterior ambulacrum	25	29	28
Length of antero-lateral ambulacrum . . . . .	.	26	27
Length of postero-lateral ambulacrum . . . . .	.	10	11

The only known British locality is that given by Thomson, "at from 400 to 500 fathoms, between Scotland and Faeroe." First reported from Norway, it has been taken at 50-452 fms. on North American coast, and at 150 fms. in Simon's Bay. From each of these localities the Museum has specimens, but it has no British examples.

3. *SPATANGUS*.

- Spatangus (pars)*, *O. F. Müller, Prod. Zool. Dan.* (1776) p. 236.
- Spatangus*, *Leske, Addit.* (1778) p. 171; *Lamk. An. s. Vert.* (1801) p. 348; *Gray, Cat. Rec. Ech.* (1855) p. 46; *Desor, Syn. Ech. foss.* (1858) p. 419; *A. Ag. Rev. Ech.* (1872) pp. 158, 564; *Lovén, Vet.-Akad. Hdlg.* xi. 7. (1874) pl. xxxvi; *Carus, Prod. faun. Mediter.* (1884) p. 102; *Duncan, J. Linn. Soc.* xxiii. (1889) p. 251.
- Echinus (pars)*, *Pennant, Brit. Zool.* iv. (1777) p. 58; *L., Gmel. Syst. Nat.* (1789) p. 3168.

Test large, thin, cordiform, grooved in front, truncated behind; the paired ambulacra petaloid, broad and sunken, the anterior and posterior pairs almost of the same length; the anterior ambulacrum in a groove, not well developed. Some of the tubercles much larger than the rest, and carrying long, strong, curved spines.

The two species have very many characters in common, but

S. raschi comes from deeper water, and has the labrum more pointed and convex.

1. *Spatangus purpureus*. (Plate XVI. fig. 10.)

- Spatangus purpureus*, O. F. Müll. *Prod. Zool. Dan.* (1776) p. 236; *id. Zool. Dan.* (1788) i. p. 5, pl. vi.
- Spatangus purpureus*, Leske, *Addit.* (1778) p. 171, pl. xliii. figs. 3-5, & pl. xlv. fig. 5; Lamk. *An. s. Vert.* iii. (1816) p. 29; Gray, *Ann. Phil.* xxvi. (1825) p. 430; *Flem. Mem. Wern. Soc.* v. (1825) p. 288; *id. Brit. An.* (1828) p. 480; *Desml. Syn. Ech.* (1837) p. 388; Edwards in Cuv. *Règne An.* (n. d.) xx. pl. 11 bis (anatomy), & pl. 17; Forbes, *Brit. Starf.* (1841) p. 182; Düb. & Kor. *Vet.-Akad. Hdly.* 1844 (1846), p. 285; *Phil. Arch. f. Nat.* 1845, p. 350; Martins, *Ann. Sci. Nat.* v. (1846) p. 157 (temperature); *Ag. & Des. Ann. Sci. Nat.* viii. (1847) p. 6; Gray, *Brit. Rad.* (1848) p. 6; Maitland, *Faun. Belg.* (1851) p. 91; Gray, *Cat. Ech.* (1855) p. 47; Thompson, *Nat. Hist. Irel.* iv. (1856) p. 441; Bronn, *Klass. u. Ordn.* ii. (1860) pl. xl. figs. 21-23 (larvæ); Sars, *Norg. Ech.* (1861) p. 99; Perr. *Ann. Sci. Nat.* xiii. (1870) p. 73; *Al. Ag. Rev. Ech.* (1872) p. 158, & (1873) p. 564; Möbius & Bütschli, *JB. Comm. Kiel*, ii. & iii. (1875) p. 150; Ludwig, *Mitth. zool. Stat. Neap.* i. (1879) p. 560; Koehler, *Ann. Mus. Marseille*, i. 3. (1883) p. 127; Carus, *Prod. Faun. Mediter.* (1884) p. 102; Prouho, *C. R.* cii. (1886) p. 1498; Bell, *Ann. & Mag.* iv. (1889) p. 442.
- Echinus lacunosus*, Penn. *Brit. Zool.* iv. (1777) p. 59.
- Echinus purpureus*, Gmel. *Syst. Nat.* (1789) p. 3197; Penn. *Brit. Zool.* iv. (1812) p. 139.
- Spatangus meridionalis*, Risso, *Eur. Mérid.* (1825) p. 280; *Phil. Arch. f. Nat.* 1845, p. 350; *Ag. & Des. Ann. Sci. Nat.* viii. (1847) p. 6; Sars, *Nyt Mag.* x. (1859) p. 62; Norman, *Rep. Brit. Assoc.* 1868 (1869), p. 315; Jeffreys, *Ann. & Mag.* v. (1870) p. 146; Gray, *Ann. & Mag.* x. (1872) p. 123.
- Spatangus spinosissimus*, *Ag. & Des. Ann. Sci. Nat.* viii. (1847) p. 6; Gray, *Cat. Rec. Ech.* 1855, p. 47.
- Spatangus reginæ*, Gray, *Ann. & Mag.* vii. (1851) p. 130; *id. Cat. Rec. Ech.* (1855) p. 47.

Test more or less broadly heart-shaped, more or less flattened, with rather tumid ambitus, broad spout-shaped lower lip. The primary spines on the dorsal surface light-coloured, curved, very long; proportionately longer in younger specimens. General colour purplish.

In addition to the large, curved, prominent, backwardly directed spines articulated to the primary tubercles found on the dorsal surface there are a number of other spines; the longest of these are found below the ambitus; those on the ventral plastron are of varying lengths, and the longer are spoon-shaped at their free ends; two tufts of longish spines on either side of the plastron below the anus; the upper surface is densely covered with short, rather fine, whitish spines; most are curved, and all are directed backwards; some of the spines are sometimes purplish.

The variations in the colour and character of the spines are very considerable. Thus the large spines may be very prominent both

from their great size and the distinctness of their bright yellow colour from the purplish test; sometimes they may be remarkable for their size only, and sometimes they may be quite inconspicuous. The general coloration, again, varies within wide limits; the general facies may be a universal purple, but it may be brown, or yellowish, or whitish. So, again, the form of the test is sometimes well rounded, sometimes flattened; the cordiform contour may be qualified, so that some specimens are more truncated and some more evenly rounded than others.

The ambulacral petals are wide and each of the antero-lateral pair is longer than the postero-lateral; the pores in the neighbourhood of the apex are quite small, and the reduction in size is most marked and most extensive in the anterior half of the antero-lateral petals; the inner pore of a pair is always smaller than the outer. Anterior groove rather wide. In the apical area the madreporite is very prominent. The mouth is wide, and the lower lip has a rounded angle. The subanal fasciole is well-marked, broad, with a wide and deep angle on the side nearer the anus. The anus is transversely oval, looks backwards and downwards. The tubercles vary considerably in size; the largest are found on the dorsal surface, and chiefly between the petals; a very few are found within the petals; the granules forming the general covering of the upper surface of the test have a tendency to become smaller as the ambitus is approached.

On the ventral surface the tubercles are generally larger; they are smallest near the ambitus and largest in the region of the mouth; within the subanal fasciole the tubercles are smallest in the narrowest region and largest in the wings on either side.

There is some not inconsiderable variation in the breadth and form of the petals; the postero-lateral are sometimes almost oblong instead of petaloid; in young specimens the pores of a pair are not markedly different in size; while always wide the anterior groove varies somewhat in depth.

Length.	Breadth.	Height.	Breadth of mouth.	Breadth of vent.	Greatest breadth of	
					Ant.-lat. ambulacra.	Post.-lat. ambulacr.
100	100	51	20·5	16	12·5	12·5
85	92	51	18	11	8	7·8
85	84	48	14·5	12·5	12	11
80	87	44	17·5	11	10·5	11·8
80	84	42	18·3	13	9·5	9
70	70	35	13	10	5·5	6·5
55	58	32	13	10	6·8	..
45	45	25	10·5	5·5	..	..
40	38	21·5	9	5	..	..
25	24·5	12	6·5	2	1·7	1·8
12	10·5	6·5				

Distribution. East side of Atlantic from the Azores to Iceland; Bermuda; North Sea; Mediterranean. 5-530 fms.

<i>a, b.</i> 60° 32' N., 0° 29' W.; 60° 28' N., 0° 33' E.	'Porcupine' Exp.
<i>c-f.</i> 59° 41' N., 7° 34' W., 458 fms.	'Porcupine' Exp.
<i>g.</i> Loch Lorn, 50-70 fms.	John Murray, Esq.
<i>h-q.</i> Near Trench and Kilbrennan Sounds, 10-14 fms.	John Murray, Esq.
<i>r-z.</i> Sanda Sound, 22 fms.	John Murray, Esq.
<i>a'.</i> 40 miles off Achill Head, 220 fms.	R. Dublin Soc.
<i>b'.</i> Off S.W. coast of Ireland, 200 fms.	G. C. Bourne, Esq.
<i>c', d'.</i> Off S.W. coast of Ireland, 50-60 fms.	'Flying Fox' Exp.
<i>e'.</i> Irish Sea.	Prof. E. Forbes.
<i>f', g'.</i> Off Liverpool.	
<i>h'.</i> Fishery-ground west of Lundy.	
<i>i'.</i> Scilly.	
<i>j', k'.</i> Jersey.	
<i>l'-n'.</i> Channel Islands.	T. H. Powell, Esq.
<i>o'-q'.</i> Plymouth.	
<i>r'.</i> South coast of England.	B. B. Woodward, Esq.
<i>s'.</i> Berwick Bay.	Dr. G. Johnston.
<i>t'-x'.</i> Montrose (July 11 & 16, 1889).	W. Duncan, Esq.
<i>y', z'.</i> Cromarty and Moray Friths.	Dr. A. Sutherland.
<i>a'', b''.</i> British seas.	

2. *Spatangus raschi*. (Plate XVI. fig. 11.)

Spatangus raschi, Lovén, *Œfvers. Vet.-Akad. Stockholm*, 1869, p. 733, pl. xiii.; *Al. Ag. Rev. Ech.* (1872-3) pp. 159 & 567; *Wyv. Thoms. Phil. Trans.* clxiv. (1874) p. 750; *Al. Ag. Chall. Ech.* (1881) p. 171; *Bell, Ann. & Mag.* iv. (1889) p. 442.

Test rather narrowly heart-shaped, high, with rather well-marked edge; the lower lip sharply angulated at its free edge. The spines purplish, none particularly prominent in length or strength; the whole test above regularly covered with spines, the smaller of which are evenly disposed among the larger; all seem to be covered, and all are directed backwards. On the lower surface the spines are scarcer, finer, and whiter. No subanal tufts. It must, however, be noted that in some specimens the spines may be as long and as prominent as in examples of *S. purpureus* of the same size; in others they are more ordinarily both smaller and less conspicuous.

The shape of the test is very variable, the height being to the length from 60 to 100 to 75 to 100, and there is some variation in the rounding of the contour; but, as a rule, the test rises more abruptly and higher than in *S. purpureus*, and the contour is more circular.

The ambulacral petals are narrower than in *S. purpureus*, and there is not, in adults, so marked a difference between the pores of a pair. The madreporite is rather less prominent. Mouth wide and large, the oral region more, sometimes much more, depressed and the lower lip more pointed and convexly curved than in *S. purpureus*. Subanal fasciole quite obscure, not constricted in the middle. The anus looks more downwards than backwards. The longer primary tubercles are less restricted in distribution than in *S. purpureus*, but they are not so large or so prominent, though more numerous.

The smaller tubercles on the dorsal surface are very delicate, but not distinctly smaller close to than at a distance from the ambitus. The tubercles of the lower surface have the same general characters as in *S. purpureus*, but are not so large.

Length.	Breadth.	Height.	Breadth of mouth.	Breadth of vent.
100	94	55	18	8.5
95	95	54	19.5	11
90	88	63	17.5	.
90	90	66	19	9
70	68	40		8.5

Distribution. Atlantic—Norway, Azores, Portugal, Agulhas Bank, Cape of Good Hope. 30(?)–200 fms.

<i>a, b.</i> Off coast of Kerry, 100–200 fms.	Royal Irish Academy.
<i>c-u.</i> S.W. Ireland, 100, 110, 180 fms., July 1889.	'Flying Fox' Exp.
<i>v.</i> 54 miles off Achill Head, 500 fms.	Royal Dublin Soc.
<i>w.</i> 30 miles off Achill Head, 144 fms.	Royal Dublin Soc.
<i>x, y.</i> 45 miles off Blackrock, 500 fms.	Royal Dublin Soc.
<i>z, a'.</i> 40 miles off Bolus Head, 115 fms.	Royal Dublin Soc.
<i>b'.</i> Shetland.	J. Gwyn Jeffreys, Esq.

4. ECHINOCARDIUM.

Echinocardium, *Gray, Ann. Phil.* xxvi. (1825) p. 430; *id. Cat. Brit. Rad.* (1848) p. 6; *id. Cat. Rec. Ech.* (1855) p. 42; *Al. Ag. Rev. Ech.* (1872) pp. 109 & 349; *Carus, Prod. Faun. Mediter.* (1884) p. 102; *Dunc. J. L. S.* xxiii. (1889) p. 261.
Spatagus (pars), *O. F. Müll. Prod. Zool. Dan.* (1776) p. 236.
Amphidetus, *Ag. Mém. Soc. Neuch.* i. (1836) p. 184; [*Amphidotus*, *Forbes, Brit. Starf.* (1841) p. 190]; *Ag. & Des. Ann. Sci. Nat.* viii. (1847) p. 11.

Test never large, rather thin, cordiform, truncated and highest behind; the paired ambulacra triangular in outline, with few large pores; anterior ambulacrum in a groove, which may or may not be deep. Spines mostly silky.

Key to the Species.

- a.* Anterior ambulacrum in a groove.
 Antero-lateral ambulacra with, generally, 7 anterior and 10 posterior pores; postero-lateral with 9 outer, and 8 or 9 inner .. 1. *E. cordatum.*
- b.* Anterior ambulacrum not in a groove.
 Antero-lateral ambulacra with, generally, 6 to 8 and 12 to 15 pores; postero-lateral with 14 and 12 2. *E. pennatifidum.*
 Antero-lateral ambulacra with, generally, 5 to 6 and 9 to 10 pores; postero-lateral with 7 and 6 3. *E. flavescens.*

1. *Echinocardium cordatum*. (Plate XVI. figs. 1-4.)

- Echinus cordatus*, *Penn. Brit. Zool.* iv. (1777) p. 58, pl. xxxiv. fig. 75 ;
id. op. cit. iv. (1812) p. 139, pl. xxxvi. fig. 2.
Spatangus arcuarius, *Lamk. An. s. Vert.* iii. (1816) p. 32.
Echinocardium pusillus, *Gray, Ann. Phil.* xxvi. (1825) p. 430.
Spatangus cordatus, *Flem. Brit. An.* (1828) p. 480.
Spatangus ovalis, *van den Ende, Nat. Verh. Hollandsche Maatsch.* xvi.
 2. (1828) p. 301.
Amphidotus cordatus, *Forbes, Brit. Starf.* (1841) p. 190 ; *Thompson,*
Nat. Hist. Irel. iv. (1856) p. 442.
Amphidetus cordatus, *Düb. & Kor. Vet.-Ak. Hdlg.* 1844 (1846),
 p. 285 ; *Ag. & Des. Ann. Sci. Nat.* viii. (1847) p. 11, & vi. (1846)
 pl. xvi. fig. 8 ; *Sars, Norg. Ech.* (1861) p. 97.
Echinocardium cordatus, *Gray, Brit. Rad.* (1848) p. 6.
Amphidotus arcuarius, *Maitland, Faun. Belg. septent.* (1851) p. 91.
Echinocardium cordatum, *id. Cat. Ech.* (1855) p. 43 ; *Duj. & Hup.*
Echin. (1862) p. 602 ; *Al. Ag. Rev. Ech.* (1872) pp. 109 & 349,
 pl. xix. figs. 10-17 & pl. xx. figs. 5-7 ; *Möb. & Büts. JB. Comm.*
Kiel, ii. & iii. (1875) p. 150 ; *Ludwig, Mitth. zool. Stat. Neap.* i.
 (1879) p. 561 ; *Koehler, Ann. Mus. Marseille*, i. 3. (1885) p. 130 ;
Carus, Prod. Faun. Mediter. (1884) p. 102 ; *Fleischmann, Zeit. f.*
wiss. Zool. (1888) p. 131 (development).

Body irregularly heart-shaped, widest at its posterior third ; anterior ambulacrum in a rather deep groove, spines silky grey, none very long above ; when the spines are well developed they considerably obscure the anterior depression, and the whole creature has a brownish hue. The longest spines are the backwardly directed, slightly curved spines found on either side of the ventral surface ; the outermost on the plastron are curved outwards and backwards, but the greater number are a little shorter, stouter, and spatulate at their free ends. On the upper surface the most prominent spines are found just in front of the apex and on either side of the anterior ambulacrum.

The test of a full-grown adult is only a little higher posteriorly than anteriorly, and the heart-like form is not very apparent. In smaller specimens, which are much more common, the hinder part is distinctly higher than the anterior and the cordiform shape of the test is much more pronounced. The hinder aspect descends vertically, and the anus is not overhung.

The groove for the anterior ambulacrum is very well marked anteriorly, on the upper surface it forms a shallower depression ; the apical system is some distance behind the middle of the back ; the internal fasciole is symmetrical on either side of the middle line and is rather broader behind than in front ; the number of well marked pairs of pores in the antero-lateral ambulacra are often 7 in the anterior and 11 in the posterior series ; while in the postero-lateral there are often 9 in the outer and 8 or 9 in the inner row ; but these numbers are not always constant ; both pairs of ambulacra are in slight depressions of the test. The periproct is large, oval, and vertical ; as a rule, there are three pairs of pore-bearing plates between the subanal fasciole. The bare ambulacral spaces below

are rather wide. The tuberculation of the test is much more uniform than in many species.

The periproct is not always longer than broad, and the hinder surface of the test is not straight vertically in fully grown specimens, and there may be only two pairs of poriferous plates within the subanal area.

Test.			Greatest diameter of	
Length.	Breadth.	Height.	Peristome.	Periproct.
67	65	47	15	10
53	56	37	11	10
47.5	53	34	13	11
36	40	24	11	6.5
32.5	33	21.5	8.5	6
26	26	16	6.5	5

Distribution. Both sides of Atlantic from Norway to Spain, and S. Carolina to Bahia. North Sea; Mediterranean. 0-85 fms.

a. Lamlash Bay.	
b-g. Southport.	Mrs. J. E. Gray.
h-m. Southport.	Edgar A. Smith, Esq.
n-p. Liverpool.	
q, r. Tenby, March 1889 (low water in sand).	
s, t. Milton Sands, Devon.	G. Montagu, Esq.
u-y. Scilly Islands.	
z-b'. Plymouth.	
c'. St. Andrews.	Dr. Macdonald.
d'-g'. Montrose.	W. Duncan, Esq.
h'-j'. Cromarty and Moray Firths.	Dr. A. Sutherland.
k'-m'. Zetland.	R. M'Andrew, Esq.
n'. British.	Robinson Bequest.

2. *Echinocardium pennatifidum*. (Plate XVI. fig. 5.)

- Echinocardium pennatifidum*, *Norm. Rep. Brit. Assoc.* 1868, p. 315;
Hodge, Tr. North. & Durh. iv. (1872) p. 142, pl. v. figs. 1-5; *Al. Ag. Rev. Ech.* (1872-73) pp. 111 & 351, pl. xx. figs. 1 & 2.
Echinocardium lævigaster, *Al. Ag. Bull. M. C. Z.* i. (1869) p. 277.
Echinocardium sp., *Bell, Ann. N. H.* xvii. (1886) p. 516.
Amphidotus gibbosus, *Barrett, Ann. N. H.* xix. (1857) p. 33, pl. vii. fig. 2 (non *Ag.*).

Body less heart-shaped than in *E. cordatum*, being either rounder or longer; anterior ambulacrum not in a groove; spines not quite so silky as in *E. cordatum*, but the longest in the same position as in it, and of much the same character both on the upper and lower surface.

The test of an adult is a good deal higher posteriorly than anteriorly; the posterior end is deeply curved in its upper half and the periproct is overhung; the internal fasciole is, or may be, asymmetrical, but the longer half may be on the right or on the left side; it is some plates farther back from the madreporite than in *E. cordatum*; the number of well-marked pores is, in the first

antero-lateral series six to eight, and in the hinder from twelve to fifteen; the outer postero-lateral series has fourteen, and the inner twelve; but these numbers must not be taken to be quite constant; these ambulacra are about flush with the test.

The periproct is an irregular oval, with the long axis at right angles to a vertical line; the subanal fasciole seems to include only one pair of plates, which are triangular in form and have a pair of pores at the outer apex of each triangle; the spines carried on them are more prominent than in *E. cordatum*; the bare ambulacral spaces below are rather narrow.

The tuberculation is a good deal finer on the upper than on the lower surface, but on each, respectively, it is very uniform.

Test.			Greatest diameter of	
Greatest length.	Breadth.	Height.	Peristome.	Periproct.
67	70	45	17.5	15
63	65	43	16	
57.5	55	40	12.5	

Distribution. Both sides of Atlantic, but known only from Shetland, North Sea, English Channel, West Indies, and Florida. Shallow water to 120 fms.

a, b. Scilly Islands.

c. Jersey.

d, e. Jersey.

Prof. Bell.

3. *Echinocardium flavescens.* (Plate XVI. figs. 6 & 7.)

Spatagus flavescens, O. F. Müll. *Prod. Zool. Dan.* (1776) p. 236.

Spatangus ovatus, *Flem. Mem. Wern. Soc.* v. (1824) p. 287, pl. vi.;

id. Brit. Anim. (1828) p. 480; *de Bl. Actin.* (1834) p. 202;

Desml. Syn. (1837) p. 388.

Amphidetus ovatus, *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846),

p. 283, pl. x. fig. 50; *Ag. & Des. Ann. Sci. Nat.* viii. (1847) p. 12;

Sars, Norg. Ech. (1861) p. 98; *Perr. Ann. Sci. Nat.* xiii. (1869)

p. 70, pl. vi. fig. 2; *Jarzynsky, Trans. Petersb. Soc. Nat.* i. (1870)

p. 319.

Echinocardium ovatum, *Gray, Brit. Rad.* (1848) p. 6; *id. Cat. Rec.*

Ech. (1855) p. 43; *Duj. & Hup. Echin.* (1862) p. 602; *Al. Ag.*

Bull. Mus. C. Z. i. (1869) p. 276.

Echinocardium flavescens, *Al. Ag. Rev. Ech.* (1872) pp. 110 & 351,

pl. xx. figs. 3 & 4; *Gauthier, C. R.* lxxix. (1874) p. 402; *Möb. &*

Bütsch. JB. Comm. Kiel, ii. & iii. (1875) p. 150; *Ludwig, Mitth.*

Stat. Neap. i. (1879) p. 561; *Al. Ag. Chall. Ech.* (1881) p. 175;

id. Proc. R. Soc. Ed. xi. (1880-82) p. 698; *Koehler, Ann. Mus.*

Marseille, i. 3. (1883) p. 129; *Carus, Prod. Faun. Mediter.* (1884)

p. 103; *Herdman, Rep. Faun. Liverp. Bay*, (1886) p. 138; *Barrois,*

Rev. Biol. i. (1889) p. 110; *Scott, Proc. R. Phys. Soc. Edinb.* 1890-91

(1892), p. 82.

Amphidotus roseus, *Forbes, Brit. Starf.* (1841) p. 194; *Thomps.*

Nat. Hist. Irel. iv. (1856) p. 442.

Test rather oblongo-ovate than cordiform in shape; anterior

ambulacrum not in a groove, spines fine and delicate. Upper part of test nearly level from hinder end to the anterior border of the internal fasciole, and then sloping gradually downwards; the anus is slightly overhung by the upper part of the test; the internal fasciole is well marked and is almost triangular in form, its hinder part is only one or two plates behind the madreporite; the number of well-marked pores is, in the front antero-lateral series five or six and in the hinder nine or ten; the outer postero-lateral series has seven and the inner six; but, as before, too much importance must not be given to the constancy of these numbers; all the ambulacra are flush with the test.

The long axis of the oval periproct is at right angles to a vertical line; the subanal fasciole contains one or two pairs of pore-bearing plates; the bare ambulacral spaces below are very wide; the tuberculation is coarser at the sides and below than it is in the median part of the dorsal surface.

Length.	Breadth.	Height.	Peristome.
34	33	23	7
24	20.5	16	5.5

Distribution. Atlantic from Norway to Cape of Good Hope; North Sea; Coast of Florida; Mediterranean. 5-140 fms.

a, b. 59° 34' N., 7° 18' W., 542 fms. 'Porcupine' Exp., 1869.
c, d. Port Erin, Isle of Man. Prof. Herdman.
e, f. Shetland. R. M'Andrew, Esq.

5. BRISSOPSIS.

- Brissopsis, *Ag. Cat. Syst. Ectyp.* (1840) p. 16; *Ag. et Des. Ann. Sci. Nat.* viii. (1847) p. 14; *Desor, Syn. Ech. foss.* (1858) p. 378; *Al. Ag. Rev. Ech.* (1872) pp. 95 & 354; *Dunc. & Sladen, Pal. Ind.* xiv. 3. (1884) p. 202; *Dunc. J. Linn. Soc.* xxiii. (1889) p. 248.
 Brissus, *Forb. Brit. Starf.* (1841) p. 187.
 Brissiopsis, *Gray, Cat. Brit. Rad.* (1848) p. 7; *id. Cat. Ech. B. M.* (1855) p. 55.
 Kleinia, *Gray, Ann. & Mag.* vii. (1851) p. 133; *id. Cat. Ech.* (1855) p. 48.
 Toxobrissus, *Des. Syn. Ech. foss.* (1858) p. 399.
 Deakia, *Pavay, Magyar földt. intézet. Budap. Evk.* iii. (1874) p. 304.
 ? Verbeekia, *Fritsch, Palæontogr. Suppl.* iii. 1. (1877) p. 92.

Test never large, rather thin, oval, somewhat compressed from side to side, truncated behind but not highest there; the paired ambulacra subpetaloid and sunken, the anterior pair as long or longer than the posterior. Anterior ambulacrum slightly sunken. Spines moderately stout.

1. Brissopsis lyrifera.

- Brissus lyrifer, *Forbes, Brit. Starf.* (1841) p. 187; *Düb. & Kor. Vet.-Akad. Hdlg.* 1844 (1846), p. 280, pl. x. fig. 46; *Thompson, Nat. Hist. Irel.* iv. (1856) p. 442.
 Brissopsis lyrifera, *Ag. & Des. Ann. Sci. Nat.* viii. (1847) p. 15; *Sars, Norg. Ech.* (1861) p. 96; *Duj. & Hupe, Echin.* (1862)

p. 597; *Al. Ag. Rev. Ech.* (1872) pp. 95 & 354; *Möb. & Bütsch. JB. Comm. Kiel*, ii. & iii. (1875) p. 150; *Ludwig, Mitth. zool. Stat. Neap.* i. (1879) p. 562; *Al. Ag. Mem. Mus. C. Z.* x. l. (1883) p. 69; *Koehler, Ann. Mus. Marseille*, i. 3. (1883) p. 135; *Carus, Prod. Faun. Mediter.* (1884) p. 103; *Rathbun, Proc. U.S. Nat. Mus.* ix. (1886) p. 289; *Hoyle, J. Linn. Soc.* xx. (1890) p. 458; *Scott, Rep. Scot. Fishery Board*, 1889 (1890), p. 316; *id. Ann. Scot. Nat. Hist.* 1892, p. 50.
Brissopsis lyrifera, *Gray, Brit. Rad.* (1848) p. 7; *id. Cat. Ech.* (1855) p. 55.

This species may be at once recognized by the lyre- or fiddle-shaped black fasciole on the dorsal surface.

Body elongated or more or less oval, rather higher posteriorly than anteriorly; pretty closely covered with rather short and delicate, slightly curved spines, which are longest and strongest on the edges of the ambulacral petals and just in front of the mouth. The general coloration is brown, but the spines are light yellow; the finer spines of the peripetalar and of the subanal fascioles are very much darker.

The peripetalar fasciole varies a good deal in the details of its course, but its general direction is as follows: there is a band at right angles to the anterior odd ambulacrum, placed at the point where the test begins to sheer downwards; on either side it takes a more or less angulated course to the tips of the antero-lateral petals; the band then curves inwards, sweeps outwards around the postero-lateral petals of either side, and joins its fellow in a nearly straight transverse band. The subanal fasciole, which is of a transversely elongated oval form, varies somewhat in the extent of its distinctness; the spines within it are disposed in two diverging tufts, but are not prominent as in *Spatangus purpureus*.

The tubercles on the test are rather coarse, and are coarsest below and anteriorly, and are nowhere very closely packed. The part within the peripetalar fasciole is longer for the antero-lateral than for the postero-lateral ambulacra, and the former are also somewhat more deeply excavated. The madreporite, which lies between the proximal ends of the latter, is rather small and very finely punctured. The lower lip is hardly at all curved from side to side or from above downwards. The periproct is irregularly oval in form and its somewhat longer axis is vertical; the outermost or peripheral plates are of some size. When the spines are particularly well-developed the peripetalar fasciole is a good deal obscured, the spines within the two fascioles become much more prominent, and those below much longer than ordinary.

A great quantity of mud becomes entangled in the spines of this species.

Length.	Breadth.	Height.	Peristome.	Periproct.
62	55.5	29	11.3	
53	46	31	10	6
51	47.5	33	10	7
40	36	23	6	4
34	30.5	21	5	

Distribution. Both sides of Atlantic, from Greenland to Cape of Good Hope and Antilles; shallow water to 1487 fms. Rare in North Sea; Mediterranean.

<i>a.</i> Loch Duich, 60 fms., 31/8/87.	John Murray, Esq.
<i>b, c.</i> Loch Hourn, 70 fms., 29/8/87.	John Murray, Esq.
<i>d.</i> Lower Loch Fyne, 80 fms.	John Murray, Esq.
<i>e.</i> Upper Loch Torridon, 30-40 fms.	John Murray, Esq.
<i>f-i.</i> Kilbrennan Sound, 10-45 fms., 22/3/88.	John Murray, Esq.
<i>j, k.</i> Kilbrennan Sound, 10-15 fms.	John Murray, Esq.
<i>l-p.</i> Kilbrennan Sound, 22 fms., 22/12/87.	John Murray, Esq.
<i>q-z.</i> Between Cumbrae and Arran.	John Murray, Esq.
<i>a'.</i> Between Great Cumbrae and Wemyss Ground.	John Murray, Esq.
<i>b'-h'.</i> Between Sanda and Ailsa Craig.	John Murray, Esq.
<i>i'.</i> Rothesay Bay.	E. Forbes, Esq.
<i>j'.</i> E. coast of Ross-shire.	Dr. Sutherland.
<i>k'-p'.</i> Shetland.	R. M'Andrew, Esq.

DISTRIBUTION OF BRITISH ECHINODERMS.

TABLE I.—Table showing the Horizontal Distribution of British Echinoderms beyond the "British Area," together with their range in depth*.

	fathoms.
1. <i>Synapta inhærens</i> . A., Ar., M.	0-96
2. — <i>buski</i> . S.	15-30
3. — <i>digitata</i> . S., L., M.	10-80
4. <i>Cucumaria hyndmani</i> . S., M.	x-420
5. — <i>planci</i> . L., M., Mauritius (?)	9-30
6. — <i>pentactes</i> . Ar., S., L., M.	10-50
7. — <i>lactea</i> . S.	0-50
8. — <i>hispida</i> . A., Ar.	40-555
9. — <i>frondosa</i> . C.	3-220
10. — <i>fucicola</i>	?
11. — <i>andrewsi</i>	?
12. <i>Thyone fusus</i> . S., M.	10-80
13. — <i>raphanus</i> . S., M.	x-155
14. — <i>flexus</i>	?
15. — <i>elegans</i>	?
16. <i>Psolus phantapus</i> . A., Ar., N.	x-127
17. — <i>fabricii</i> . C.	5-148
18. <i>Colochirus andersoni</i>	?
19. <i>Phyllophorus pellucidus</i> . A., Ar.	5-70
20. — <i>drummondi</i> . S.	x-80
21. <i>Holothuria intestinalis</i> . S., Ar.	x-672
22. — <i>tremula</i> . S., L.	45-672
23. — <i>nigra</i>	4-20
24. — <i>aspera</i>	1000
25. <i>Stichopus tizardi</i>	516-570
26. <i>Antedon eschrichti</i> . A., Ar.	20-632
27. — <i>bifida</i> . L., M.	0-100
28. — <i>petasus</i> . S.	20-100
29. — <i>tenella</i> . A., Ar.	50-740
30. — <i>prolixa</i> . S., Ar.	25-743
31. — <i>phalangium</i> . L., M.	x-700
32. <i>Pontaster tenuispinis</i> . A., Ar.	70-778
33. <i>Plutonaster bifrons</i> . A.	210-1360
34. — <i>pareli</i> . S.	155-1608
35. <i>Ctenodiscus crispatus</i> . A., Ar.	7-632
36. <i>Leptoptychaster arcticus</i> . A., Ar.	20-690
37. <i>Astropecten irregularis</i> . A. (eastern half), M.	10-1000
38. — <i>sphenoplax</i>	500
39. <i>Psilaster andromeda</i> . Ar.	40-690
40. <i>Bathybiaster vexillifer</i>	344
41. <i>Luidia ciliaris</i> . L., S., M.	x-87
42. — <i>sarsi</i> . L., S.	x-374

* In this list A. signifies North Atlantic; Ar. Arctic Ocean; S. Scandinavian region; L. Lusitanian; M. Mediterranean; N. North Sea; C. Circumpolar. x signifies that the least depth is not certainly known.

	fathoms.
43. <i>Pentagonaster granularis</i> . A., Ar.	20-750
44. — <i>greeni</i>	1000
45. <i>Nymphaster subspinosus</i> . A.	163-1525
46. <i>Hippasterias phrygiana</i> . A. (northern parts), Ar.	x-150
47. <i>Mimaster tizardi</i>	516-555
48. <i>Porania pulvillus</i> . S.	x-106
49. <i>Rhegaster murrayi</i>	285-433
50. <i>Cheilaster fimbriatus</i>	1360
51. <i>Lasiaster villosus</i>	542
52. <i>Asterina gibbosa</i> . L., M.	0-35
53. <i>Palmipes placenta</i> . L., M.	0-30
54. <i>Stichaster roseus</i> . S., North Sea	x-200
55. <i>Neomorphaster eustichus</i> . Azores ...	900-1000
56. <i>Zoroaster fulgens</i> . A.	500-1350
57. <i>Solaster papposus</i> . A., Ar.	0-640
58. — <i>endeca</i> . A., Ar.	0-150
59. — <i>furcifer</i> . A., Ar.	x-605
60. <i>Corethraster hispidus</i> . S., Ar.	101-632
61. <i>Pteraster militaris</i> . A., Ar.	10-600
— —, var. <i>prolata</i>	608
62. — <i>personatus</i> ...	750
63. <i>Hymenaster pellucidus</i> . S., Ar.	70-1537
64. — <i>giganteus</i> ...	750
65. <i>Henricia sanguinolenta</i> . A., M.(?)	x-1350
— —, var. <i>abyssicola</i> ...	516-555
— —, var. <i>curta</i>	0-5
66. <i>Asterias glacialis</i> . S., L., M.	0-66
67. — <i>muelleri</i> . A., Ar.	53-433
68. — <i>rubens</i> . S., L., Ar., M. (??), Japan ..	0-110
— —, var. <i>attenuata</i>	x-53
69. — <i>murrayi</i> ...	22-65
70. — <i>hispidus</i> ...	?
71. <i>Brisinga endecacnemus</i> . S., L.	100-1095
72. — <i>coronata</i> . S., L., M.	200-1360
73. <i>Odinia pandina</i>	440-500
74. <i>Ophiura ciliaris</i> . S., L., M.	7-100
75. — <i>albida</i> . Ar., S., L., M.	x-250
76. — <i>sarsi</i> . A., Ar.	290-345
77. — <i>robusta</i> . A., Ar.	14-180
78. — <i>signata</i> . A.	327-640
79. — <i>affinis</i> . A., M.	10-192
80. — <i>aurantiaca</i> . A.	466-570
81. <i>Ophiocten sericeum</i> . A., Ar.	50-2435
82. <i>Ophiochiton ternispinis</i>	862
83. <i>Ophiomusium lymani</i> . A., Pacific.	180-1825
84. <i>Ophiocnida brachiata</i> . S., L., M.	x-20
85. <i>Amphaura chiyui</i> . A., M.	0-120
86. — <i>filiformis</i> . A., M.	0-120
87. — <i>elegans</i> . A. (including West Indies, Cape), S.E. of Australia	20-120
88. — <i>securigera</i> . A.	40-50
89. — <i>borealis</i> . S.	80-400
90. — <i>bellis</i> , var. <i>tritonis</i>	516
91. <i>Ophiactis abyssicola</i> . S.	400
92. — <i>balli</i> . A.	64-767
93. <i>Ophiopus arcticus</i> . S., Ar.	x-203

	fathoms.
94. <i>Ophiopholis aculeata</i> . A., Ar.....	0-300
95. <i>Ophiacantha bidentata</i> . A. (northern part), Ar.	20-2335
96. — <i>spectabilis</i> . S.	40-433
97. — <i>abyssicola</i> . S., Ar.	20-312
98. <i>Ophiocoma nigra</i> . S., Ar. ...	x-87
99. <i>Ophiopsila annulosa</i> . M.	40-50
100. <i>Ophiothrix fragilis</i> . S., L., M.	0-52
101. — <i>luetkeni</i> . Azores. ...	90-315
102. <i>Ophioscolex glacialis</i> . A., Ar.	100-300
103. — <i>purpurea</i> . A.	64-767
104. <i>Ophiobyrsa hystericis</i>	315-400
105. <i>Ophiomyxa serpentaria</i>	363
106. <i>Astronyx loveni</i> . C. to North Sea and Japan ..	x-350
107. <i>Gorgonocephalus lincki</i> . S.	x-150
108. — <i>eucnemis</i> . A. (northern parts), Ar.	x-433
109. <i>Cidaris papillata</i> . ? World-wide	0-874
110. — <i>purpurata</i>	542
111. — <i>gracilis</i>	750
112. <i>Asthenosoma hystrix</i> . A.....	103-547
113. <i>Phormosoma placentata</i> . A.	150-1242
114. — <i>uranus</i> . A.	399-1742
115. <i>Echinus acutus</i> . ? World-wide	x-1350
116. — <i>norvegicus</i> . ? World-wide	x-2435
117. — <i>microstoma</i> , L.	110-500
118. — <i>miliaris</i> . Ar., S., L., M.	x-45
119. — <i>esculentus</i> . A., Ar., M., Port Natal	0-110
120. — <i>elegans</i> . A., M., Admiralty Islands	x-1350
121. <i>Strongylocentrotus droebachiensis</i> . C.	0-640
122. — <i>lividus</i> . A., M.	0-2
123. <i>Sphærechinus granularis</i> . L., M.	0-37
124. <i>Echinocyamus pusillus</i> . A., M.	0-325
125. <i>Neolampas rostellata</i> . Florida	100-229
126. <i>Schizaster fragilis</i> . S.	50-500
127. <i>Spatangus purpureus</i> . A., M.....	5-530
128. — <i>raschi</i> . A.....	30 (?) -200
129. <i>Echinocardium cordatum</i> . A., M. ..	0-85
130. — <i>pennatifidum</i> . A.	x-120
131. — <i>flavescens</i> . A., Ar.	5-140
132. <i>Brissopsis lyrifera</i> . A., M.	10-1467

TABLE II.—*Species not known beyond the British Area.*

Of these species twenty-five are known only from the neighbourhood of our own shores; they fall into one of three categories.

(1) Littoral and rare or very local.

1. *Holothuria nigra*: Canon Norman, whose opinion on British forms must always be most respectfully considered, is inclined to think this is the same as a Mediterranean species.
2. *Asterias murrayi*, which is, I think, with our present lights, a good species.
3. *A. hispida*: this is a very difficult form to recognize, and one is often inclined to regard it as the young only of some commoner form.

(2) Incompletely known.

1. *Cucumaria fucicola*.
2. — *andrewsi*.
3. *Thyone flexus*.
4. — *elegans*.
5. *Colochirus andersoni*.

(3) Deep-water forms.

1. *Stichopus tizardi*.
2. *Holothuria aspera* (single specimen).
3. *Astropecten sphenoplax* (diagnosed in 1892).
4. *Bathyiaster vexillifer* (single specimen).
5. *Pentagonaster greeni* (single specimen).
6. *Mimaster tizardi*.
7. *Rhegaster murrayi*.
8. *Cheilaster fimbriatus*.
9. *Lasiaster villosus*.
10. *Pteraster personatus* (described in 1891).
11. *Hymenaster giganteus* (described in 1891).
12. *Odimia pandina*.
13. *Ophiochiton ternispinis*.
14. *Ophiobyrsa hystricis*.
15. *Ophiomyxa serpentaria*.
16. *Cidaris purpurata*.
17. — *gracilis* ("probably immature"; described in 1891).

Of the third category it may be confidently predicted that some of the species will be found to be synonyms of others already described, and that the range of most will be extended by future dredgings in deep water.

TABLE III.—List of British Echinoderms, arranged by grades of Depth from above downwards.

Not known beyond		Number of Species.
10 fms.	<i>Strongylocentrotus lividus</i>	1
20 fms.	<i>Holothuria nigra</i> , <i>Ophiocnida brachiata</i>	2
30 fms.	<i>Synapta buski</i> , <i>Cucumaria planci</i> , <i>Palmipes placenta</i> ..	3
40 fms.	<i>Asterina gibbosa</i> , <i>Sphærechinus granularis</i>	2
50 fms.	<i>Cucumaria pentactes</i> , <i>C. lactea</i> , <i>Amphiura securigera</i> , <i>Ophiopsila annulosa</i> , <i>Echinus miliaris</i>	5
60 fms.	<i>Ophiothrix fragilis</i>	1
70 fms.	<i>Phyllophorus pellucidus</i> , <i>Asterias glacialis</i> , <i>A. murrayi</i>	3
80 fms.	<i>Synapta digitata</i> , <i>Thyone fusus</i> , <i>Phyllophorus drummondi</i> .	3
90 fms.	<i>Luidia ciliaris</i> , <i>Ophiocoma nigra</i> , <i>Echinocardium cor-</i> <i>datum</i>	3
100 fms.	<i>Synapta inhærens</i> , <i>Antedon bifida</i> , <i>A. petasus</i> , <i>Ophiura</i> <i>ciliaris</i>	4

Not known beyond		Number of Species.
120 fms.	<i>Porania pulvillus</i> , <i>Asterias rubens</i> , <i>Amphiura chiajii</i> , <i>A. filiformis</i> , <i>A. elegans</i> , <i>Echinus esculentus</i> , <i>Echinocardium pennatifidum</i>	7
150 fms.	<i>Psolus phantapus</i> , <i>Ps. fabricii</i> , <i>Hippasterias phrygiana</i> , <i>Solaster endeca</i> , <i>Gorgonocephalus lincki</i> , <i>Echinocardium flavescens</i>	6
200 fms.	<i>Thyone raphanus</i> , <i>Stichaster roseus</i> , <i>Ophiura affinis</i> , <i>O. robusta</i> , <i>Spatangus raschi</i>	5
250 fms.	<i>Cucumaria frondosa</i> , <i>Ophiura albida</i> , <i>Ophiactis balli</i> , <i>Neolampas rostellata</i>	4
500 fms.	<i>Cucumaria hyndmani</i> , <i>Astropecten sphenoplax</i> , <i>Bathybaster vexillifer</i> , <i>Luidia sarsi</i> , <i>Rhegaster murrayi</i> , <i>Asterias muelleri</i> , <i>Odinia pandina</i> , <i>Ophiura sarsi</i> , <i>Ophiopholis aculeata</i> , <i>Amphiura borealis</i> , <i>Ophiopus arcticus</i> , <i>Ophiacantha spectabilis</i> , <i>O. abyssicola</i> , <i>Ophiothrix luetkeni</i> , <i>Ophioscolex glacialis</i> , <i>Ophiobyrsa hystericis</i> , <i>Ophiomyxa serpentaria</i> , <i>Astronyx loveni</i> , <i>Gorgonocephalus eucnemis</i> , <i>Echinus microstoma</i> , <i>Echinocyamus pusillus</i> , <i>Schizaster fragilis</i>	22
750 fms.	<i>Cucumaria hispida</i> , <i>Holothuria intestinalis</i> , <i>H. tremula</i> , <i>Stichopus tizardi</i> , <i>Antedon eschrichti</i> , <i>A. phalangium</i> , <i>A. proluxa</i> , <i>A. tenella</i> , <i>Ctenodiscus crispatus</i> , <i>Leptopychaster arcticus</i> , <i>Lasiaster villosus</i> , <i>Psilaster andromeda</i> , <i>Pentagonaster granularis</i> , <i>Mimaster tizardi</i> , <i>Solaster furcifer</i> , <i>S. papposus</i> , <i>Corethraster hispidus</i> , <i>Pteraster militaris</i> , <i>P. personatus</i> , <i>Hymenaster giganteus</i> , <i>Ophiura signata</i> , <i>O. aurantiaca</i> , <i>Amphiura bellis</i> var. <i>tritonis</i> , <i>Cidaris purpurata</i> , <i>C. gracilis</i> , <i>Asthenosoma hystrix</i> , <i>Strongylocentrotus droebachiensis</i> , <i>Spatangus purpureus</i>	28
1000 fms.	<i>Holothuria aspera</i> , <i>Pontaster tenuispinis</i> , <i>Astropecten irregularis</i> , <i>Pentagonaster greeni</i> , <i>Neomorphaster eustichus</i> , <i>Ophiactis abyssicola</i> , <i>Ophiochiton ternispinis</i> , <i>Ophioscolex purpurea</i> , <i>Cidaris papillata</i>	9
Known be yond		
1000 fms.	<i>Plutonaster bifrons</i> , <i>P. pareli</i> , <i>Nymphaster subspinosus</i> , <i>Cheilaster fimbriatus</i> , <i>Zoroaster fulgens</i> , <i>Hymenaster pellucidus</i> , <i>Henricia sanguinolenta</i> , <i>Brisinga endecacnemos</i> , <i>B. coronata</i> , <i>Ophiocten sericeum</i> , <i>Ophiomusium lymani</i> , <i>Ophiacantha bidentata</i> , <i>Phormosoma placenta</i> , <i>P. uranus</i> , <i>Echinus acutus</i> , <i>E. norvegicus</i> , <i>E. elegans</i> , <i>Brissopsis lyrifera</i>	18

TABLE IV.—List of British Echinoderms, arranged by grades of Depth from below upward.

Not known above		Number of Species.
1000 fms.	<i>Hol. aspera</i> , <i>Pentagonaster greeni</i> , <i>Cheilaster fimbriatus</i> .	3
750 fms.	<i>Neomorphaster eustichus</i> , <i>Pteraster personatus</i> , <i>Ophiochiton ternispinis</i> , <i>Cidaris gracilis</i> , <i>C. purpurata</i>	5

Not known above		Number of Species.
500 fms.	<i>Stichopus tizardi</i> , <i>Zoroaster fulgens</i> , <i>Astropecten sphenoplax</i>	3
400 fms.	<i>Odinia pandina</i> , <i>Ophiopus arcticus</i>	2
250 fms.	<i>Rhegaster murrayi</i> , <i>Brisinga coronata</i> , <i>Ophiura sarsi</i> , <i>O. signata</i> , <i>Ophiobyrsa hystericis</i> , <i>Ophiomyxa serpentaria</i> , <i>Phormosoma uranus</i> ...	7
100 fms.	<i>Plutonaster bifrons</i> , <i>Pontaster pareli</i> , <i>Nymphaster subspinosus</i> , <i>Corethraster hispidus</i> , <i>Brisinga endecacnemos</i> , <i>Ophiomusium lymani</i> , <i>Ophiocolax glacialis</i>	7

We see, then, that of the 126 species as to whose bathymetrical distribution we have some information,

3	occur at or below the 1000 fm. line.	
5	others	750
3	"	500
2	"	400
7	"	250
7	"	100

On the other hand,

18	extend beyond the 1000 fm. line.	
9	" to the	1000
28	"	750
22	"	500
4	"	250
5	"	200
6	"	150
7	"	120
4	"	100
3	"	90
3	"	80
3	"	70
1	"	60
5	"	50
2	"	40
3	"	30
2	"	20
1	"	10

Of the six as to which we have no definite information, we may suppose that none were dredged from more than 100 fms.

Limiting ourselves, however, to the 126, we note:—

- (1) Only 13 are limited by the 50 fm. line.
- (2) Only 27 " " 100 "
- (3) While 22 reach the 500 "
- (4) And 28 " 750 "

It is obvious that, if there be a natural British area, that area must be limited in depth as well as in extent, and the bathymetrical limit must lie at the point where the coast of Britain becomes continuous with the continent of Europe. Outside this the land sheers rapidly downwards, and not far from the mouth of the English Channel the dredge will sink for more than 2000 fms.

But, for Echinoderms at any rate, there is no natural British area; Shetland belongs as certainly to the Scandinavian area as do the Channel Islands to the Lusitanian, or the deep water off Ireland to the general Atlantic fauna.

The only conclusions, therefore, which we need attempt to reach are such as may be of interest to a collector who finds himself more or less within hail of the United Kingdom.

He will find that, if his apparatus be sufficient, he may dredge to any depth with almost a certainty of finding Echinoderms. He will often find them in profusion and sometimes in great variety. He will find that the teaching of the earlier marine zoologists as to zones or belts of animal life is hardly confirmed by the extension of such characteristically shore forms as the Common Sea-Star or the Heart-Urchin to, respectively, 120 fms. and 85 fms. Forms which he has dredged from a few fathoms, like the Fiddle-Urchin, will be found at a depth of more than a hundred times ten fathoms, or, like *Ophiacantha bidentata*, to extend from 20 to 2000 fms.

Of a number of Echinoderms found within a few hours' or days' sail of the British coast, we know far too little; nearly every deep-sea dredging increases the bathymetrical range of familiar forms, and there is, doubtless, much work to be done in the future.

Well known forms, if taken from considerable depths will often appear at first sight to present important points of variation from specimens already known, but comparison with a large series will often show that they are only some of the many varieties of a widely-distributed species.

TABLE V.—*Distribution of Echinoderms within the British Area.*

The distribution of the British Echinoderma within the artificial region selected offers some points of interest: for example, the area of the North Sea contains far fewer species than the western coasts of our islands; a number of the forms here catalogued are confined to, or, to speak more strictly, are only known as yet from, the Faeroe Channel, and the fauna of the Channel Islands is very different from that of Shetland.

I proceed, therefore, to give a Table of Distribution for nine areas, which will, I think, be found generally useful to the collector.

Table of Distribution of British Echinoderms (*continued*).

Name of Species.	Faeroe Channel.	W. Scotland.	S. & W. Ireland.	Irish Sea.	St. George's Channel.	English Channel.	North Sea.	Shetland.	Channel Islands.
55. <i>Neomorphastraster eustichus</i> .....		..	*				
56. <i>Zoroaster fulgens</i>	*	*	..	*	*	*	*	*	*
57. <i>Solaster papposus</i>	*	*	*	*	*	*	*	*	*
58. — <i>endeca</i> ... ..	..	*	*	*	*	*	*	*	*
59. — <i>furcifer</i>	*	*	*	*	*	*	*	*	*
60. <i>Corethraster hispidus</i>	*	*	*	*	*	*	*	*	*
61. <i>Pteraster militaris</i>	*	*	*	*	*	*	*	*	*
62. — <i>personatus</i> .....	..	..	*				
63. <i>Hymenaster pellucidus</i>	*	*	*						
64. — <i>giganteus</i> .....	..	*	*	*	*	*	*	*	*
65. <i>Henricia sanguinolenta</i>	*	*	*	*	*	*	*	*	*
66. <i>Asterias glacialis</i> .....	..	*	*	*	*	*	*	*	*
67. — <i>muelleri</i>	*	*	*	*	*	*	*	*	*
68. — <i>rubens</i>	N. Rona.	*	*	*	*	*	*	*	*
69. — <i>murrayi</i>. .....	..	*	*	*	*	*	*	*	*
70. — <i>hispidus</i> .....	..	*	*	*	*	*	*	*	*
71. <i>Brisinga endecacnemos</i>	*	*	*	*	*	*	*	*	*
72. — <i>coronata</i>	*	*	*	*	*	*	*	*	*
73. <i>Odimia pandina</i>	*	*	*	*	*	*	*	*	*
74. <i>Ophiura ciliaris</i>. .....	..	*	*	*	*	*	*	*	*
75. — <i>albida</i>	*	*	*	*	*	*	*	*	*
76. — <i>sarsi</i> .....	*	*	*	..	..	..	..	..	..
77. — <i>robusta</i> .. ..	..	..	..	..	..	..	..	..	..
78. — <i>signata</i> .. ..	*	*	*	..	..	..	..	..	..
79. — <i>affinis</i> .....	..	*	*	..	..	..	..	..	..

Table of Distribution of British Echinoderms (*continued*).

Name of Species.	Faeroe Channel.	W. Scotland.	S. & W. Ireland.	Irish Sea.	St. George's Channel.	English Channel.	North Sea.	Shetland.	Channel Islands.
108. <i>Gorgonocephalus eucnemis</i>	*								
109. <i>Cidaris papillata</i>. . . . .	..	*	*					*
110. — <i>purpurata</i>		*							
111. — <i>gracilis</i> . . . . .	..		*					
112. <i>Asthenosoma hystrix</i>	*		*						
113. <i>Phormosoma placenta</i>	*		*						
114. — <i>uranus</i>	*		*						
115. <i>Echinus acutus</i>	*		*		*	*	*	*	
116. — <i>norvegicus</i> . . . . .	..		*		..			*
117. — <i>microstoma</i>. . . . .	..		*		*	*	*	*
118. — <i>miliaris</i>		*	..	*	*	*	*	*	
119. — <i>esculentus</i>		*	*	*	*	*	*	*	
120. — <i>elegans</i>	*		*		..	*	*	*	*
121. <i>Strongylocentrotus droebachiensis</i> . . . . .					..	*	*	*
122. — <i>lividus</i> . . . . .			*		..	*	..	..	*
123. <i>Sphaerechinus granularis</i> . . . . .	..			*				*	*
124. <i>Echinocyamus pusillus</i>	N. Rona.			*	*	*	*	*	*
125. <i>Neolampas rostellata</i> . . . . .	..	Scotland							
126. <i>Schizaster fragilis</i>	Between	and Fae roe.							
127. <i>Spatangus purpureus</i>	*		*	*	*	*	*	*	*
128. — <i>raschi</i>			*		..			*	*
129. <i>Echinocardium cordatum</i>		*		*	*	*	*	*	*
130. — <i>pennatifidum</i>	N. Rona.				..	*	*	*	*
131. — <i>flavescens</i>		*	*	*	..	*	*	*	*
132. <i>Brissopsis lyrifera</i>	*		*	*	..	*	*	*	*

So far as at present known 56 species are found in the Faeroe Channel, of which 25 are not known in the seas nearer Britain; of the 43 found at Shetland only 3 have not been collected further south. The record of Channel Islands species ought, in all probability, to be a good deal higher than 22; of these, only one (*Sphaerechinus granularis*) is not found to the northward of those islands. Forty-four species are recorded from the North Sea, but the east coast of England would seem to be particularly poor, if we may form an opinion from the Collections in Museums.

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DESCRIPTION OF THE PLATES.

Plates I.-VI. illustrate the spicules of Holothurians, magnified, unless otherwise stated, 290 times. Spicules for microscopic observation can be readily prepared by cutting off a podion or a small portion of the skin, and treating it with a few drops of caustic potash at a moderate heat.

PLATE I.

- Fig. 1. Anchors and plates of *Synapta inhærens* (p. 33).
Fig. 2. " " " *buski* (p. 34).
Fig. 3. " " " *digitata* (p. 34).

PLATE II.

- Fig. 1. *a*, Plates from the body-wall; and *b*, Spicules from the podia of *Cucumaria hyndmani* (p. 36).
Fig. 2. The same from *Cucumaria planci*; *c*, Spicules, $\times 450$ (p. 37).

PLATE III.

- Fig. 1. *a*, Plates from the body-wall; and *b*, Spicules from the podia of *Cucumaria pentactes* (p. 37).
Fig. 2. The same from *Cucumaria lactea* (p. 38).

PLATE IV.

- Fig. 1. Spicules of *Cucumaria hispida*, shown as large as they are for the purpose of being easily compared with the others, as they are drawn to exactly the same scale as most (p. 38).
Fig. 2. The same of *C. frondosa*; these generally become less numerous as the animal increases in size (p. 39).

PLATE V.

- Fig. 1. Spicules of *Thyone fusus*, the two lower $\times 450$ to show the details of those figured on their right (p. 42).
 Fig. 2. Spicules of *Thyone raphanus* (p. 42).
 Fig. 3. „ „ *Phyllophorus pellucidus* (p. 46).
 Fig. 4. „ „ „ *drummondi* (p. 47).

PLATE VI.

- Fig. 1. Spicules of *Psolus phantapus* (p. 44).
 Fig. 2. „ „ „ *fabricii*: *a*, from the body-wall; *b*, from the podia (p. 45).
 Fig. 3. Spicules of *Holothuria intestinalis* (p. 48).
 Fig. 4. „ „ „ *tremula* (p. 49).
 Fig. 5. „ „ „ *nigra* (p. 49); the three uppermost $\times 450$ to show the details of those which lie just below them.

PLATE VII.

Figures of external forms of Holothurians, from specimens preserved in spirit.

- Fig. 1. *Synapta digitata*, nat. size (p. 34).
 Fig. 2. Tentacles of *Synapta digitata*, $\times 6$, to show the arrangement of the pinnæ on the tentacles.
 Fig. 3. *Thyone fusus*, nat. size (p. 42).
 Fig. 4. *Phyllophorus drummondi*, nat. size (p. 47).

PLATE VIII.

Figures of external forms of Holothurians; figs. 1, 2, and 5 from life, 3 and 4 from spirit-specimens.

- Fig. 1. *Cucumaria planci*, $\times \frac{2}{3}$ (p. 37).
 Fig. 2. *Cucumaria pentactes*, $\times \frac{1}{2}$ (p. 37).
 Fig. 3. *Thyone raphanus*, $\times 2$ (p. 42).
 Fig. 4. *Psolus phantapus*, nat. size (p. 44).
 Fig. 5. *Holothuria nigra*, $\times \frac{2}{3}$ (p. 49).

PLATE IX.

Figures to illustrate the structure and variations of *Antedon bifida* (p. 54).

- Fig. 1. Dorsal view of disk to show the cirrus-pits (*cp*), the modes of branching of the arms, the form of the radials (R^3), and a syzygy (*sz*), $\times 8$.

PLATE XIV.

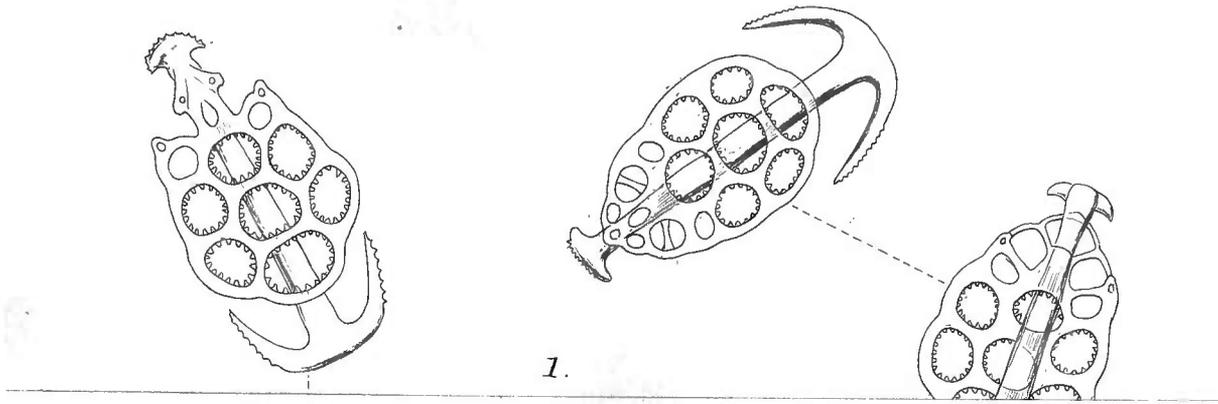
- Fig. 1. *Echinus microstoma* (p. 149), nat. size, to show the general aspect of the species with the spines on.
- Fig. 2. Part of test of same, $\times 2$, to show the characters of the ornamentation of the test.
- Fig. 3. *Echinus elegans* (small specimen) (p. 154), nat. size, to show the general aspect of the species with the spines on.
- Fig. 4. Part of test of same, $\times 2$, to show the same points as fig. 2.

PLATE XV.

- Fig. 1. *Strongylocentrotus droebachiensis* (p. 156); portion of test, $\times 2$, to show the arrangement of the tubercles on the ambulacral and interambulacral plates, and some of the variations exhibited by the number of pores in an arc.
- Fig. 2. *Sphærechinus granularis* (p. 158); portion of test, $\times 2$, to show the arrangement of the tubercles and of the poriferous plates.
- Fig. 3. *Sphærechinus granularis*, to show the ordinary appearance of the species, nat. size.

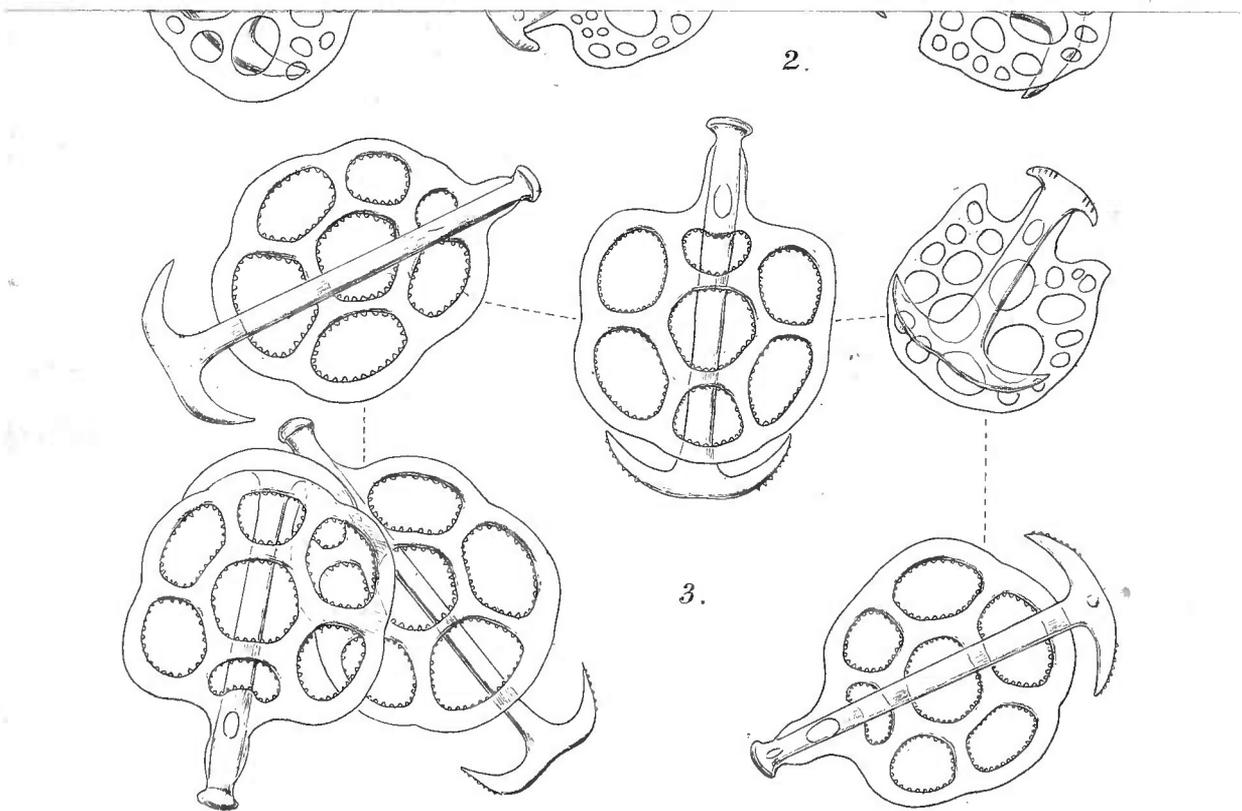
PLATE XVI.

- Fig. 1. *Echinocardium cordatum* (p. 169), nat. size, to show the general appearance of this common species when found, as it often is in abundance, thrown up on the sea-shore. The disposition of the pores is to be specially noted.
- Figs. 2-4. Outlines of tests of the same, nat. size, to show some of the variations exhibited in the shape of the test.
- Fig. 5. *Echinocardium pennatifidum* (p. 170), nat. size; the spines remaining on the left side, but removed from the right, so as to show the disposition of the pores.
- Fig. 6. *Echinocardium flavescens* (p. 171), nat. size, from above; the absence of an anterior groove is to be noted.
- Fig. 7. The same, seen from below.
- Fig. 8. *Echinocyamus pusillus* (p. 160), $\times 2$, seen from above.
- Fig. 9. The same, $\times 2$, seen from below.
- Fig. 10. Outline of labrum of *Spatangus purpureus* (p. 165), nat. size, to be compared with
- Fig. 11, in which the more pointed labrum of *Spatangus raschi* (p. 167) is shown.



In legend to Plate I.

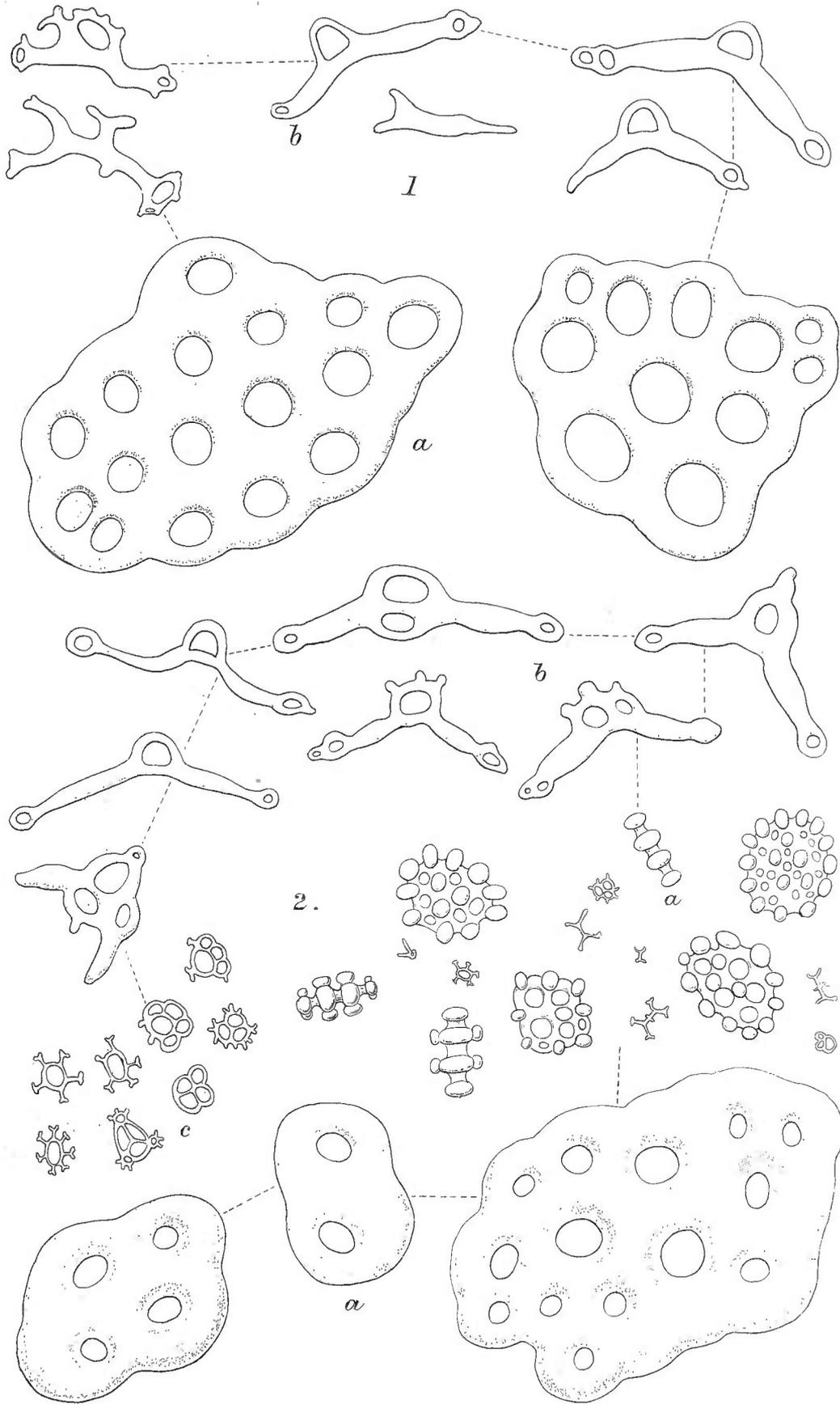
For 2 read 3, and for 3 read 2.



Bejéan & Highley del. et sc.

Mintern Bros. imp.

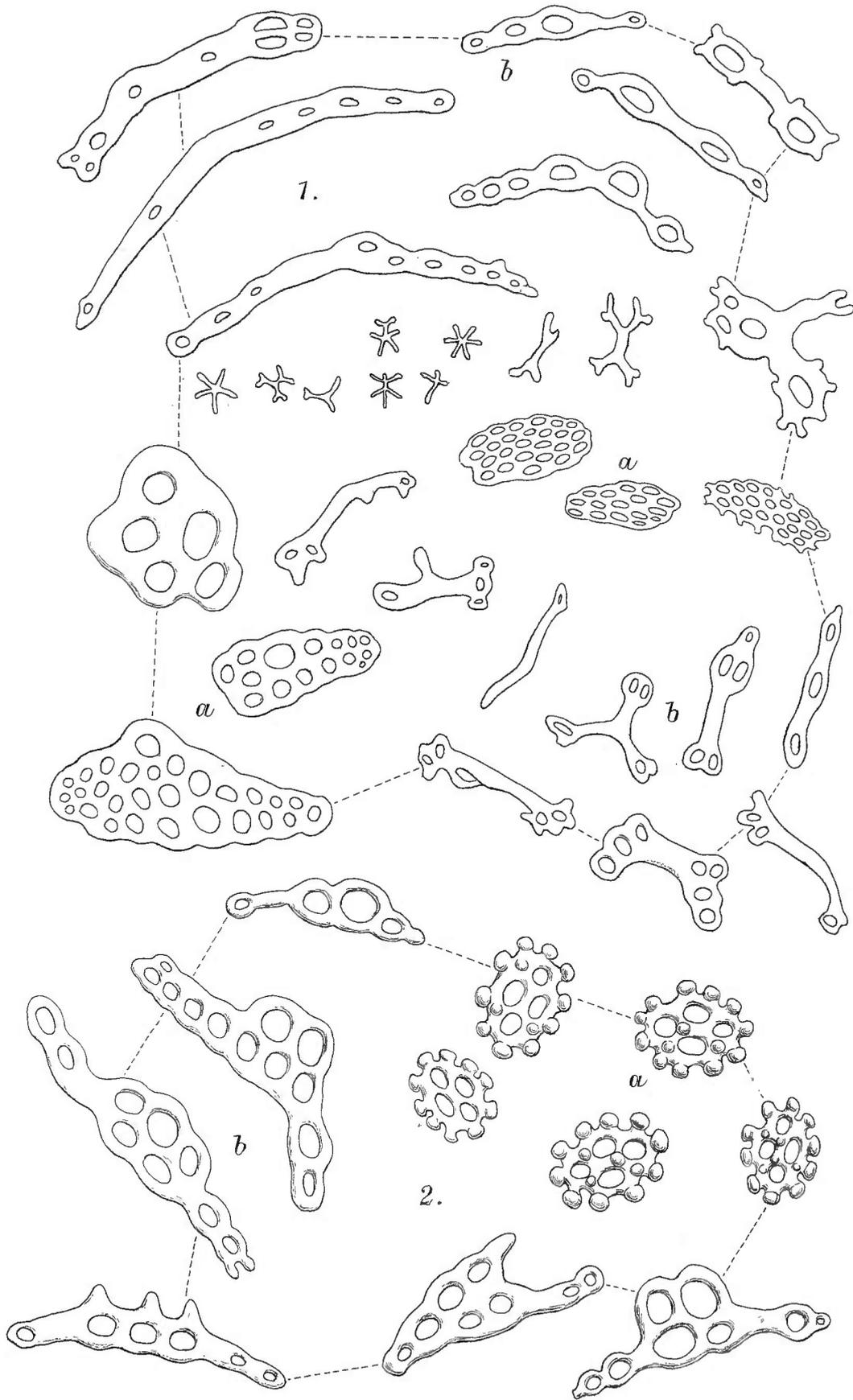
1. *Synapta inhaerens*. 2. *Synapta buski*. 3. *Synapta digitata*.



Berjeau & Highley del. et sc.

Mintern Bros. imp.

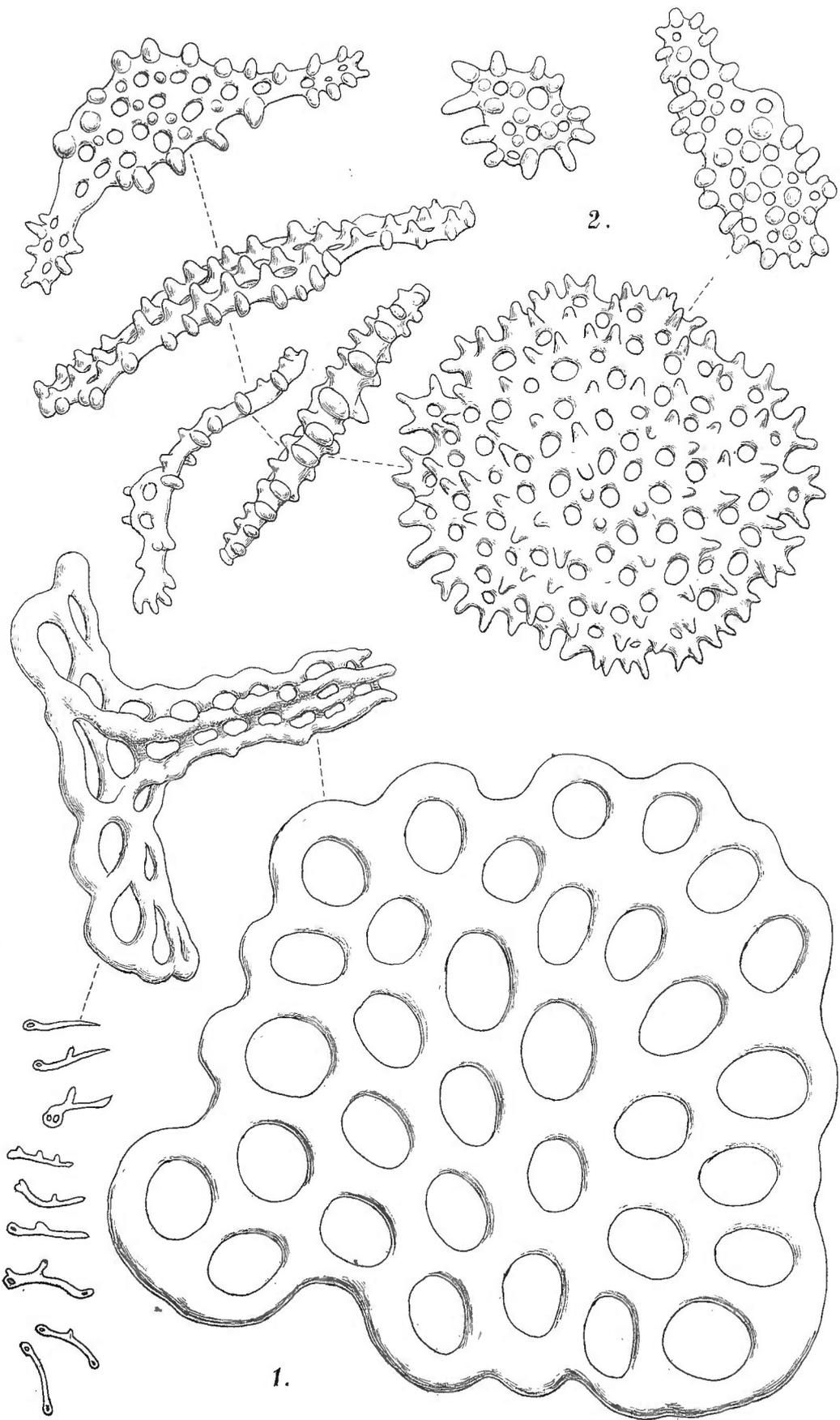
1. Cucumaria hyndmani 2. *Cucumaria planca*



Berjeau & Highley del. et sc.

Mintern Bros imp

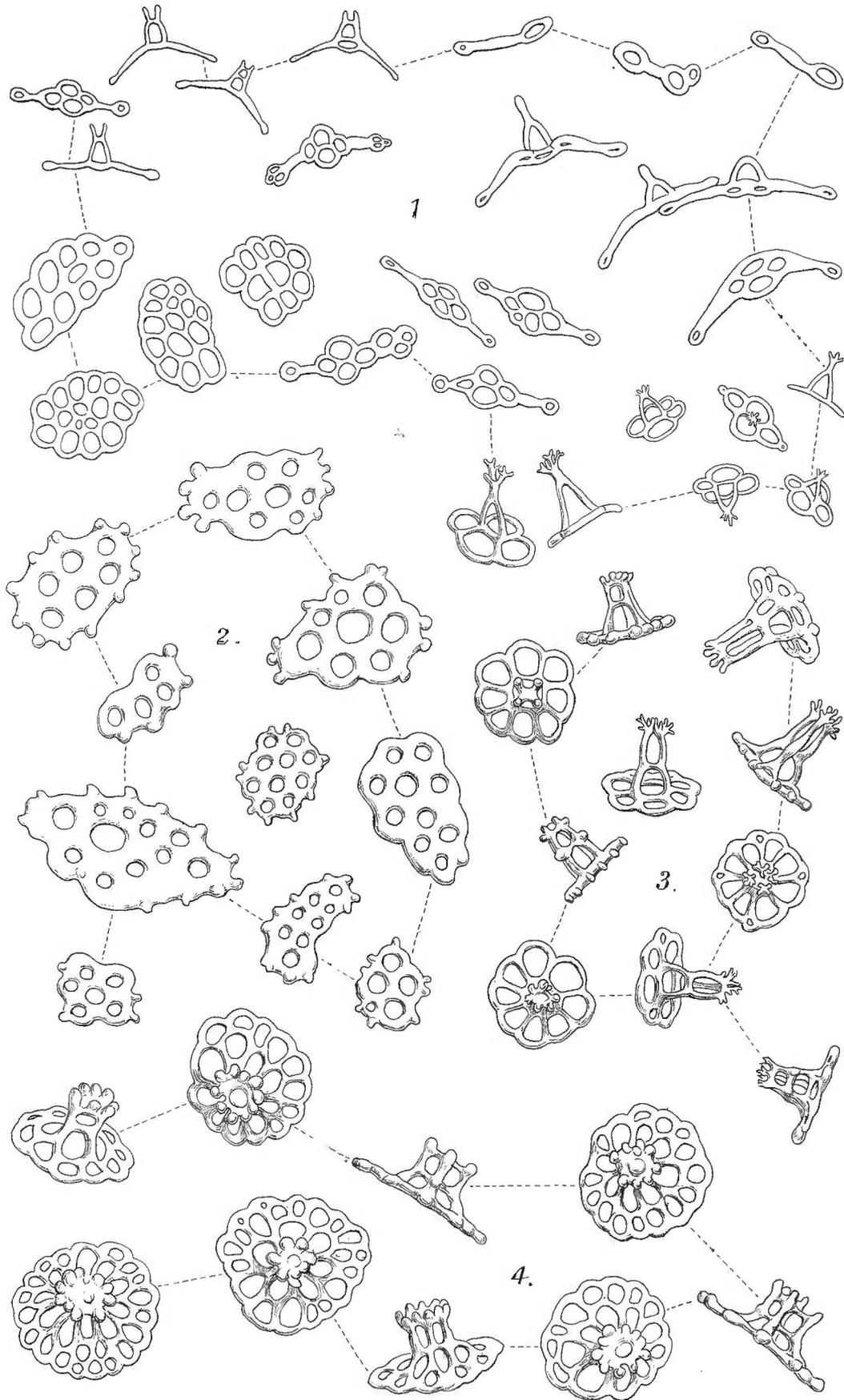
1. *Cucumaria pentactes*. 2. *Cucumaria lactea*.



Benjéau & Highley del. et sc.

Mintern Bros. imp.

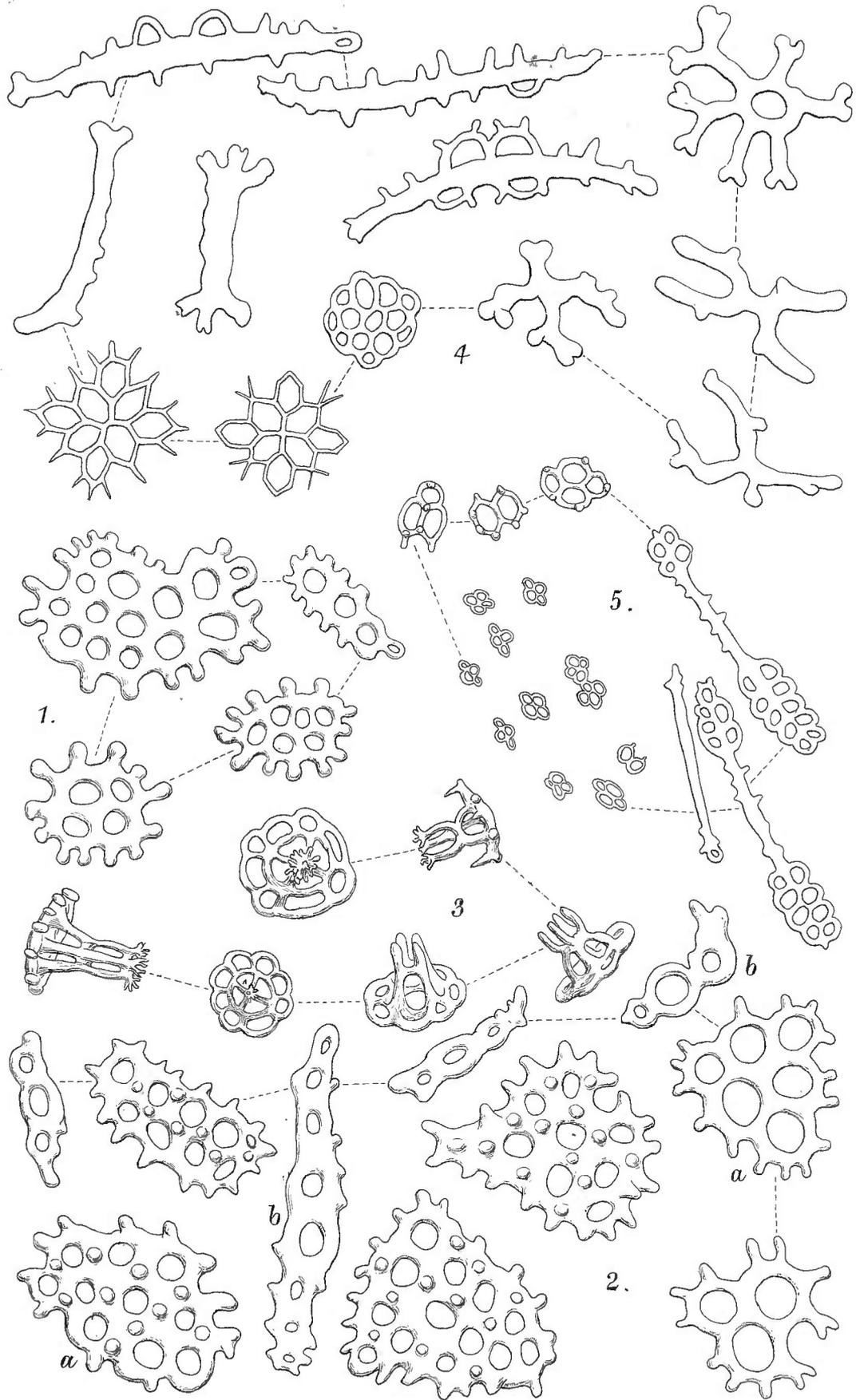
1. *Cucumaria hispida* 2. *Cucumaria frondosa*



Berjeau & Highley del. et sc.

Mintern Bros. imp.

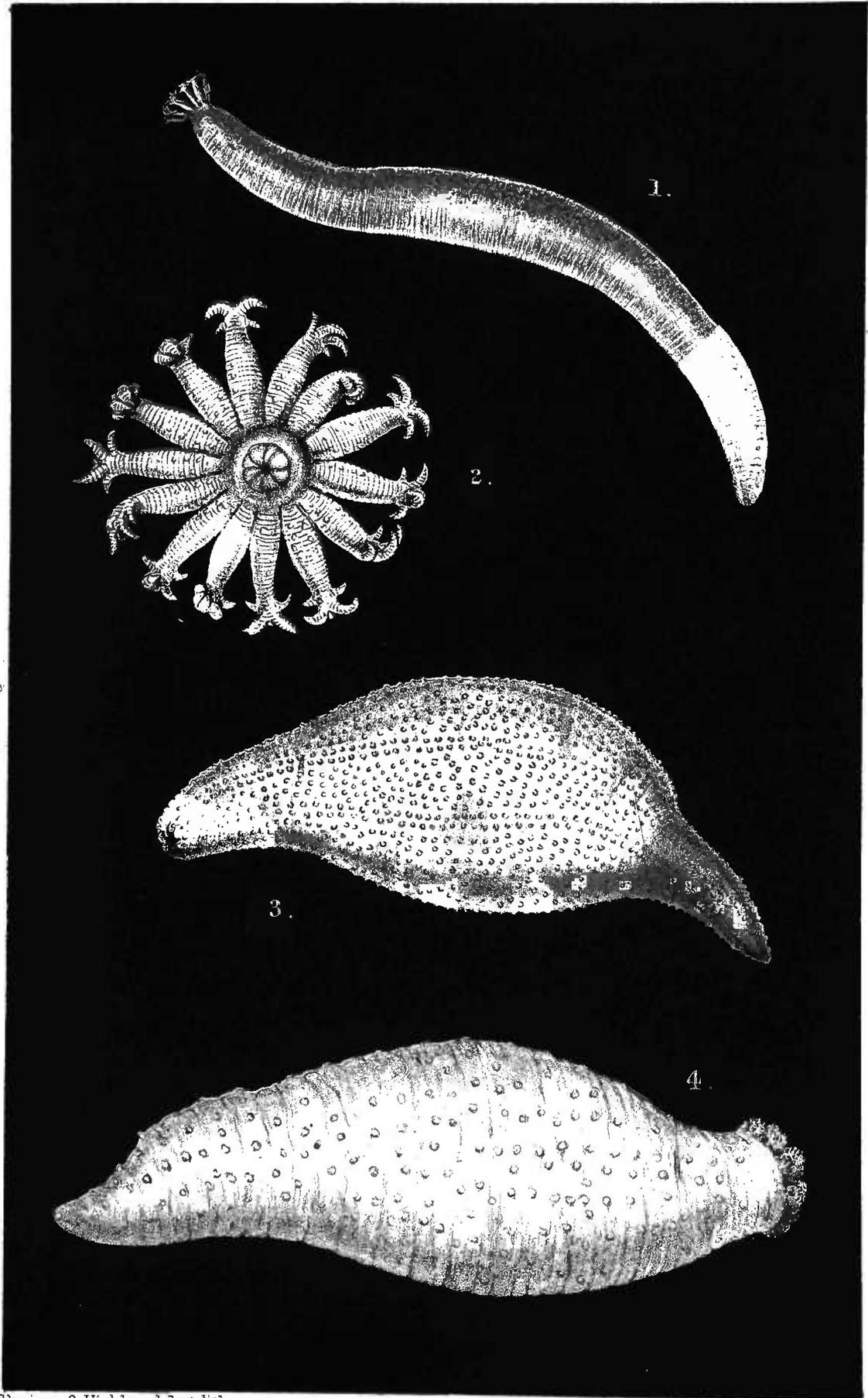
1. *Thyone fusus*. 2. *Thyone raphanus*
3. *Phyllophorus pellucidus*. 4. *Phyllophorus drummondii*.



Berjeau & Highley del. et sc.

Mintern Bros. imp.

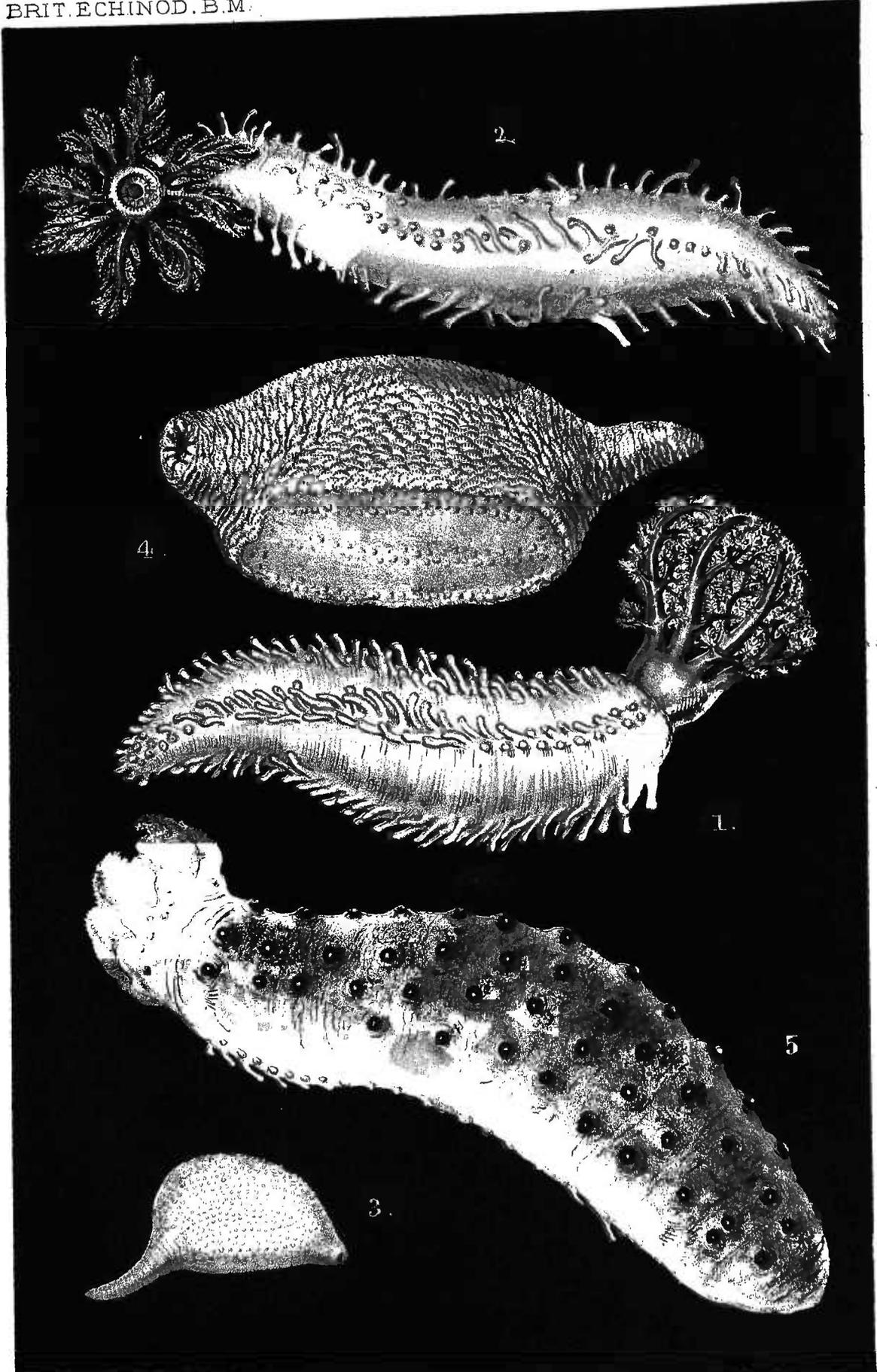
1. *Psolus phantapus* 2. *Psolus fabricii*.
 3. *Holothuria intestinalis*. 4. *Holothuria tremula*. 5. *Holothuria nigra*



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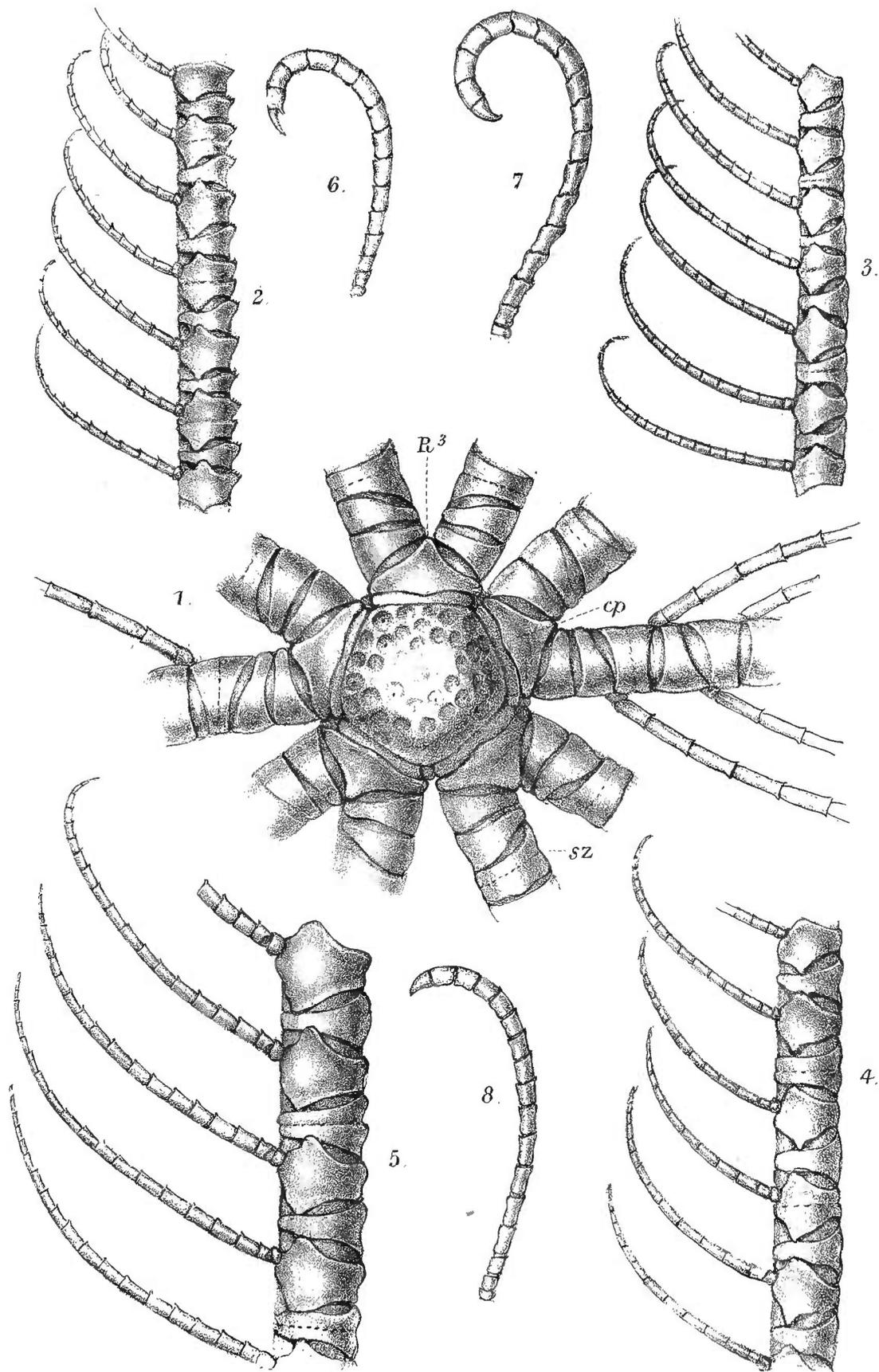
1. *Synapta digitata*. 2. Tentacles of *Synapta digitata*.
3. *Thyone fusus* 4. *Phyllophorus drummondi*



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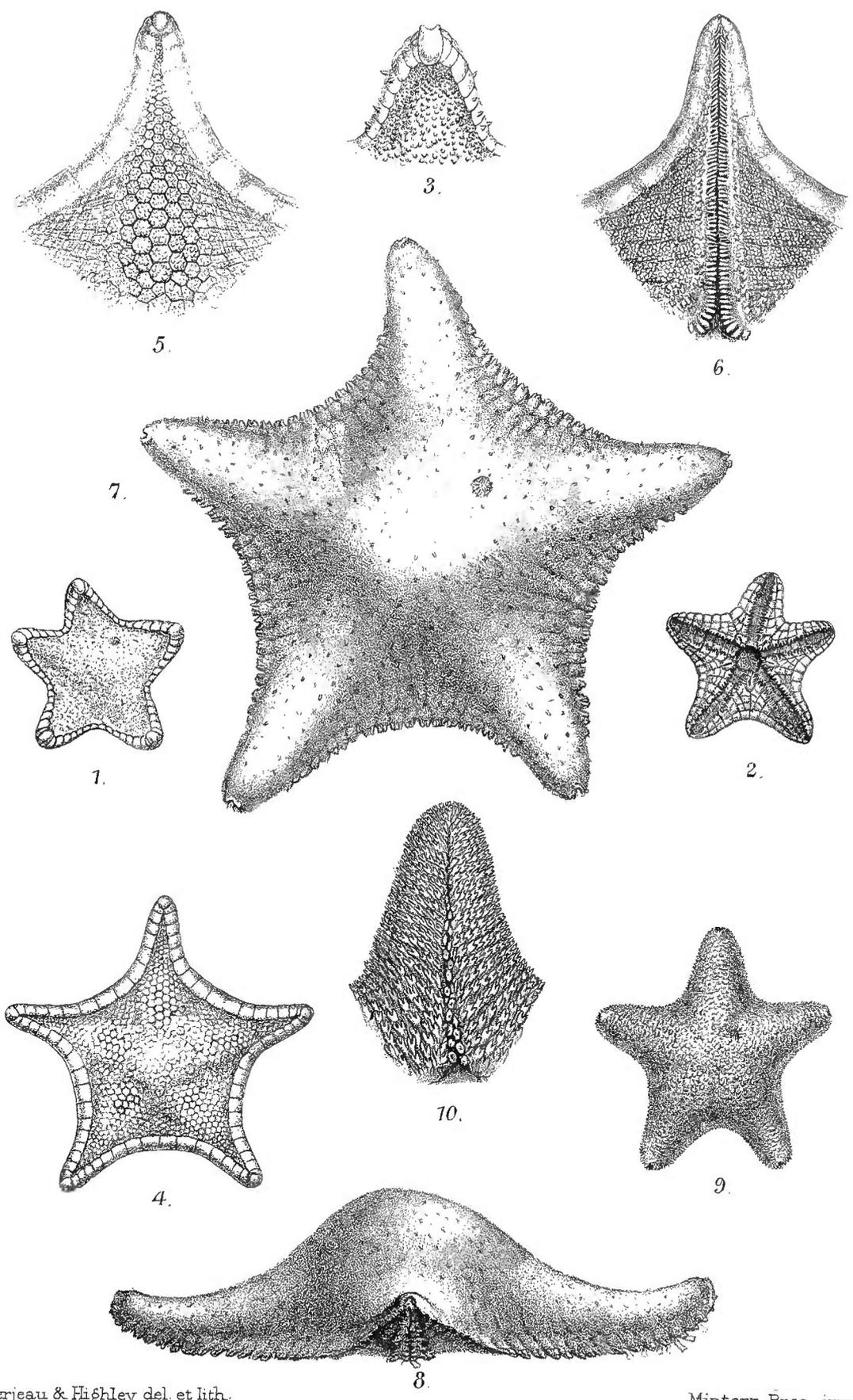
1. *Cucumaria planci*. 2. *Cucumaria pentactes*. 3. *Thyone raphanus*.
 4. *Psolus phantapus*. 5. *Holothuria nigra*.



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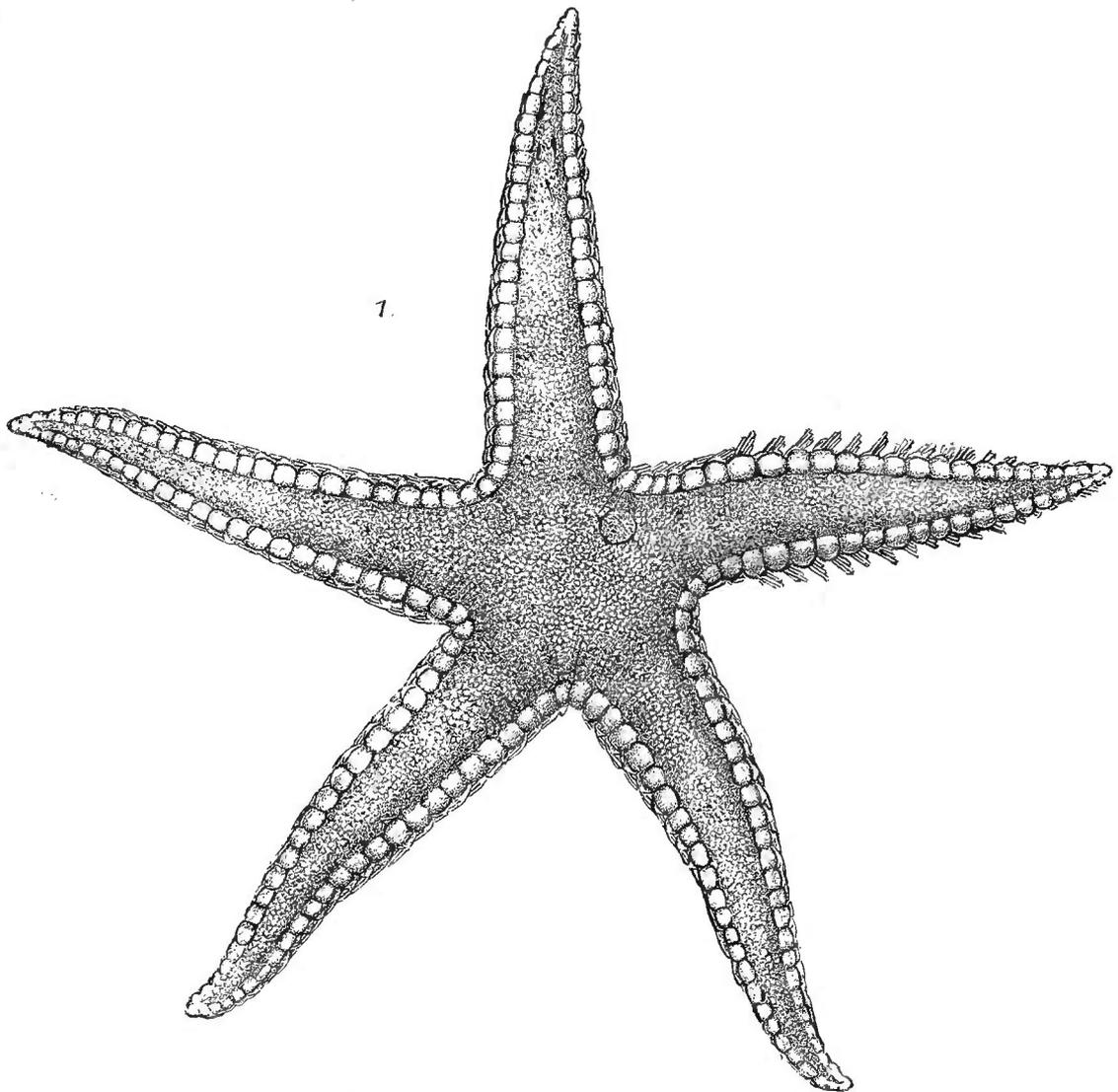
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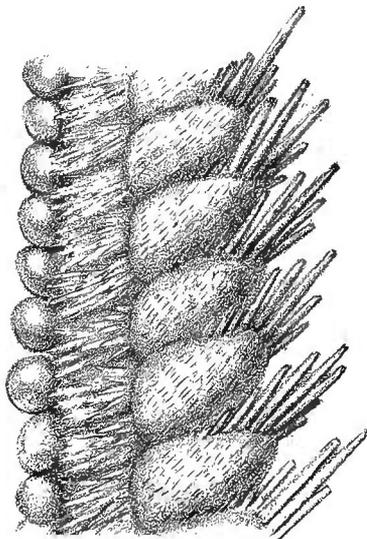
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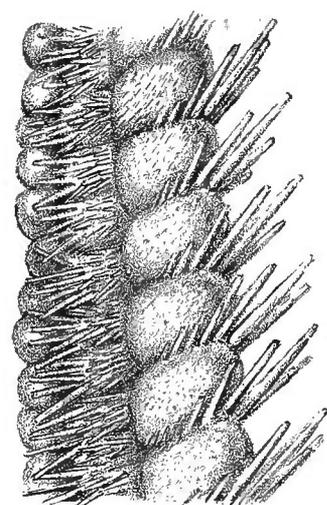
1-3. *Ctenodiscus crispatus*. 4-6. *Pentagonaster regularis*.
 7, 8. *Porania pulvillus*. 9, 10. *Asterina gibbosa*.



1.



2.

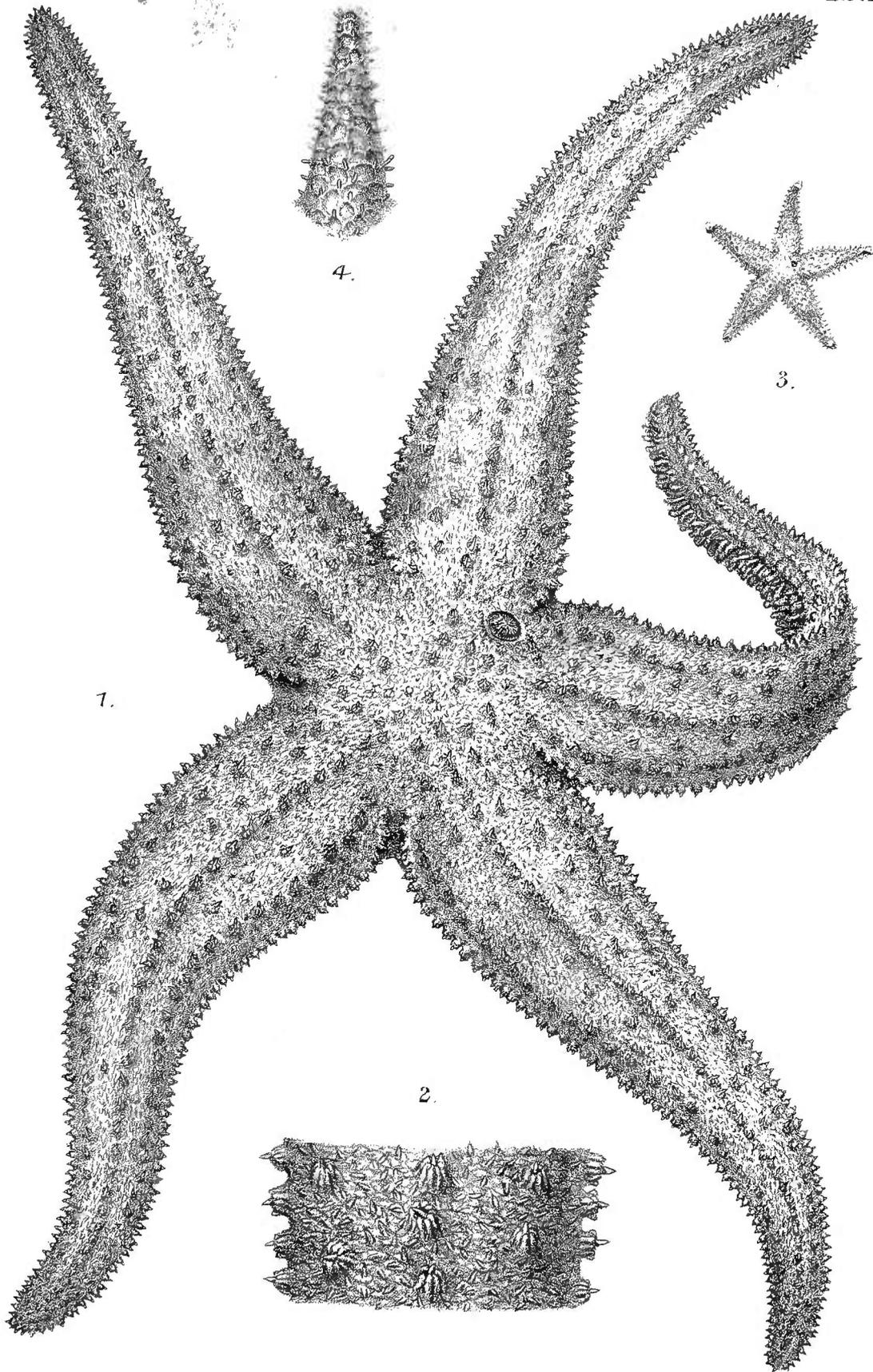


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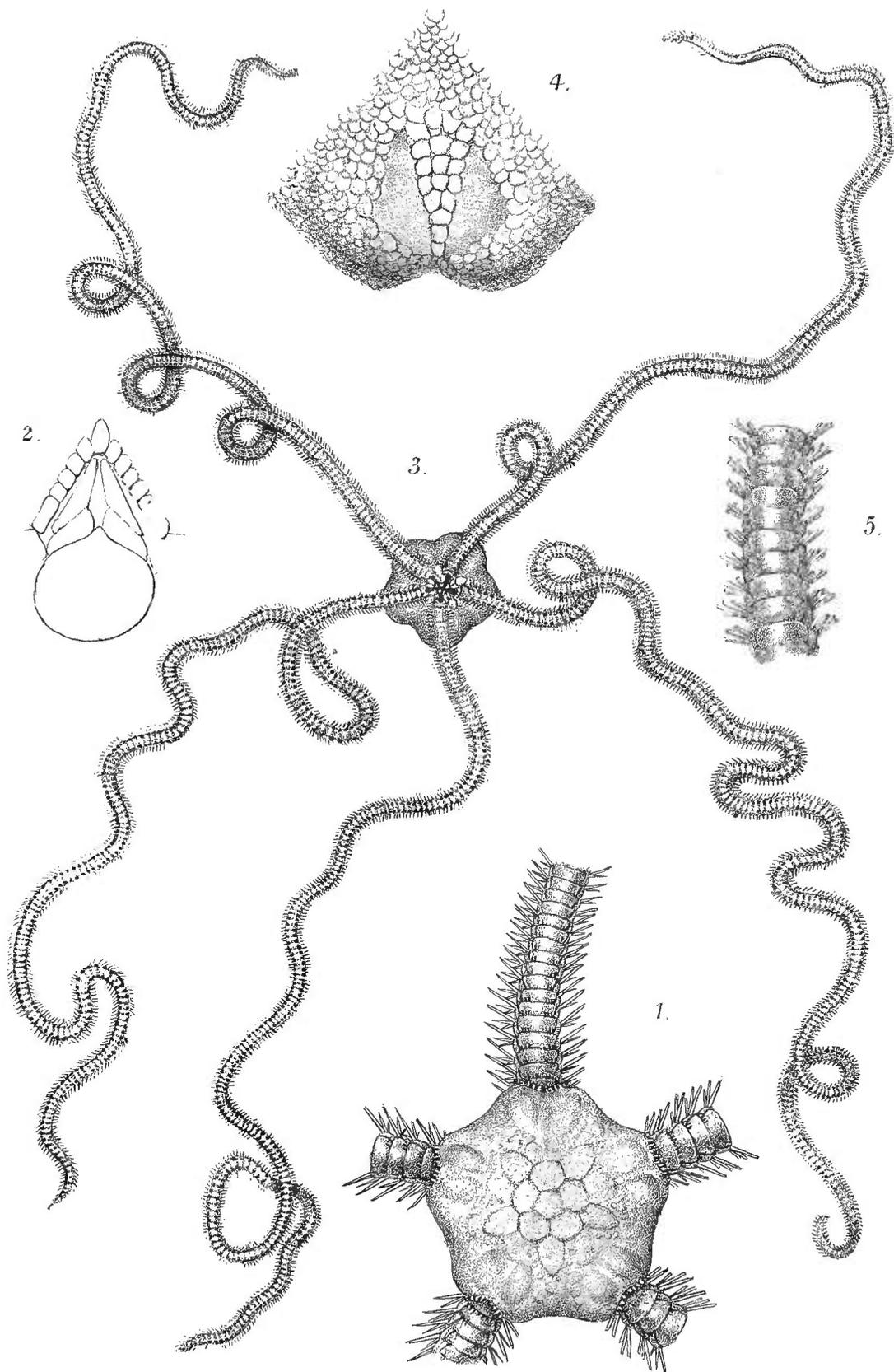
Astropecten sphenoplax.



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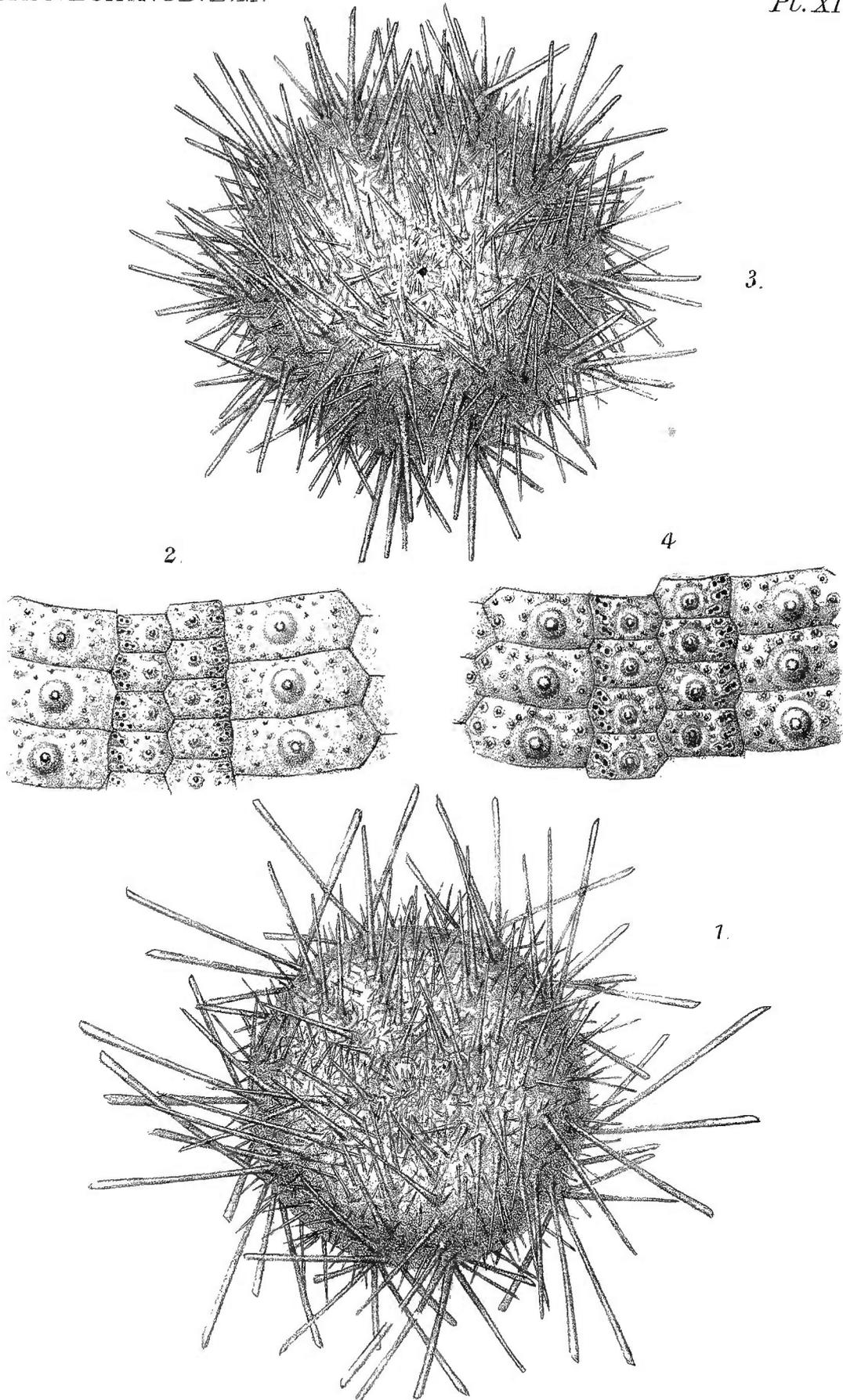
1, 2. *Asterias murrayi*. 3, 4. *Asterias hispida*



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1 & 2. *Ophiocten sericeum*. 3-5. *Ophiocnida brachiata*.

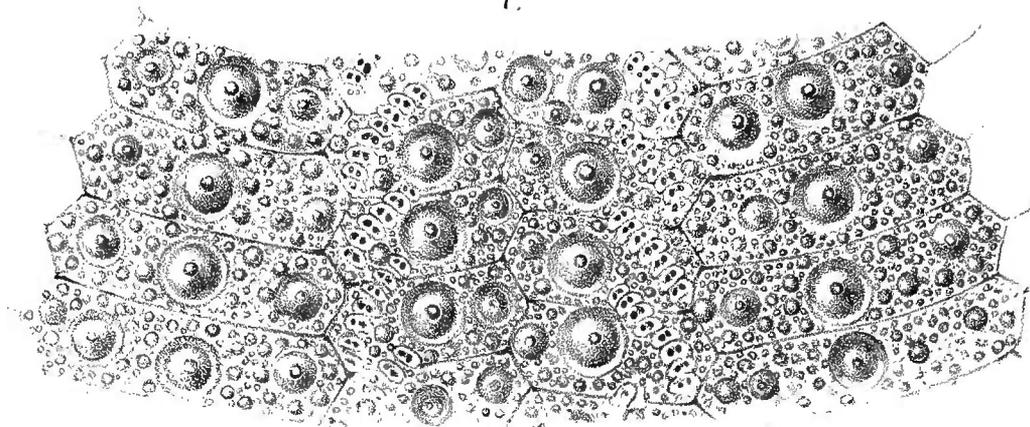


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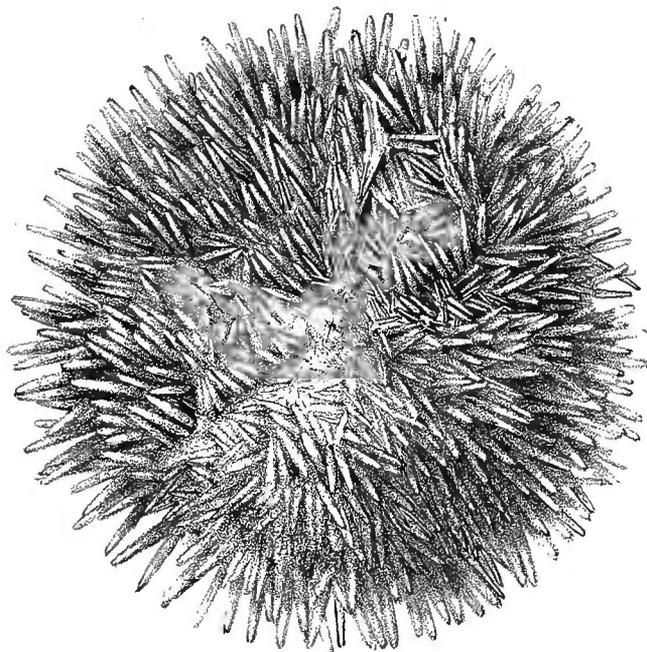
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1, 2. *Echinus microstoma*. 3, 4. *Echinus elegans*.

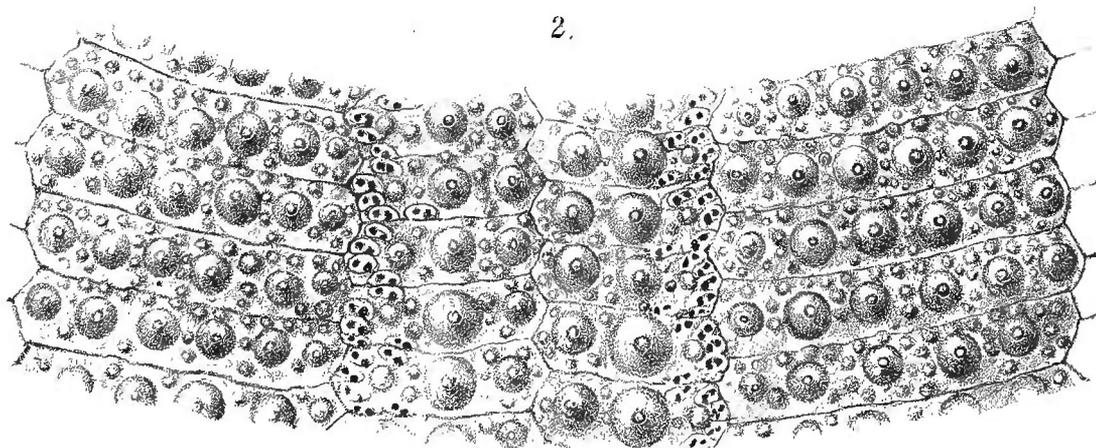
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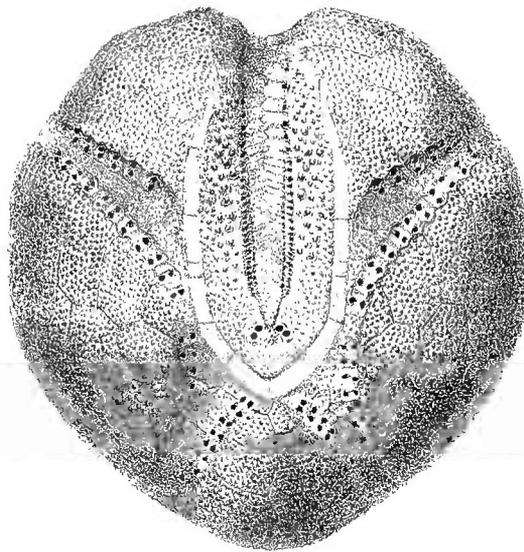


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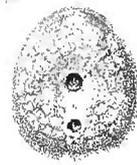




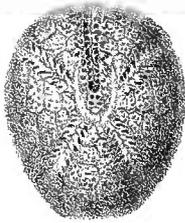
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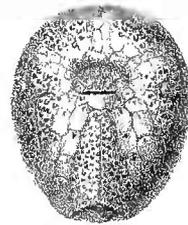
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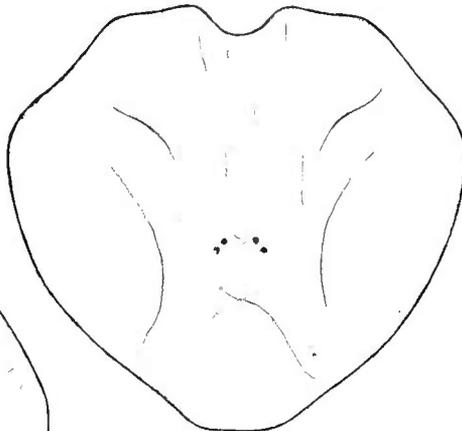
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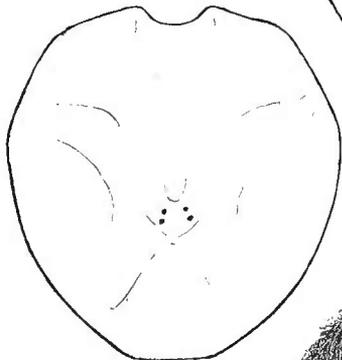
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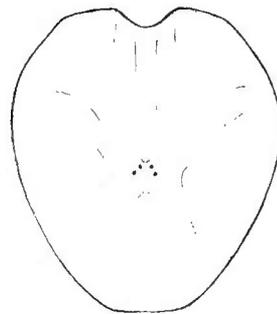
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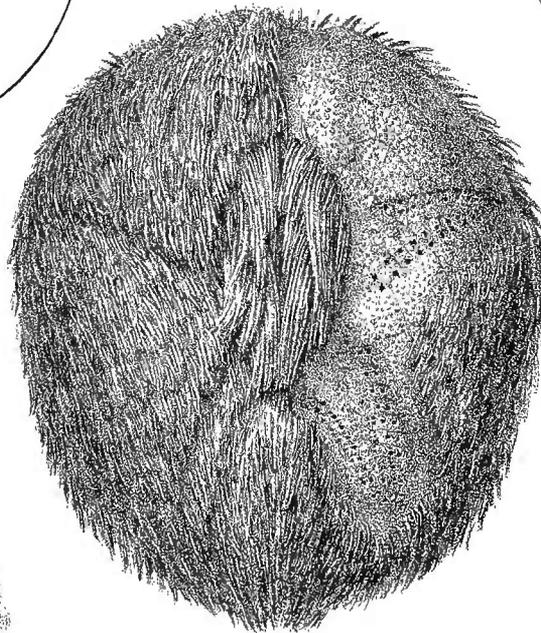
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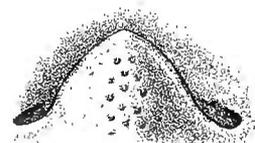
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W. H. FLOWER,
Director.

British Museum
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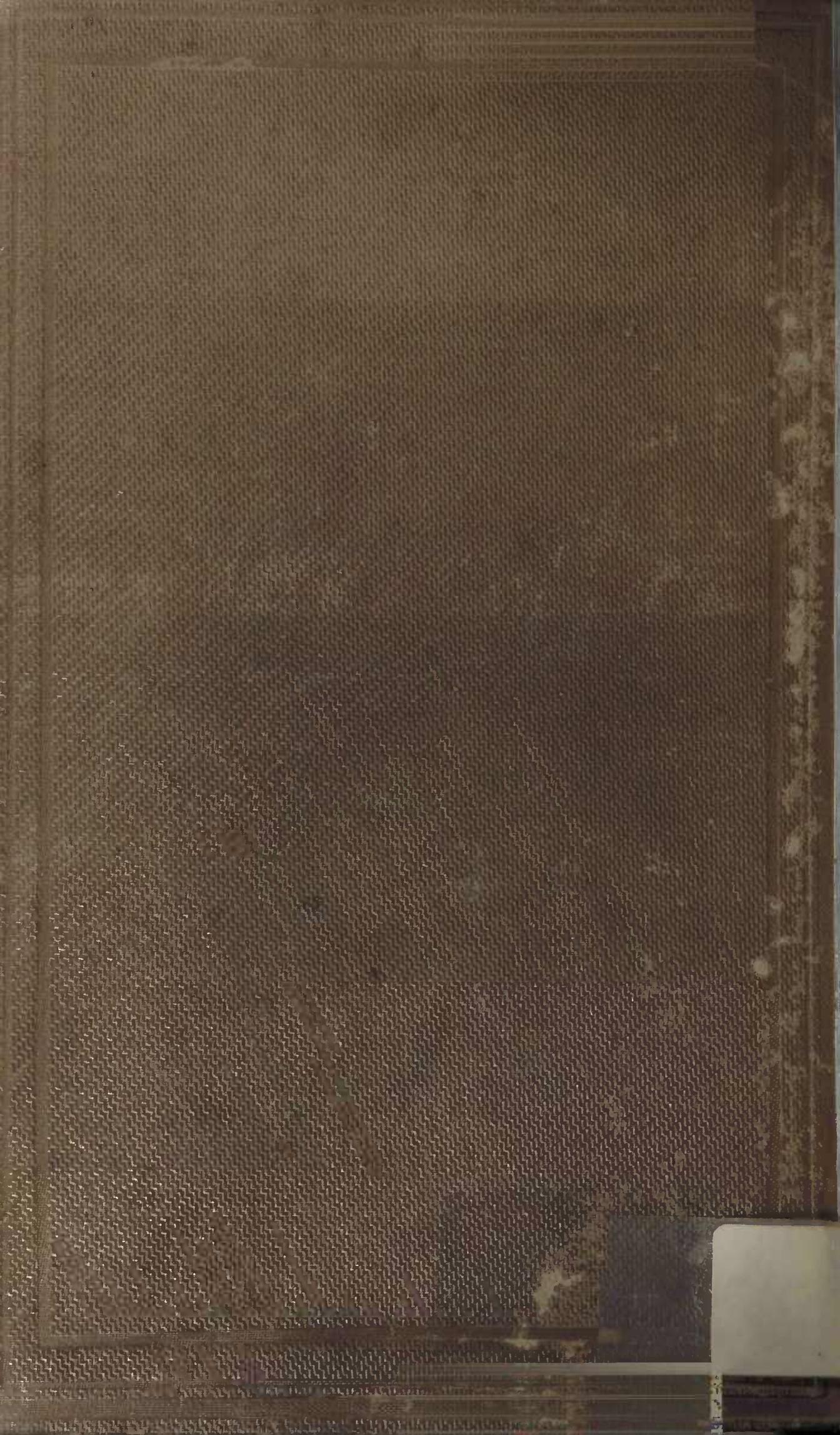
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