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A

MONOGRAPH

OF THE

BRITISH NAKED-EYED MEDUSÆ:

WITH

Figures of all the Species.

BY

EDWARD FORBES, F.R.S.; L.S.; AND G.S.

PROFESSOR OF BOTANY IN KING'S COLLEGE, LONDON;
AND PALÆONTOLOGIST TO THE GEOLOGICAL SURVEY OF THE UNITED KINGDOM.

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PREFACE.

This short preface is intended both as an explanatory notice and as a dedication. Without the aid of my friend Mr. M'Andrew, the following Monograph could not have been drawn up. The mass of the materials employed in its construction was the produce of several delightful scientific cruises, when I accompanied him in his Yacht, the Osprey. Nine years ago this history was commenced: were it not for the ardent friend of science, whose name I wish to associate with my work, as many more would be required for its completion. Even now, I can offer only an outline of a most curious and interesting, though neglected, department of British Zoology. The greater part of the matter in this essay is new. With one exception—kindly communicated by Mr. Alder—every species has been examined by myself. Every figure is original. Any defects in the engravings must be laid to my charge; their merits are due to my friends Mr. W. Baily, and Mr. C. R. Bone, for whose exertions I have to return many thanks.

Edward Forbes.

London; June 25, 1848.

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PLATES.

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* In this plate for *Polyxenia cyanostyla*, read *Polyxenia Alderi*.

† In this plate for *Thaumantias cymbaloidea*, read *Geryonopsis delicatula*.

BRITISH NAKED-EYED MEDUSÆ.

The creatures which I am about to describe and delineate in the following monograph are animals of very simple organization and beautiful form. They are members of the lowest section of the Animal Kingdom, and are intimately allied to the polypes, as we shall see when we come to consider their classification, which will be best understood after we have examined their structure. They are mostly minute, often microscopic, though many of their nearest relations, such as the great stinging Medusæ, grow to a considerable bulk. They are active in their habits, graceful in their motions, gay in their colouring, delicate as the finest membrane, transparent as the purest crystal. They abound in the sea, but are not equally plentiful at all seasons. They have the power of emitting light, and when on a summer's evening the waves flash fire as they break upon the shore, or glow with myriads of sparks as they curl and froth around the prow of the moving ship or under the blade of the striking oar, it is to delicate and almost invisible Medusæ that they chiefly owe their phosphorescence.

They belong to that section of Acalephæ termed by Eschscholtz *Discophoræ:* the upper portion of the body being formed in the shape of a hemispheric disk. All the Discophoræ may be conveniently arranged in two great groups: the first consists of those which have the eye-like bodies or *ocelli* of their margin protected by more or less complicated membranous hoods or lobed coverings, a character which accompanies one of great importance, viz. their possession of a much ramified and anastomosing series of vessels. This section I propose to name *Steganopthalmata* (στεγανος, covered).

The second division includes all those which have the ocelli naked, often aborted, and which possess a very simple vascular system, the circulating canals proceeding to the margin either altogether unbranched, or if divided, not anastomosing with each other. These I term the naked-eyed Medusæ, or *Gymnopthalmata* (γυμνος, naked).

It is to the history of the British species of the second division that this monograph is devoted. The observations embodied in it are the fruit of several years' research, having been commenced in the year 1839, and continued every summer, either in the British seas or abroad, until the autumn of 1846, when an account of them was read, for the first time, at the Southampton Meeting of the British Association. That year and the previous summer were

by far the most prolific in results; the voyages which I had the pleasure of making with my friend Mr. M'Andrew around the British coasts having afforded admirable opportunities for the study of our Medusæ. These creatures are of so very delicate and often unpreservable a nature, that casual circumstances usually determined the extent to which the examination of their structure and habits could be pursued, and as most of my observations had necessarily to be made at sea, those circumstances were not always most favorable. In the present very unsatisfactory state of this branch of zoology, however, I do not think it necessary to apologise for unavoidable imperfections, for having often experienced the difficulty of conducting inquiries into tribes of which the species had as yet been but vaguely defined and rarely figured. I trust this account of an important and beautiful tribe of animals, of which so far as the British seas are concerned, only a few very fragmentary notices are accessible, may serve as a basis for future and more extensive researches. They offer a fresh and but little explored field for discovery. Their organization is but partially understood, and much requires to be done before the signification of their several parts be fully made out; of their habits we possess but very slight knowledge. Their development is a subject of the greatest interest, seeing that upon its clearing up will probably depend the future classification of the zoophytes. On most of these points I can scarcely pretend to speak; what I offer are the rudiments only of an extensive subject. It is for naturalists expert in physiological and anatomical investigations, skilled in the use of the microscope, and not too trustful in its revelations, free in their movements, and with time untrammelled at their disposal, to carry out this most interesting branch of research, to which, if my imperfect monograph give an impetus, I am content—

Quod potui, feci; quod restat suppleat alter
Doctior, et nostris faveat non invidus ausis.

Before commencing a detached description of the species, it is best to examine the features of organization common to the tribe.

The parts presented by these animals are the following:

A. The disk or *umbrella*. This forms the greater portion of the animal's body. It is hemispheric, but varies from being extremely depressed and almost plane, as in certain species of *Thaumantias* and *Æquorea*, to a nearly cylindrical form, as in *Turris*. One of its commonest shapes is that of a round glass shade, such as is placed over ornaments or statuettes to protect them from dust. It is usually smooth, rarely pilose. Its under surface, on which in certain tribes the reproductive bodies are placed, is called the *sub-umbrella*. Around its margin internally there is in many species a projecting ledge of membrane called the *veil* (*velum*). The margin itself is usually provided with more or less numerous tentacles (*cirri marginales*), of variable structure, the bases of which are often swollen into a bulb, and deeply coloured or marked with a brilliant spot (*ocellus*). In the substance of the disk are the vessels, often conspicuously visible.

B. From the centre of the sub-umbrella hangs a more or less produced proboscis-like body (*pedunculus*), of variable form and dimensions. In this is the stomach, and, in certain genera, the ovaries. At its extremity is the mouth, surrounded by variously-formed contractile lips, occasionally furnished with produced tentacula.

Such are the characters visible at a glance. A more minute examination makes us acquainted with the structures they include.

Substance.—When we examine a naked-eyed Medusæ by polarized light, we see that at least two distinct tissues enter into its composition; these are equally distinguishable by the naked eye, if the creature be sufficiently large, when we see the one presenting the aspect of a transparent, and almost always colourless gelatinous membrane, the other a translucent, and as if granular, substance. The former constitutes the mass of the body; the latter forms the margin of the mouth, the edge of the umbrella, and the tentacula. The first is immoveable and uncontractile, elastic, but not extensile; the second is highly contractile and active. They are both composed of cells, those forming the active tissue differing in being nucleated cells of the fibrous order, and intermingled with granular corpuscles. The former are covered with a fine amorphous smooth epidermis, beneath which, in the higher forms and in the so-called *Oceania cruciata*—possibly in most species—are cells containing a spiral thread. Such cells are also present on the surface of the tentacula in many species, exactly as in the hydroid polypes. Will described the cells beneath the epidermis of *Geryonia* as round, transparent, and lobed. A ciliated epithelium has been observed by Will in the inner surface of the lip-ring in *Geryonia,* also in the tentacular canals. It lines (as I have seen) the gastro-vascular canals in *Thaumantias,* and probably in all the genera. Several of the higher Medusæ (conspicuously those of the genus *Cyanæa*) have the power of stinging severely. The power resides in the skin, and, especially in some of the appendages of the sub-umbrella, appears to be always connected with the second or granular tissue. Wagner has attributed it to the filiferous vesicles, which, in some species if not in all, have the power of projecting the contained thread with its barbed extremity, even as the hydroid polypes and the Actineæ do. But as many Medusæ and Actineæ provided with these curious organs do not sting, such explanation is doubtful. I have never found any of the naked-eyed species to sting.

Muscular System.—The motor tissue in these Medusæ is of the simplest kind, and consists, in most cases, simply of bands of the granular substance just described. In certain genera, especially in *Turris,* the motor bands exhibit a distinct fibrous arrangement (Plate III, f. 1, *e*, and f. 2, *i*), and Professor R. Wagner has stated that distinct muscular fibres with transverse striæ are present in the "*Oceania cruciata*" (a *Thaumantias?*) of the Mediterranean.* Will has observed a few longitudinal fibres in the motor ring of a *Geryonia.* In the higher Medusæ the muscular system is much more developed, especially in *Rhizostoma,* the movements of which may be shown experimentally to depend on the muscular bands lining the sub-umbrella. I have paralysed one side of a *Rhizostoma Aldrovandi,* whose disk measured more than a foot across, by removing with a scalpel the bands of that half, whilst the other side contracted and expanded as usual, though with more rapidity, as if the animal was alarmed or suffering. All the Medusæ when irritated become much more rapid in their movements, and contract and expand their disks or bodies in a hurried and irregular manner, as if endeavouring to escape from their persecutors. In the naked-eyed species, the muscular system usually consists of a marginal motor ring, the tissue of which is continuous with the tissue of the marginal tentacula; concentric rings of motor tissue forming the walls of the tentacles themselves, and a ring of similar tissue forming the margin of the

* Ueber den Bau der *Pelagia noctiluca* und der organization der Medusen. 1841.

lips. To these there is superadded, in the genus *Turris*, longitudinal, highly-developed muscular bands, running from the base of the peduncle to the marginal band. Whatever be the arrangement, the movement is the same. The animal swims in an oblique position, contracting and expanding alternately its umbrella; occasionally pausing as if to rest, but capable of continuing its motions for an indefinite time. The lips can be expanded or contracted as occasion may require to seize its prey. The tentacles in many species are capable of wonderful extension, and can be retracted suddenly into a very small compass, often into a mere tubercle; but there are many naked-eyed Medusæ which vary their tentacles at an almost uniform length. Each of these organs may be extended or contracted singly, or in concert with its fellows, evidently obeying promptly the will of the animal of which they form part. They guide the Medusa through the sea, and can anchor it. I have seen a *Geryonia* anchor itself by means of its lips, clasping a coralline with them, and remaining tranquil so fixed for a considerable time.

Nutritive System.—This consists of a stomachal cavity excavated in a more or less produced proboscis, depending from the summit of the sub-umbrella, opening externally by a more or less expanded mouth, margined by variously-formed contractile lips, and superiorly communicating with a system of radiating canals, which run to a common marginal canal. The orifices of these canals probably in every case open into a common cavity or intestinal reservoir superior to the stomach, though sometimes stated to open directly into the latter. The true position of the stomach in these animals has been a subject of much dispute, which is not to be wondered at, considering the extreme variations presented by the central peduncle. It was indeed for a long time supposed that several of the *Discophoræ* had no true mouths, but absorbed, as if by suckers or roots, their nourishment from without, a view, however, which all the more recent researches have tended to disprove. By some naturalists, the cavity above the cavity of the peduncle has been regarded as the stomach, and the latter as a pharynx, a view which has been partially supported by Milne Edwards. Eschscholtz made the mistake of supposing the ovaries in the naked-eyed species to be stomachs. Will, and more recently Frey and Leuckhart, regard the peduncular cavity only as the stomach, a view which, certainly among the gymnopthalmatous Discophoræ, I hold from my own observations, for I have observed that the process of digestion goes on wholly in that cavity. Its dimensions vary greatly; among our British forms, it is especially large in *Stomobrachium*, a genus which approaches nearly *Æquorea*, where it is almost an open space surrounded by a slight veil of membrane. In *Turris* and *Oceania*, it is also large and well defined. In *Willsia* and *Thaumantias*, it is campanulate, and occupies the greater part of the peduncle. In *Geryonia* and *Tima*, it is small, in comparison with the peduncle, and confined to its extremity. In *Slabberia*, *Sarsia*, and *Steenstrupia*, it is tubular, but can assume a bell-shape. In *Bougainvillea* and *Lizzia*, it is a conical cavity, with singularly branched lips. The communication of the stomach with the gastro-vascular canals is not clearly made out in all the genera. Will, in his description of *Geryonia pellucida*, states that at the fundus of the stomach there are four small obtuse prominences, each of which presents a small aperture, which is the orifice of one of the water-canals. In another species, the base of the stomach into which the vessels opened seemed to be separated from the remainder. In *Thaumantias leucostyla*, he found a distinct cavity separated from the stomach at its base, the walls of

which were lined with vibratile cilia; from this cavity the vessels sprang. In *Æquorea*, Milne Edwards describes the canals as opening directly into the large and gaping stomachal cavity. My own observations accord with those of Will, to the effect that, in most cases (among the *Gymnopthalmata*), there is either a well-defined cavity at the base of the stomach into which the vessels open, or an indication of such a cavity. This I regard as homologous with the sac so distinctly separated from the digestive tube in the *Ciliograda*, and into which the vessels from beneath the rows of cilia open. The superior cavity in both cases may be regarded as an effort towards a specialization of the respiratory system—a view first suggested by Will. From it the circulating fluids flow into the gastro-vascular canals, which all run without dividing, except in the case of *Willsia*, into a common marginal vessel, cæcal projections of which, in several instances, appear to be prolonged into the marginal tentacula. Will, however, observes, and I can confirm his remark, that the canals of the tentacles in *Thaumantias* do not communicate with the vessels. The walls of the gastro-vascular canals are ciliated. The fluid within becomes coloured, according to the food taken by the animal. I have seen it in a *Thaumantias* fed upon small crustacea turn completely yellow.

The system of vessels, partly nutritive, partly respiratory, proceeding directly from the stomach, or from a cavity opening directly into it, may be regarded as a good instance of phlebenterism. Dr. Will, however, regards it as an aquiferous system, and describes a circulatory system distinct from it. He asserts that in *Geryonia* all the water-vessels are accompanied by blood-vessels, which spring from the sides of the stomach, and proceed to its base, there to run alongside of the water-vessels. He states that they are distinctly to be recognised on both sides of the latter, especially when they contract; then the blood-vessels remain expanded, and appear much thicker. At the circular marginal water-vessel the blood-vessel is usually observed only on one side, and that at the lower. Sometimes there appears a narrow margin, filled with blood-corpuscles at the upper edge. "The contents of the blood-vessels usually consist of a clear fluid, in which a great number of finely granular corpuscles, of a diameter from 1-400—1-500‴, are floating." He observed similar blood-vessels in *Thaumantias*.

Aware of these observations, and of the accuracy of the observer, I made every endeavour to satisfy myself on the matter with the species of several genera. But though I sometimes fancied I saw such vessels, in the end I came to the conclusion that the appearances were deceptive. No such vessels appear to have been noticed by Wagner or Milne Edwards. Will described similar vessels distinguished by this red colouring in *Beroe*. I have seen the appearances to which he alludes, but could not satisfy myself of their vascular nature. Frey and Leuckhart, also, with Will's observations before them, have sought in vain; their remarks upon this subject are so much to the point that I quote them verbatim: "Our attention whilst investigating was likewise directed to this point, but without discovering the characters mentioned (i. e. by Will). Neither in *Cydippe*, nor in *Geryonia*, nor in *Cyanæa*, did we succeed in discovering particular blood-vessels in addition to the canals of the abdominal cavity. We may assert, with particular distinctness, that the species (new?) of *Geryonia* observed by us is altogether deprived of a peculiar system of blood-vessels, although Will has recognised such in *Geryonia pellucida*, described by him, and from which our species is principally distinguished only by having marginal tentacles of equal length. A result,

entirely correspondent with ours, was likewise obtained by our respected friend Professor Bergmann, during numerous observations which he had an opportunity of instituting, during a residence at Iceland, on many different Medusæ. Will himself does not appear to have discovered any particular system of blood-vessels in all Acalephæ . . . We believe ourselves justified in pronouncing an opposite opinion, viz., that no special blood-fluid, or any special vascular system, exists in many of the Acalephæ, except the nourishing fluid contained in the abdominal cavity. Some Medusæ, however, may possess such. This can be the less objected to *à priori*, since we know that the development of the vascular system in the different classes is subject to very considerable differences. The statements of Will are moreover, in many respects, too decided, as not to allow us altogether to doubt the correctness of his observations, although it is the very peculiar behaviour of the blood-vessels, as described by him, which justifies us in believing in the possibility of an error; in addition to which, we must mention that our own as well as Bergmann's observations have furnished quite a different result from those of Will. Indeed the question can only be decided by new and careful observations."*

With these judicious remarks I entirely agree, and hope the suggestion of further inquiry will be taken up by some of our expert microscopical observers, qualified for such an inquiry by possessing the requisite physiological knowledge, without which microscopical researches must always, and justly, be received with distrust.

Reproductive System.—The majority of the naked-eyed Medusæ have very distinct reproductive glands. These are placed either on the surface of the sub-umbrella, or on the inner and upper part of the peduncular cavity. In each case their position has a distinct relation to the arrangements of the gastro-vascular canals. Instances of the former arrangement are seen in *Stomobrachium*, *Geryonia*, *Thaumantias*, *Circe*, and *Slubberia;* of the latter, in *Turris*, *Saphenia*, *Oceania*, and *Willsia*. They are not so definitely marked in *Sarsia*, *Steenstrupia*, and *Modeeria*, in which genera the whole of the substance of the walls of the peduncle seems to be composed of a germ-producing tissue. In *Bougainvillia* and *Lizzia*, the condition of the reproductive glands is intermediate between the two modes just described. In *Euphysa*, the ovary appears to depend from the centre of the peduncular cavity.

The organs of generation in these Medusæ were long misunderstood. Peron and Lesueur recognised their true position in most of their "monostomous gastric Medusæ," in which the genera *Oceania* and *Æquorea*, according to their view of the extent of those groups, were placed along with *Pelagia*, and other forms having no true immediate affinity. In the case of *Æquorea*, however, they did not recognise the ovaries. In their group of "agastric Medusæ," of which *Geryonia* may be cited, they seem altogether to have misunderstood these organs. Their importance and meaning were equally lost sight of by Lamarck. Eschscholtz still further lost the clue to their signification; for, founding his system upon the supposed manifestation or obscurity of the reproductive glands, he divided all the *Discophoræ* into *Phanerocarpæ* (exactly equivalent to my *Steganopthalmata*) and *Cryptocarpæ*, the latter group including the naked-eyed forms, describing the generative organs in the latter as stomachs or appendages of the stomach. Cuvier, misled probably by Peron, does not seem to have clearly comprehended the signification of the parts in this section of the Medusæ, though

* Frey and Leuckhart.

practically versed in the higher group. Blainville recognised the ovaries in *Oceania* (following Peron and Lesueur), but mistook them (following Eschscholtz) for stomachal appendages in *Thaumantias*, *Geryonia*, and allied genera. Lesson, confused throughout, repeats the same mistake. Ehrenberg recognised their true position in his "*Melicertum campanulatum*" (i. e. *Stomobrachium octocostatum*) and *Oceania pileata*. Sars first described them in *Thaumantias* and *Stomobrachium* as dilatations of the gastro-vascular canals; but more lately recognised their true office. Milne Edwards demonstrated their true nature in *Æquorea violacea*, and inferred their office by analogy in all the so-called *Cryptocarpæ*. Brandt appears to have followed Eschscholtz. Will perfectly comprehended their true nature, and demonstrated their structure. Frey and Leuckhart take the same view. Indeed, it seems strange that such great diversity of opinion and so much error should ever have prevailed respecting the position of the glands of generation in the naked-eyed Medusæ, especially when their true nature in the steganopthalmatous species was recognised by all.

In *Turris*, the genus which may be regarded as the highest in organization of the order under consideration, the ovaries are highly developed, and line the upper part or chamber of the stomachal cavity in the form of convoluted tubular and fimbriated membranes, conspicuous from their brilliant colour. Such an arrangement closely approaches that met with in the *Steganopthalmata*. In *Oceania*, a similar arrangement, though not so perfectly made out, prevails. In *Geryonia*, *Thaumantias*, and allied genera, the ovaries are more or less clavate or leaf-shaped, and are either expanded on the under surface of the sub-umbrella in the course of the gastro-vascular canals, or depend from it as membranous sacs or laminæ, the latter form being that seen in *Stomobrachium* and *Æquorea*. In *Willsia*, *Bougainvillia*, and *Lizzia*, they present the appearance of lobes on the sides of the stomach; but those of the first-named genus are much more regular and normal than those of the two latter. Their number, when well defined, may be very considerable (as in *Æquorea* and *Mesonema*); but in our British forms the greatest number is that seen in *Stomobrachium* and *Circe*, where there are eight: next, *Willsia*, which has six; the remaining genera have four ovaries, each of which, in several instances, is composed of two equal and similar parts.

Though I have used the word ovaries for these bodies, as if the animals were unisexual, I have done so only as a convenient form of speech. There is every reason to believe that the majority of the Medusæ are bisexual, though the two sexes appear to be united, but maintained by distinct organs in certain forms, especially in the higher group. The diœcious character of the naked-eyed forms has been demonstrated by Milne Edwards, Wagner, and Will. The first-named naturalist showed that some individuals of *Æquorea violacea* were females, having eggs in their generative organs, others on which there were no trace of eggs, but abundance of spermatozoa, being males.

Will describes the sexual organs of *Geryonia pellucida* as lying in the course of the radiating gastro-vascular canals, their further extremities rounded, the inner ends pointed. At the latter he found ducts of emission which reach the base of the peduncle. Each gland consists of two lancet-shaped halves; each half is provided with a special duct of emission, so that there are consequently eight ovaries in the female, and eight testicles in the male, of this genus. "The ovaries are twisted sacs in which the eggs lie close to each other, the largest towards the margin of the disc, the smallest towards the peduncle. The perfectly-developed eggs are of a whitish colour, opake, and measure 1-8‴; the germinal spot is round and

1-200‴ in size. The males cannot be distinguished from the females either by shape or size of the body, or by the form of the sexual glands." Will fancied these glands had a greenish glitter in the male, which was not present in the female. "The testicles are likewise twisted sacs filled with spermatozoa. The latter consist of a thick oblong body, measuring 1-800‴ and an extremely slender, long tail, which is only visible during vibration." Will found at all times as many males as females.

Organs of Sense.—The lips and their appendages, the marginal tentacula, and the bulbs at their bases, may be enumerated under this head. The lips and the tentacula are instruments of touch and prehension, the former chiefly for the purpose of seizing the animal's prey, and sometimes, as I have seen in the case of a *Geryonia*, for anchoring the body. The lips vary much in form. They are sometimes (as in *Circe*, most species of *Thaumantias*, and *Polyxenia*) simple lobes; in other cases (as in *Turris*, *Geryonia*, and *Oceania*) fimbriated lobes; in *Bougainvillea* and *Lizzia*, they are furnished with single or branched tentacular processes, reminding us of the curious gland-tipped cirrhi, which are so conspicuous in the genus *Cassiopeia* among the higher *Discophoræ*, and which were long supposed, and are usually still described to be roots or suckers for the purpose of absorbing nourishment. In *Sarsia*, *Slabberia*, and *Steenstrupia*, the lip is a simple ring around the orifice of the tubular digestive cavity. The tentacula in all our British examples of the naked-eyed Medusæ, are simple and usually filiform, though highly contractile, and in some species often reduced almost to a point. In *Slabberia* we have an abnormal form of these organs, their termination presenting the appearance of a bulb. In *Euphysa*, the single tentacle is clavate and different in structure from that of any other British genus. In the same curious form all the tentacles except one are aborted, a remarkable modification seen also in *Steenstrupia*. In a new species of *Geryonia*, here figured, alternate tentacles are glanduliferous. In not a few species there are two varieties of tentacles placed in a single series round the margin, but the majority have the tentacles only of one kind.

At the base of the marginal tentacula or cirrhi there are present in a great many of these animals coloured spots or bulbs. In some species (as in *Thaumantias pilosella*, *Slabberia halterata*, *Willsia stellata*, *Lizzia octo-punctata*, &c.) these points are very strongly coloured, and from their magnitude indicate the course of the animal when in motion, appearing like a circle of gems in the water. Where some of the tentacula are aborted (as in *Steenstrupia* and *Euphysa*), they are not aborted with these organs, but are all conspicuously developed; in many forms only certain tentacles have bulbs at their bases. In other forms, the tentacula are present and highly developed, but no coloured spots or bulbs are seen at their bases, as in certain kinds of *Geryonia* and *Circe*. When these bulbs are examined under the microscope, we find their organization more complicated than at first glance it would seem to be. In the majority of species, perhaps in all, these bulbs, whether conspicuous from colouring or not, contain a small cavity quite distinct from any coloured spot which may be present. The former is the *otolitic vesicle*, the latter the *ocellus*.

The *otolitic vesicle*, which, from analogy and its peculiar structure, is considered an organ of hearing, is a small spherical sac developed in the midst of the granular substance of the bulb, and containing more or fewer minute vibrating bodies. Will has described the otolitic vesicle and its contents in a *Geryonia* as follows: "The auditory vesicles are seated

in the course of the marginal circular vessel in very uncertain number, usually, however, one at each side of the larger marginal cirrhi, and beside the smaller one, only at one side. They are round, measuring 1-40th of a line in diameter, and consist of a tolerably thick membrane: they contain from one to nine, and even more, round globules. If there is only one, it is situated exactly in the centre of the vesicle, but if there are several, they are lying together either in two groups or separately joined to each other at the wall of the vesicle. Their size varies from 1-300—1-150‴. I have never observed them move. Muriatic acid dissolves them, and causes the vesicle to burst." In his *Thaumantias leucostyla*, he describes the auditory vesicle as "measuring 1-60‴, and containing globules of the dimensions 1-200‴. They are seated beneath the basis of the marginal fibres on a small projection. They are not present, however, beneath all the marginal fibres." Milne Edwards observed, in his *Æquorea violacea*,* two hemispheric or oval vesicles on each side of each marginal tubercle, and containing two or three spherical corpuscles. Kolliker observed that the otolitic cavities or vesicles in *Oceania* (as well as in higher forms) were lined with vibratile cilia, and that the otolites vibrated. Frey and Leuckhart, whilst they saw the otolites vibrate distinctly in certain Ciliograda, found them perfectly motionless in *Geryonia*, even as Will had observed. I have observed the vibration of the otolites distinctly in more than one species of *Thaumantias;* so has my friend Dr. Melville. I have seen them also vibrating in their cavities at the bases of the tentacles of more than one species of *Oceania*, a genus in which they are highly developed.

The *ocelli*, from analogy, are regarded as rudimentary eyes, or rather light-perceiving organs. In the gymnopthalmatous Medusæ they are very rudimentary, and in most species consist only of an assemblage of pigment-cells more or less symmetrically disposed. They vary much in colour, different species of *Thaumantias*, for instance, presenting purple, orange, yellow, black, and even variegated ocelli. Yellow, with a red dot, is a common appearance. This dot indicates a higher or more concentrated condition of the organ. It is especially defined in *Oceania*, and in *Turris neglecta*, forms at the head of the tribe. In *Slabberia*, the resemblance of the ocelli to the coloured bulbs which terminate the tentacula is very striking, but when minutely examined, they are easily distinguished from the latter organs by the presence of a small black dot. In some forms of *Sarsia* and in *Euphysa* we have curiously particoloured ocelli; also in *Willsia*, though not so defined. In *Lizzia*, and especially in *Bougainvillia*, we have compound ocelli, formed out of several united, and variously coloured, either entirely black, or entirely yellow, or piebald, black and yellow, or yellow and bright red. In *Circe*, and some other forms, no ocelli can be observed.

That these bodies are the eye-spots, there can be no doubt, when we compare them with similar bodies in the higher Medusæ. In them crystals are present, as was first pointed out by Gaedé. These crystals were shown by Rosenthal to be silicious, a character by which they are strikingly distinguished from otolitic crystals, which are always calcareous.

Though, as we have seen, there are well-marked organs of sense in these animals, the presence of a nervous system has not been clearly made out. For my part, I have not been able to satisfy myself as to the existence of either ganglia or nervous filaments in any of the

* Ann. Sc. Nat. (2d Ser.) t. xvi, p. 195.

naked-eyed Medusæ, though I have seen appearances, both in the higher *Discophoræ* and in the *Ciliograda*, which would induce me to admit their presence in some *Acalephæ*. Will has observed that in *Geryonia* there is a small cavity beside the otolitic vesicle, which is filled with a yellowish-green matter, in which the vesicle itself is bedded to a third of its circumference, and he considers this a ganglion, whilst he admits it cannot be proved to be so histologically. I believe I have seen a similar appearance in several species, but not so constantly as to permit of the assignment of so important an office as the duty of a nervous ganglion to the tissue. Frey and Leuckhart recognised the same bodies in *Geryonia*, but doubt their nervous nature, and remark that the individual masses in this instance did not seem to be sufficiently distinctly separated from the neighbouring parenchyma, as to warrant their concluding with certainty that such bodies are peculiar isolated formations.

Power of Stinging.—In the minds of most people who have been at the sea-side the notion of a *Medusa* naturally associates itself with that of a nettle, since both the animal and the plant enjoy an equal reputation for their stinging powers, and for the production of an extremely similar, though not the less unpleasant sensation, when incautiously handled or inadvertently touched. The term *Acalephæ*, so frequently applied to the whole of the Medusa tribe, is significant of their nettle-like nature. Yet it is not improbable that this offensive faculty of stinging is possessed by only a small minority of the sea-jellies—a minority chiefly, if not wholly, composed of the steganopthalmatous species. Among them the *Cyanæa capillata* of our seas is a most formidable creature, and the terror of tender-skinned bathers. With its broad, tawny, festooned, and scalloped disk, often a full foot or even more across, it flaps its way through the yielding waters, and drags after it a long train of riband-like arms, and seemingly interminable tails, marking its course when the body is far away from us. Once tangled in its trailing "hair," the unfortunate who has recklessly ventured across the graceful monster's path, too soon writhes in prickly torture. Every struggle but binds the poisonous threads more firmly round his body, and then there is no escape; for when the winder of the fatal net finds his course impeded by the terrified human wrestling in its coils, he, seeking no combat with the mightier biped, casts loose his envenomed arms and swims away. The amputated weapons severed from their parent body vent vengeance on the cause of their destruction, and sting as fiercely as if their original proprietor itself gave the word of attack. The *Cyanæa Lamarckii* possesses a like dangerous power, and *Pelagia cyanella* also, though very faintly, as I have experienced. But, unless *Chrysaora hysoscella* sting, no other Medusæ of our seas besides those mentioned, have been observed, at least by me, or naturalists known to me, to possess this noxious property. I have in vain endeavoured to elicit such nettling proofs of rage in any of the naked-eyed species, though I have stirred, and grasped, and rubbed together hundreds of them belonging to many genera. It is right, however, to notice this matter, for it may yet be found that either at particular seasons, or under peculiar circumstances, more than one species can sting. Dicquemare has stated that certain species of *Oceania* sting, though very slightly, and only when they come in contact with very sensitive parts, such as the eyes. Not being ambitious of suffering stone-blindness by playing too closely with even the smallest gorgon's head, I have never ventured to repeat the worthy Abbé's experiment, and prefer keeping my eyes intact to

poking Medusæ into them. For such rash experiments, Ben Jonson's song might be paraphrased—

> "O do not wanton with those eyes,
> Lest *you* be sick with seeing,"

—and not bad advice either.

In such Medusæ as do sting, the power has been believed by Dicquemare, Eysenhardt, and others who have practically looked to the subject, to reside in a mucus which can be thrown off by the animal. Certainly such mucus, as I have often experienced, retains its urticating properties for some time after being detached from its producer. If the view which has been of late mentioned, that the filiferous capsules with their barbed projectiles are the causes of the stinging sensation, the power of the mucus to sting does not contradict it, for usually in it numbers of filiferous capsules may be perceived under the microscope.

Phosphorescence.—Whatever doubt there may be about the stinging faculty of the naked-eyed sea-jellies, there can be none about their capability of emitting light in the dark. This wondrous power, possessed by comparatively few inhabitants of the air, is a gift bestowed on many of the dwellers in the waters, and is especially possessed by creatures of the order Radiata, as if, to use a fanciful analogy, their star-like forms had given them star-like properties. The true polypes exhibit the phenomenon of phosphorescence in great perfection, but as the majority of them are fixed, at least in their supposed most perfect condition, they can play but little part in producing the luminosity in the sea, as seen by ordinary observers. Many annelides and other articulata are phosphorescent, and even starfishes of the *Ophiura* tribe, as has recently been shown by Quatrefages, but for similar reasons they are not likely to be chief producers of the light. It is mainly by the *Arachnodermata* and minute animals closely allied to them that the waves at night are—

> "Spangled with phosphoric fire
> As though the lightnings there had spent their shafts,
> And left the fragments glittering in the field."*

The phenomenon of the luminosity of the sea was known to be produced by Medusæ as long ago as the time of Pliny,† and has attracted much attention in connexion with the more ordinary species of Acalephæ ever since. The first observations of importance on this subject in modern times were those of the accurate Forskal, who described the phosphorescence of the *Pelagia* and *Æquorea*, observed by him during his voyage to Egypt, in 1762. Since his time many voyagers and travelling naturalists, including Banks, Humboldt, Chamisso, Peron, Lesueur, Spix, Mertens, and Baird, have published valuable observations on this interesting subject. On our own coasts, attention has been called to the subject, more especially by Macculloch and Macartney. The valuable observations of Suriray in France were chiefly confined to some minute animals allied to Medusæ. In Germany, Tilesius and, above all, Ehrenberg have published important and original essays on this subject; and in Italy, the experiments of the indefatigable Spallanzani still furnish some of our best modern data. Many more authors might be cited who have treated the matter in greater or less detail,

* James Montgomery, Pelican Island. Canto I.
† Hist. Nat., lib. xxxii, c. 10.

and those of our readers who may wish for fuller information on the general question, would do well to consult the excellent essay of Brandt, in the 'Transactions of the Imperial Academy of St. Petersburgh' for 1838, and the article "Luminous Animals," in Dr. Todd's 'Cyclopædia of Anatomy,' by Dr. Coldstream, a gentleman well versed in such inquiries. Several very interesting observations on the phosphorescence of the *Cilograda** have also been published by authors, both British and foreign; but these are foreign to my subject at present, as I wish to confine the discussion mainly to the naked-eyed Medusæ, and intend on a future opportunity to treat of the *Beroe* tribe in full, having accumulated abundant new materials for an essay on the British *Ciliograda*.

Most of the accounts of the phosphorescence of Medusæ have reference to the higher or steganopthalmatous species only; nevertheless, at an early period the light given out by naked-eyed species attracted attention, for we find in the middle of the last century the phosphorescence of one of them ("Medusa microscopica"—probably a young state of the *Saphenia dinema* of modern authors) attracted the attention of the observant Slabber. Previously, the phosphorescence of "*Medusa æquorea*" (*Æquorea Forskalina*, Lamarck) was noticed by Forskal: "Rasa ligno, parum adeo in tenebris splendet."† Peron and Lesueur afterwards mentioned their *Æquorea phosphorifera* as possessing the luminous power. Tilesius observed it in *Charybdea marsupialis;* Rathke, in his "*Oceania Blumenbachii*."‡ Macartney announced the *Thaumantias hemisphærica* to be an active cause of the luminosity of the sea on our own coasts, and detailed some interesting experiments which I shall presently have to cite. Among the twenty phosphorescent Medusæ mentioned by Macculloch, it is probable that several were species of this division. One of the forms figured by Baird as a cause of phosphorescence in tropical seas§ appears to be a *Sarsia*. Ehrenberg observed this phenomenon in *Oceania pileata*, "*Melicertum campanulatum*" (*Stomobrachium octocostatum*), "*Oceania microscopica*," and *Thaumantias lenticula* and *hemisphærica*.‖

The British naked-eyed Medusæ in which I have observed phosphorescence are species of *Turris, Oceania, Dianæa,* and *Thaumantias*. In no case have I seen it continuous or constant in any one species. In every instance the light has been given out only under circumstances of irritation, and not always even then. Thus, on the 27th of July, 1845, when in the Zetland Islands with Mr. M'Andrew, we collected myriads of small Medusæ, and placing great numbers in a basin of sea-water, irritated them by many annoying devices, but though the vessels were charged with individuals of *Thaumantias, Steenstrupia,* and *Lizzia,* active and in good health, no light was given out; nor could this arise from any peculiarity of conditions in the vessel or contained water, for individuals of the ciliograde *Mnemia norvegica* (*Bolina hibernica* of Patterson) gave out flashes of vivid bluish light, so as at times to illuminate the whole vessel. This experiment was often repeated with the same result, though at the same season in the following year, the not giving out light was the

* The essays of Mr. Robert Patterson, in the 'Transactions of the Royal Irish Academy,' should especially be consulted. I may here mention that such members of the Ray Society as have not attended much previously to the subject of this essay, could not prepare themselves better for a practical study of it, than by consulting the admirable little 'Zoology for Schools,' by the valued friend just mentioned.

† Fauna Arabica, p. 110.

‡ Philosophical Transactions, 1810.

§ Loudon's Mag. Nat. Hist., vol. iii, 1830.

‖ Berlin Transactions, 1832.

exception, and not the rule with similar Medusæ, on the coast of Cornwall. Spallanzani fancied that the higher Medusa, *Pelagia phosphorea*, always emits light more or less, but his own experiments go far to disprove the notion. My friend and countryman Dr. I. Heywood Thompson, R.N., has, during his voyages on the western coast of Africa, and elsewhere in tropical and in southern seas, paid careful attention to the phenomenon of phosphorescence of the sea, and has never observed it, when the product of animal life, to occur, except under circumstances of irritation.*

Macartney narrates the following experiments, instituted on a species of Thaumantias, with the view of ascertaining the effects of various irritating conditions :—

"1. Some hemispherical Medusæ were put into a spoon, containing a small quantity of sea-water, and held over a burning candle. As soon as the water became heated, the Medusæ appeared like illuminated wheels, the spots at the margin and centre alone emitting light, in which manner they shone vividly and permanently for about 20 seconds, when they shrunk and died, after which they were no longer luminous.

"2. Some of the same species were put into spirits: a strong and unremitting light was instantly given out, which issued from the central and marginal parts, as in the preceding experiment, and continued until they died.

"3. Some of the scintillating and hemispherical species of Medusæ, contained in a small glass jar, were introduced into the receiver of an air-pump, and the air being exhausted, they shone as usual when shaken ; if any difference could be perceived, the light was more easily excited, and continued longer in vacuum.

"4. A *Medusa hemisphærica* was placed in a small glass dish, containing a quantity of water, merely sufficient to allow the animal to preserve its figure ; being insulated, it was electrified and sparks drawn from it, which had not the slightest effect; the experiment was repeated several times with different individuals, but without exciting the animals to throw out light.

"5. Some hemispherical Medusæ were placed in contact with the two ends of an interrupted chain, and slight electric shocks passed through them. During the very moment of their receiving the shock no light was visible, but immediately afterwards the Medusæ shone like illuminated wheels, which appearance remained for some seconds. Upon the closest inspection with a magnifying glass, no motion could be perceived to accompany the exhibition of light. The application of electricity in this instance seems to have acted as a strong mechanic shock."†

Ehrenberg placed the same species in spirits, with a view to observe the effect, and found the phosphorescence brilliantly revived when it had ceased to be exhibited by ordinary modes of irritation.

Spallanzani had, previous to either, instituted similar experiments with those described by Macartney, but on one of the higher *Medusæ*, the *Pelagia* only. He found raising the temperature revive the phosphorescence, when it had otherwise ceased to appear.

I have found the sudden plunging of *Thaumantias* into fresh water or spirits call forth the dormant phosphorescence suddenly, and with extreme vividness. It gradually fades away

* His notes will appear in the account of the Niger Expedition by Capt. Allen and Dr. Thompson.

† Phil. Trans., 1810.

as life departs. The same phenomenon is exhibited by the hydroid, helianthoid, and asteroid polypes. If a bunch of one of the bushy corallines, such as *Sertularia abietina*, be plunged when alive and active into fresh water or spirits, a gorgeous display of living stars is instantaneously produced. So also with *Pennatula phosphorea.**

The light of the Medusæ, as Spallanzani observed, is not given out by all parts of the body indifferently, but only by certain structures. Spallanzani states that when he cut off the margins of the *Pelagia phosphorea* to a depth of from 5 to 6‴, the border continues to shine, which is not the case with the disk, and he attributes the phenomenon to the production of a phosphorizing mucus by the light-producing parts. Ehrenberg regards the light as an act of organic life. He observes that "the active organic phosphorescence appears frequently periodically, produced either spontaneously, or by excitement, frequently as rapidly produced sparks, resembling small electric discharges. This repeated sparkling converts a mucous, gelatinous fluid, which is discharged more abundantly during the operation, into a secondary state of phosphorescence, which continues for a time, even after the death of the organism, or after the severing of its parts." He considers the mucus enveloping the ovaries as particularly susceptible, when in a fresh state, to this imparted phosphorescence. In *Oceania pileata* he observed the light emanate from the locality of the ovaries, which, being pendant in the centre of the sub-umbrella, illuminated the animal as an argand lamp illuminates its glass shade. In *Thaumantias hemisphærica* he observed the light to be given out by the bulbous bases of the tentacula, which formed a garland of sparks of fire around the circumference of the umbrella. Macartney had previously noticed, as we have seen, that in this naked-eyed species, the light was given out from the same spots, and, he adds, from the centre also. I have observed that in *Thaumantias lucida* the light was invariably given out by the bulbs of the tentacles, and so also in other species of the same genus. In the *Dianea appendiculata*, which is a beautifully luminous species, the phosphorescence is of a greenish hue, and appears to radiate from the reproductive glands. In the Mediterranean I have seen a large *Mesonema* give out rich flashes of flame from the bases of its numerous marginal tentacles. Both Spallanzani and Tilesius have noticed that the light in the higher *Medusæ* shone most vividly during the contractions of the umbrella.

Taking one fact with another, it would seem that the phosphorescence in the naked-eyed Medusæ is developed by the reproductive and motor systems: how, we cannot say. Ehrenberg has concluded that the production of the light is "a periodical vital act dependent on the nervous system, and similar to the development of electricity." But this can only be regarded as an hypothesis. We have no clear evidence yet of the presence of a nervous system in these animals.

Development.—When treating of the reproductive organs of these animals, I discussed the ovarian and spermatic glands; but the naked-eyed Medusæ do not reproduce their species only in the normal fashion, i. e. by fecundated eggs; several of them are now known to multiply their kind by gemmation, little ones springing out almost ready made from the substance of their parents, as Minerva budded on the creative brain of Jupiter. This mode

* See a notice of the phenomena exhibited by this zoophyte when phosphorescing, in the second edition of Dr. Johnston's British Zoophytes.

of propagation by gemmation was long supposed among Radiata to be an especial privilege and distinction of the true zoophyte; but the march of discovery and the revolutions of science, do away with such artificial distinctions, though the recognition of them in their time gave no small impulse to the onward progress which was eventually to destroy them. The discoveries of Sars, Dalyell, Loven, Wagner, Van Beneden, Dujardin, and Steenstrup have changed the face of this section of creation seriously, and prophetically indicate many coming changes. It is the duty of the philosophical zoologist to keep pace with the railroad speed of modern research, and whilst conservative of all past statements, as yet insufficiently combated, never to hesitate to cast away preconceived notions and old teachings the moment they are clearly shown to be untrue. "Free and unprejudiced spirits will neither antiquate truth for the oldnesse of the notion, nor slight her for looking young, or bearing the face of novelty."*

The polypes of the genus *Coryne* and its allies, of *Tubularia* and *Eudendrium*, and of the beautiful *Corymorpha*, send forth at certain times bud-like bodies, more or less symmetrically arranged around their heads. These bodies have long been recognised as young animals, though not until very recently was it known that the creatures so produced bear no resemblance to their parents, but were indeed true *Medusæ*, and not polypes, which, however, in their turn produced eggs capable of producing polypes. Such appears to be the true interpretation of the phenomenon—a part of the justly celebrated theory of alternation of generations which has originated in the imaginative mind of Steenstrup. On the bearing of such discoveries on the better classification of the Radiata, I shall have to make a few remarks presently. Now, among the *Acalephæ*, no such reproduction by gemmation in the manner of the *Coryne* was known until discovered in 1836 by Sars, who had previously been the first to announce the surprising fact of the intermediate *Strobila* condition of the higher Medusæ, a discovery made independently and simultaneously in Scotland by Sir John Graham Dalyell.

The discovery made by Sars was that certain forms of naked-eyed Medusæ multiply their species by means of gemmation, the buds being produced either from the walls of the peduncle or stomachal proboscis, or from the surface of the ovaries, the former mode occurring in the "*Cytæis octopunctata*" (*Lizzia octopunctata*, Mihi), the latter in *Thaumantias multicirrata*. In both cases, the new individuals were not different from, but similar to, their parents, and, in one instance, provision seemed to be already made in the new-formed individuals for continuing to propagate by the same mode other individuals similar to itself. The full account of these remarkable and highly important observations, illustrated by excellent figures, is contained in the lately published 'Fauna Norvegica,' a most admirable work, by one of the greatest of living investigators of life in the sea. I shall extract it hereafter when describing the *Lizzia*, in the second part of this essay. At present I shall cite the summing up given by Sars, and his notice of the phenomenon as it occurs in the *Thaumantias*.

"We now recognise a mode of procreation and development hitherto unknown among the Acalephæ. From a certain part of the body (in this instance the tubular stomach, hanging independently in the cavity of the disk) roundish knobs grow forth from the upper towards the lower part, which gradually assume the shape of a bell, by opening themselves at the free

* Henry More.

end ; on the margin of these openings dark granules (marginal granules) make their appearance, being the nuclei or first beginnings of the marginal fibres, which latter gradually grow forth, and the stomach exhibits itself at the base of the cavity of the bell-formed disk, together with the mouth and mouth-tentacle ; from the stomach vessels radiate towards the margin of the disk ;—in short, the young Acalephis, being merely attached to the mother by means of a short peduncle issuing from the back of the disk, develops itself in all essential organs, whilst it is still attached to the mother like the bud of a plant. Finally, after a certain expiration of time, it severs itself from the mother, and now swims about as an independent individual.

"I likewise found quite the same mode of perpetuation, on the 9th of May, 1837, in *Thaumantias multicirrata*, in an Acalephis of more than one inch in diameter. In the four narrow, folded together, so-called ovaries that issue from the stomach, and extend along the margin of the disk, there were blossoming forth, even as described in *Cytæis*, some globular bell-shaped gemmules (I observed from five to six towards the external extremity of the ovarium), the smallest of them furnished with four, the largest with eight black marginal granules, and short marginal fibres growing forth from the former. Perpetuation by means of prolification has hitherto been chiefly observed among the polypes, in which indeed it is the prevalent mode, but it was latterly also observed among the Infusoria (Vorticelles), the Tunicata (the compound Ascidians), and, lastly, also in some of the Annelides (the *Naides* and *Syllis prolifera*, to which I may add the *Filograna implexa*). We now likewise recognise this mode of perpetuation in an animal which will undoubtedly be declared by all classifiers to be an Acalephis, against the assertion of Ehrenberg, that 'a bud-bearing or self-dividing Acalephis is a *contradictio in adjecto*.' Thus are our speculations and inferences not unfrequently frustrated by a boundless and ever-varying nature."

I am not aware of any naturalists having confirmed the observations of Sars. With very great pleasure, therefore, am I able not only to bear out, by personal observation, the remarkable statements of the Norwegian naturalist with respect to the species he mentions, but also to extend them to other species and other genera.

I have observed four modes of propagation by gemmation among the naked-eyed Medusæ. 1st. Gemmation from the ovaries, as noticed by Sars in *Thaumantias multicirrata*, and which I have seen, though not in an advanced stage, in my *Thaumantias lucida*, a nearly allied species. 2d. Gemmation sub-symmetrically from the peduncular stomach, as described by Sars in his account of *Lizzia octopunctata*. This I have seen in all its stages, exactly as he narrates, in the same species, a very abundant animal in the Zetland seas. I call it sub-symmetrical gemmation, for whilst the four gemmæ are symmetrically arranged around the peduncle, one of them is constantly in a more advanced condition of development than the other three. This appears to be a generic habit, for I find the same phenomenon in *Lizzia blondina*, a new and very distinct species of the same genus, in which gemmiparous reproduction is equally conspicuous. 3d. Gemmation irregularly from the walls of a tubular proboscis. This I have discovered in a new *Sarsia*, which I have named *Sarsia prolifera*. From the sides of the long peduncle many gemmules are seen springing in all states of development, and presenting an indistinct spiral arrangement. There is no order of development with respect to position, individuals variously advanced springing indifferently from various parts of the peduncle. [See the account of the species in the Second Part.] The fourth mode of

gemmation, and a very remarkable and quite novel one, I have discovered in another form of *Sarsia*, taken abundantly in 1836 on the coast of Cornwall, and named by me *Sarsia prolifera*. In this extraordinary animal the buds are produced at the bases or tubercles of the four marginal tentacles, and hang from them in bunches, like grapes. The degree of development is not equal in all four bunches, and in each case buds are seen in very various stages of development, from embryo wart-like sproutings to miniature Medusæ, simulating in their essential characters the parent animal. [See figures and description of *Sarsia prolifera* in the synopsis of the species.]

I look upon this last discovery as very important in its bearing on the history of this phenomenon of gemmation among these creatures, seeing that in the case under consideration the seat of reproduction is not in the peduncle, where in *Sarsia* the true ovaries might be supposed to be seated, since they are not manifest elsewhere, but in a portion of the animal quite apart. It would appear, indeed, that gemmation can occur anywhere in the course of the granular motor tissue, or from the true ovaries, but not from other than the motor, and especially reproductive, tissues. The power of the motor tissue to produce germs occurs also in other orders of Medusæ: for I have seen the same phenomenon in the *Beroe*. When treating of the phosphorescence of the naked-eyed Medusæ, we have seen that that phenomenon was exhibited either by the ovaries, or centre (peduncle) or bases of the tentacles and rim; all, as I have just proved, seats of reproductive power. This goes far to connect that phenomenon with the generative functions.

The development of the ovum in the naked-eyed Medusæ has still to be observed. Not until the phenomena attending it have been made known, can we hope to ascertain the history of the metamorphoses which they possibly, indeed most probably, undergo before arriving at the state in which we usually find them.

The preceding outline of the structure and physiology of the naked-eyed Medusæ, so far as known, will enable the reader to understand the detailed account of our British genera and species, which I shall now proceed to give, reserving remarks on their zoological affinities as a group, for a review of the subject at the conclusion of the synopsis, when we shall have the necessary evidence before us.

There are forty-three species of *Gymnopthalmatous Pulmograda* known to the author as inhabiting the British seas. The greater number of these are undescribed forms. They may all be arranged under eighteen Genera, grouped together as in the following table:

I. Vessels branched. (Willsiadæ.)
   1. *Willsia.*

II. Vessels simple; ovaries convoluted, and lining the pedunculated stomach. (Oceanidæ.)
   2. *Turris.*
   3. *Saphenia.*
   4. *Oceania.*

III. Vessels simple, eight or more; ovaries linear, in the course of the vessels on the sub-umbrella. (Æquoreadæ.)
   5. *Stomobrachium.*
   6. *Polyxenia.*

IV. Vessels simple, eight; ovaries as many as the vessels, small, on the course of the sub-umbrella. (CIRCEADÆ.)

7. *Circe.*

V. Vessels simple, four; ovaries four, in the course of the vessels on the sub-umbrella. (GERYONIADÆ.)

8. *Geryonia.*
9. *Tima.*
10. *Geryonopsis.*
11. *Thaumantias.*
12. *Slabberia.*

VI. Vessels simple, four; ovaries in the substance of the peduncle. (SARSIADÆ.)

13. *Sarsia.*
14. *Bougainvillea.*
15. *Lizzia.*
16. *Modeeria.*
17. *Euphysa.*
18. *Steenstrupia.*

WILLSIADÆ.

Genus I. Willsia, Forbes (1846).

Char. Gen. Umbrella globose; ovaries six, radiating around the base of the short, campanulate, four-lipped stomach; vessels six, twice dichotomously dividing before they reach the marginal vessel; a marginal tentacle opposite each branch: ocelli conspicuous.

Willsia stellata, Forbes.

(Plate I, Fig. 1.)

I have constituted this genus for one of the most elegant of our naked-eyed Medusæ, strikingly distinct in its characters from all recorded forms, and quite new. I have dedicated it to my friend Dr. Will, of Erlangen, whose work on the 'Medusæ of the Adriatic,' already often quoted, is one of the most valuable and original contributions to this department of zoology ever printed.

This beautiful little creature is, when full grown, about a quarter of an inch in diameter. The umbrella is nearly globular, quite smooth, and colourless. The sub-umbrella is small in comparison, and hemispheric, or slightly cylindrical in form. The margin bears twenty-four extensile, pale yellowish tentacula, of a minutely granular tissue, and moniliform structure. At the base of each is a bulb or ocellus, of a deep purple red and tawny yellow colour, the darker hues being disposed in an arrangement partly crescentic, and partly eye-like. When highly magnified, the coloured parts are seen to include a cavity containing a central body, which, though not observed to vibrate, is probably the homologue of an otolitic mass. Some specimens were observed which had only twenty tentacula.

The central peduncle, or stomach, is campanulate, and opens widely by four scarcely undulated lips.* Sometimes the orifice presents a six-lipped appearance, and it is very probable that it may contract itself indifferently into four or six divisions. Around the base of the stomach, partly attached to its side, and partly to the sub-umbrella, are the six double ovaries, or reproductive bodies, each of an oblong, somewhat spoke-like shape, and coloured of a tawny yellow. The colour is due to two fulvous masses on each side the gastro-vascular canal, one of which traverses the centre of each ovary. The fulvous masses are bordered by a

* In the figure there is an appearance as if of a fifth lip, which is a mistake.

nearly colourless margin. The six ovaries together form a beautiful star around the base of the stomach. Each gastro-vascular canal runs without dividing through the corresponding ovary, but when it reaches half way down the sub-umbrella, it divides into two, and at a fourth of the distance between the margin and the centre, each branch again divides into two, which is the final division, for these last two branches run directly into the marginal canal, each opposite the origin of a tentacula.

The *Willsia stellata* was first observed by Mr. M'Andrew and myself, in September, 1845, in the Bay of Oban. Many specimens occurred, and its appearance in the vessel of sea-water, was very striking, the star-like ovaries conspicuously distinguishing it from Medusæ of other genera. It is so transparent, that usually only the reproductive star and the marginal circle of brilliant ocelli—like a mimic sun with its surrounding planets—could be perceived by the naked eye. When placed in a watch-glass, however, the singular arrangement of its vessels, and the other details of its structure, may easily be made out without the use of a high magnifying power.

In August, 1836, when visiting Penzance Bay, we took great numbers of the same species, so that it would appear to be rather widely distributed. It was not observed at Zetland, nor further west than the Lizard on the south coast of England.

In the Plate, fig. 1 represents the natural size; 1, *a*, a magnified view as seen from the side; 1, *b*, the creature seen from above; 1, *c*, the mode of division of one of the gastro-vascular trunks; 1, *d*, an ovary; and 1, *e*, a tentacle, both greatly magnified.

OCEANIDÆ.

Genus II. Turris, Lesson (1837).
Conis, Brandt (1838).?

Umbrella sub-cylindrical or mitrate; ovaries four, double, dense, convoluted, lining the cavity of the peduncle; vessels simple; margin of the umbrella with numerous tentacula; muscles of the disk conspicuous and highly developed; mouth of the peduncle fimbriated.

This well-marked genus was constituted by Lesson for three species of naked-eyed Medusæ, having an organization which seemed to indicate a high position in their order, though not so high as the founder of the generic group would seem to place it. It forms part of the tribe *Nucleiferæ* in the arrangement of Lesson, where it is strangely associated with *Pandea*, *Circe*, and *Bougainvillea*. The high development of the muscular system in the species of *Turris*, indicate their superiority to the *Oceaniæ* proper, which otherwise they closely resemble. The only species known besides the following, is the *Turris papua* of the author cited, who discovered it near the island of Waigiou.

The *T. papua* has only eight tentacles, whilst our native species are remarkable for the number of those organs fringing their margin. This variation in number of tentacles seems a good source of specific distinction in the genus.

1. *Turris digitalis* (sp.), Müller.

Plate III, Fig. 1.

Synonyms. *Medusa digitale.* O. F. Muller, Prod. Z. D., p. 233, No. 2824 (1766).
O. Fabricius, Fauna Groenlandica, p. 366 (1780).
Melicerta digitale. Peron, Ann. du Mus., t. xiv, p. 352 (1809).
Dianea digitale. Lamarck, Ann. Sans. Vert. (1817).
Eirene digitale. Eschscholtz, Syst., p. 95 (1829).
Turris borealis. Lesson, Prod. (1837), and Hist., p. 284 (1843).

This beautiful species is an inhabitant of the northern seas. It was observed on the coast of Greenland by Otho Fabricius, who, in his 'Fauna Groenlandica,' one of the most remarkable zoological works of the last century, has given a short but expressive description of it. "Hæc omnium minima digitale tam figura, quam magnitudine refert. Corpus conicum hyalinum, vix in aqua observaretur, si non motu ejus margo coloratus in conspectum veniret. Striæ multæ vix notabiles longitudinaliter in verticem concurrunt. Margo ciliatus est ciliis

intus hamatis flavis cum albis mixtis. In cavitate infera, quæ profunda, pistillum apice, ut videtur penicillato dependet, in aliis album, in aliis penicillo flavo. Habitat in mari ad oras exteriores. Est vivida satis ; margine flexo in aqua salit."

This account of its characters and habit seems to have furnished all subsequent authors with the brief notices which they give of the species, indeed it is doubtful whether it has been examined by any since the days of the author of the 'Fauna Groenlandica.' Müller probably intended to give a representation of it in his invaluable 'Fauna Danica,' but, as it is, we have no figure extant.

When enjoying a delightful cruise with my friend Mr. Smith, of Jordanhill, in his yacht the Amethyst, during the summer of 1839, I paid particular attention to the Medusæ of the Clyde, and laid the foundation of the present monograph. Not so well versed then, as now, in the art of securing these fragile and floating creatures, it was a source of not unfrequent vexation to behold many of them, either apparently new or doubtful, pass by our vessel beyond our reach, or when we endeavoured to secure them, sinking slowly in the sea depths. Among those which we failed altogether in catching, was one of considerable size—three inches or so in length—and conspicuously distinguished from all others of my acquaintance by its singular cylindrical umbrella, and the dense, brilliantly-coloured nucleus. A rude and rapid memorandum of its aspect in the water, as seen over the vessel's side, was all the record which we could bring away.

In the autumn of 1845, when on a voyage of research with Mr. M'Andrew, in his yacht the Osprey, we procured numerous Medusæ in the sound of Brassay, among the Zetland Isles. It was with no small pleasure that, on emptying the tow-net one morning in August, I found in it what at first glance appeared to be a floating Actinea, but which, on closer examination, was evidently identical with the creature I had seen in the Frith of Clyde six years before, and which I had often anxiously looked for since, but in vain. A further inspection, and a comparison of it with published descriptions, soon convinced me that we had secured the finger-shaped Medusa, so pithily described by Otho Fabricius.

The umbrella is sub-cylindrical and mitrate, swelling gently into a bell-shape in the centre, somewhat apiculated at the apex. Its substance is highly transparent and colourless, but firm. Its margin is fringed by fifty or more long annulated, and as if granulated, tentacula, which are white, with orange bases, and when contracted, are curled or rather hooked at their extremities. The bases of the marginal tentacles are covered by an external veil-like prolongation of the margins. The sub-umbrella occupies slightly more than two thirds of the length of the body, and is cylindrical in form. Along its sides are seen to run eight conspicuous longitudinal bands of muscular tissue, which have a furbelowed appearance, in consequence of habitually contracting at fixed intervals. The substance of these bands is composed of distinct fibres. From the centre of the sub-umbrella depends a capacious and cylindrical pedunele, the whole of whose interior is occupied by the stomach and ovaries, or reproductive glands. The latter bodies consist of four quadrate groups of foliated and convoluted masses, of a bright reddish-brown or brownish-red hue, arranged in the course of four simple gastric vessels. Each of these masses consists of a double series of fimbriated organs, each series being placed on one side of a vessel. Below the ovaries the pedunele contracts, though not greatly, and expands again to form the much divided fimbriated lips, which fringe and border the wide oral orifice, and which are parted into four somewhat indistinct lobes. The lips are

of a fine rose colour. They reach to a level with the margin of the umbrella. The specimen I have described was a little more than an inch in length, exclusive of its tentacula. It was sluggish, possibly owing to fatigue, as it had probably been in the tow-net during a greater part of the night. I have represented it in Plate III, fig. 1, *a*, of the natural size; fig. 1, *b*, is an outline showing the arrangement of the muscular bands; fig. 1, *c*, represents a portion of the peduncle laid open, with two of the ovarian masses, and the fimbriated lips, also a part of the border of the umbrella with its tentacula; fig. 1, *d*, is a portion of one of the tentacles, magnified; and fig. 1, *e*, a portion of the tissue of one of the muscular bands, as seen under a high power.

Eschscholtz has strangely placed this Medusa as an associate of *Dianæa viridula*, in his genus *Eirene*.

2. *Turris neglecta*, Lesson.

Plate III, Fig. 2.

Synonyms. *Turris neglecta.* Lesson, Prod., No. 38 (1837), and Acal. Hist., p. 284 (1843).
Cyanæa coccinea. Davis, Ann. Nat. Hist., t. vii, p. 234, pl. 2, f. 12, 13 (1841).
Carminrothen beroe. Slabber, Ph. Vet., p. 59, t. xiii, f. 3? (1781).
Oceania sanguinolenta. Peron, Ann. de Mus., p. 347? (1809).
Oceania tetranema. Peron, Ann. de Mus., loc. cit.? (1809).

A beautiful little species, which, when in its native element, is brilliant as a bead of brightest coral. It appears to be not uncommon in the Solent and around the Isle of Wight. I first caught it on the south coast of that island in 1844, when geologising there with my friend Captain Ibbetson. Since then it was taken in the west bay of Portland, just before the Southampton meeting of the British Association, by Mr. M'Andrew and myself, and again off the mouth of Southampton harbour during the week of the meeting, in a memorable day's cruising, when a small band of British naturalists fraternised with Agassiz and Middendorf, and enjoyed themselves as true students of Nature only know how, when "dredging the waters under."

The umbrella is transparent, smooth, and sub-hemispheric, inclining to conical. Its summit is slightly pointed. The sub-umbrella is small in proportion, reaching to a little more than half the height of the former. It is slightly pyramidal, with a truncated summit. The muscular bands are distinctly seen striping its sides. The peduncle is large, and has a singularly substantial aspect, in consequence of the compact masses of rich crimson or vermilion convoluted and fimbriated ovaries which occupy its broader and upper half. This bright red nucleus causes the animal, small as it is, for it reaches scarcely more than one fourth of an inch in height, to be very conspicuous in the water. The substance of the lining of the sub-umbrella is also very firm. The brilliant colouring of the ovaries is due to the presence of large red ova. I met with individuals, which at first sight seemed as if belonging to a different species, in which the reproductive glands were dull pink. These may have been males. The peduncle terminates in four lips, which are fimbriated at their edges, and highly muscular.

The radiating vessels are four, and all simple. The margin of the umbrella is studded with a close-set circle of tentacula, more than sixty in number (16×4+4), very contractile, being sometimes elongated into hair-like filaments, and at others contracted into little knobs. Each tentacle has a large bulbous base, the upper part of which bears a brilliant ocellus, consisting of crimson pigment-cells, and there is another speck, probably the site of an otolitic mass below.

A very interesting account of this species, under the name of *Cyanæa coccinea*, was given by Dr. J. F. Davis, in the seventh volume of the 'Annals of Natural History.' "Amongst the variety of animals," writes that gentleman, "which we had opportunities of seeing, during our stay at this charming marine watering-place (Tenby), none afforded greater interest than a small Medusa belonging to the genus *Cyanæa*, Cuvier. . . . . Having been discovered by Mrs. Davis, who had likewise the best opportunity of watching its motions during several weeks that she kept it in a glass of sea-water at Tenby, and afterwards here (Bath), whither it was conveyed in a phial of the same, and lived three weeks after its arrival, I will state the history of this 'thing of light and life' in her own words. 'One morning, while pouring some sea-water into the vessel containing my *Actiniæ*, I observed two small objects, which I took for the young of these animals, and as quickly as possible raised them in a spoon out of the basin, and placed them in a tumbler of clean sea-water. They resembled tiny bell-glasses. Four transverse rays were perceptible on their sides, and a minute red body, with four white arms forming a cross, was suspended in the water. Around the edge of the bell or disk appeared a delicate white fringe, which was lengthened or shortened at the pleasure of the animal. The contraction was sometimes so great, as to give the fringe the appearance of being knotted up to the edge of the bell or disk. It was highly interesting to watch their movements in the water as they ascended from the bottom, the bell or disk contracting and dilating alternately, until the animal arrived near the surface of the water. This motion was particularly conspicuous at the edge of the disk, and the fringe or tentacula became shortened as the animal rose in the water; but when they descended again the tentacula lengthened, sometimes to a great degree, after which the animals sunk gradually, and without any visible effort. At the end of a fortnight one of my pets turned itself inside outwards, and remained in this state for some time, when it died, and left only a few flocculent particles at the bottom of the vessel. The other lived more than two months longer, and even bore a voyage to Bath in a closed phial of sea-water, and remained active and vigorous during the space of three weeks, when it likewise shrunk, died, and disappeared like the former, but without the previous eversion.'"

Plate III, fig. 1, *a*, *Turris neglecta*, much magnified; 1, *b*, body seen from above, showing the muscular bands alternating with the vessels; 1, *c*, proboscis and lips; 1, *d*, one of the lips magnified; 1, *e*, a group of tentacles; 1, *g*, a tentacle with its bulb, showing the ocellus and otolitic mass; 1, *h*, portion of a tentacle highly magnified; 1, *i*, ova; 1, *k*, muscular tissue.

Genus III. Saphenia, Eschscholtz (1839).

Umbrella sub-cylindrical, campanulate, or hemispheric; ovaries four, double, convoluted, lining the upper part of the cavity of a highly extensile peduncle; vessels simple, four; margin of the umbrella with two large, and numerous very small tentacula; mouth of the peduncle four-lipped.

I have no doubt whatsoever that the Medusa I am about to describe, is one of those regarded by Eschscholtz as characteristic of his genus *Saphenia*, although his definition, "Pedunculus apice simplex," does not apply. He founded his genus on figures and imperfect descriptions; but, as it seems to be a good group wrongly defined, I have adopted it, and revised the character.

1. *Saphenia dinema* (sp.), Peron (1809).

Plate II, Fig. 4.

Synonyms. *Geryonia dinema.* Peron, Ann. de Mus., p. 346 (1809).
Dianæa dinema. Lamarck, First Ed., p. 505 (1817).
Campanella dinema. De Blainville, Man. d'Act., p. 286 (1834).
Saphenia dinema. Eschscholtz, Syst., p. 93 (1839).

I have met with this species in our seas during two seasons, once near Hillswick, on the western coast of Zetland (1845), and thrice on the south coast of England, in Cornwall and at Portland, in 1846. It is small, being scarcely more than one fourth of an inch in length, but conspicuous, owing to the colour of its ovaries and tentacles. The umbrella is cylindrical, somewhat mitrate, obtuse (acute in young specimens), and smooth. It is quite transparent and colourless. From the margin spring two large orange purplish tentacles, with bulbous and rather large bases; in the interspaces, and covered by a short veil, are a number of minute and very short colourless tentacles, about twenty-four in all. These appear to increase with age, as young specimens had fewer. The sub-umbrella is about two thirds the length of the body. From its centre depends the highly contractile peduncle, which is sometimes drawn out into a long tube, sometimes contracted into a short bell. In its uppermost part are lodged the four reproductive glands, short, convoluted, double, distinct, of a bright purple colour when adult, and when immature, tawny. The part of the peduncle below the ovaries is most contractile, and is of a pale fawn colour, with four dark purple lines in the course of the ovaries proceeding to the four slightly fimbriated lips bordering the orifice, and which, when drawn together, give the club-like appearance that appears to have misled Eschscholtz and other observers.

Plate II, fig. 4, *a* and *b*, represent this species (enlarged), as seen from the side and from above; 4, *c*, is the appearance of the peduncle when contracted.

Genus IV. Oceania (nom. Peron), (1809).
Tiara and Oceania (pars), Lesson.

Umbrella conical, mitrate, or rarely globular; ovaries four, double, convoluted, lining the cavity of the peduncle; vessels simple, four; margin of the umbrella with few, or many, similar tentaculæ; no conspicuous muscular bands; mouth of the peduncle four-lipped.

The natural wish to preserve a name in a manner consecrated by long usage, has induced me to retain that of *Oceania*, even at the risk of employing it in a somewhat different generic signification from any of the many meanings hitherto given to it, and thereby perhaps almost increasing confusion. In such a case it becomes a toss-up whether the conservative or the destructive process be best; but as even the most virulent of reformers gladly seize on an excuse for upsetting usurpers, whilst good-natured people are inclined to stand by ancient dynasties, however bad, rather than risk the chances of change, I think it safest (though prepared to do either) to adopt *Oceania* as a genus for the present, and, by defining it more strictly, endeavour to make it more useful.

The term *Oceania* has been so often and generally applied to the *Medusa pileata* of Forskal, and similar forms, that I think it best to restrict it to that group. Peron, who first founded the genus, included them within it, though it is doubtful whether he would have regarded the Forskalian species as the type. Lesson gives the generic name of *Tiara* to *M. pileata*; and those who are extremely anxious to use a new name may adopt it. Eschscholtz included its allies in his view of the genus, but also some very distinct forms.

Using it in the sense here taken, the genus consists of those mostly mitre-shaped Medusæ, which have an ample dependent peduncle and convoluted ovaries within, a conspicuous character indicating a close relationship with *Turris*. Their muscular tissue, however, is not nearly so highly organized as in the last-named genus, whilst the uniform character of the tentacles separates them from *Saphenia*.

The species of *Oceania* range throughout the European seas, extending into the Mediterranean. They will probably be found much more numerous than at present recorded. Sars has described and figured in his 'Beskrivelser,' &c., 1835, a species with twenty-four tentacula, and resembling in form our *O. episcopalis*, which may probably inhabit our seas. He names it *O. ampullacea*, and describes it as ovato-campanulate, terminating above in an oblong, conical appendage; the mouth furnished with very short fimbriations; the length of the body about an inch. Forskal's name of "*Medusa pileata*" has been applied to more than one species of the genus. He described it as "ovato-campanulate, terminated above by a hyaline sphere; within containing an oblong, red nucleus; the margin fringed with numerous tentacula, having yellow bases." His figure does not show clearly the number of tentacula, but they appear to have been sixteen and upwards. The animal figured by Ehrenberg as *Medusa pileata* from the Norwegian seas, has a yellow nucleus, and appears to be the *Oceania ampullacea*. The colour of the nucleus, the general form of the umbrella, and the number of the tentacula, are evidently the most important sources of character in this genus, and should be carefully noted.

1. *Oceania octona* (sp.), Fleming.

Plate II, Fig. 3.

Synonym. *Geryonia octona.* Fleming, Edin. Phil. Journ., vol. viii, p. 299 (1822).
British Animals, p. 501 (1828).

Umbrella smooth, transparent, mitrate, somewhat constricted above the centre, and produced into a conical acuminated apex. Margin with eight elongated yellow tentacula, springing from thick bulbous bases. On each bulb is a minute red ocellus, and an otolitic cavity beneath, with an included vibrating mass. Between each pair of tentacles are three yellow minute tubercles springing from a narrow, yellow, marginal ring. On each tubercle is a minute red ocellus. The central one is largest. Down the sides of the sub-umbrella, which occupies about two thirds of the body, run four wide vessels to join a wide marginal vessel. The upper part of the sub-umbrella has often a lobed appearance. From its centre depends an ample, yellow, vasiform peduncle, including in its upper part four convoluted bright yellow ovaries. Its orifice is wide, and bordered by four fimbriated yellow lips. I have taken this species off the mouth of the Frith of Forth, where it has also been observed by my friend Mr. Henry Goodsir, and in the seas near the east coast of Zetland.

It was first noticed and described by Dr. Fleming, who observed it in the sea of the east coast of Scotland in 1821. In his account of an excursion made that year, published under the title of Gleanings of Natural History, in the eighth volume of the 'Edinburgh Philosophical Journal,' he describes it as follows: "Having returned from the Bell rock to the vessel, I devoted some time to the examination of the molluscous cargo which I had brought on board. While observing the motions of some of the animals in a glass of sea-water, a Medusa presented itself belonging to the genus *Geryonia* of Peron and Lesueur. The body was diaphanous, round at the margin, sub-conical at the summit, and slightly acuminated. The central mouth was trumpet-shaped, and shortly pedunculated. The circumference of the body was furnished with eight similar tentacula, equal to its diameter. As it differs from *Geryonia dinema* and *Geryonia proboscidalis*, the only known species, I have named it *G. octona*." (Loc. cit. p. 298.)

2. *Oceania episcopalis*, Forbes.

Plate II, Fig. 1.

The great fishing-banks which stretch along the coasts of the Zetland Isles, whether eastern or western, are among the most interesting of stations in the British seas for marine researches. The beautiful Medusa which I have now to describe was taken in the neighbourhood of the western line of bank, forty miles from the mainland of Zetland, in the autumn of 1845. When lying to there, as much in open ocean as if we had been in the very middle of the Atlantic,—the sea calm, though the heavy swell tossed our little vessel to and fro with a motion that would make land-loving naturalists wish themselves on shore, and vow never more to meddle with the wonders of the deep, but keep steadily at their studies among cockchafers and tom-tits,—we were delighted by the sight of shoals of swimming gelatinous animals, with brilliant purple nuclei, passing in succession near the surface of the water, and having all the

aspect of *Salpæ*. On securing some, however, by means of the hand-net, they proved not to be mollusks but Medusæ, allied to, but very distinct from, the *Geryonia octona* of Dr. Fleming. Mr. Patterson appears to have met with a species very similar, if not identical, at Bangor, County Down.

The largest of the individuals taken measured an inch and a half long in the body; its marginal tentacula far exceeding that dimension. The umbrella is very transparent, smooth, and mitre-shaped, its upper part more or less tumid, and at times assuming a sub-globular form, as if the body was crowned by a mobile glass ball. Round the margin are twelve ($2\times4+4$) highly contractile tentacula, with thick bases. These tentacles are of a pale yellowish hue; between each pair of them are three minute yellowish tubercles, the central one slightly the largest. All these tubercles and all the bulbous bases of the tentacles bear very minute red ocelli ($12\times3+12=48$). Round the orifice of the umbrella is a veil, borne upwards and inwards. The sub-umbrella is conico-cylindrical, and occupies about two thirds of the length of the body. From its centre is suspended an ample urn-shaped peduncle, including in its upper and most tumid part the eight convoluted ovaries, dense, and of a rich maroon purple colour. Four very wide gastric vessels run in the course of the reproductive glands, and proceed down the sub-umbrella to join the wide marginal vessel. The peduncle terminates in a campanulate proboscis, with a wide orifice, surrounded by four fimbriated lips of a pale purplish-tawny hue.

It is a most active and graceful, but very delicate creature.

Plate II, fig. 1, *a*, represents an individual slightly enlarged; 1, *b*, shows the disposition of the ocellated tubercles between the tentacula.

3. *Oceania turrita*, Forbes.

Plate II, Fig. 2.

Umbrella campanulate, smooth, transparent, produced above into a long, conical, acute, and mobile process, turned more or less to one side. Margin with four long yellow tentacles, their bases much swollen; on the bulb of each is a very minute crimson ocellus, composed of a well-defined group of pigment-cells, and in the substance of the bulb below it is a cavity containing a vibrating mass of crystalline particles (calcareous?), mixed with brown pigment-cells. This, no doubt, is the otolitic body. Between each pair of tentacles are three yellowish marginal tubercles, with rudimentary ocelli. The sub-umbrella occupies about half the length of the body. Down its sides run four broad vessels to join a wide marginal vessel. From its centre depends a rather short, but wide yellow peduncle, in the upper part of which are four convoluted bright yellow reproductive glands. The orifice of the peduncle is campanulate, and bordered by four slightly fimbriated lips. The body measures about half an inch in length.

When I first caught this singular and active little Medusa, I fancied we had secured the "*Piliscelotus vitreus*" of Templeton. That anomalous animal, however, I now believe to have been merely a *Sarsia tubulosa* turned inside out. The *Oceania turrita* was taken in the Zetland seas, in 1845.

Plate II, *a*, represents this animal much enlarged; 2, *b*, the body as seen from above; 2, *c*, the bulb of a tentacle with the red ocellus and the otolitic cell; 2, *d*, the peduncle and included ovaries; and 2, *e*, the arrangement of the tentacles and tubercles.

4. *Oceania globulosa*, Forbes.

Plate III, Fig. 3.

This is a minute species,—not larger than a pea,—but so very distinct, that it cannot possibly be confounded with any of its congeners as yet described. The umbrella is globular, inflated, and very wide, extending much beyond the orifice on every side, quite smooth and transparent. The sub-umbrella is also globular, and occupies rather more than half of the interior. Down it run four broad radiating vessels, to join an ample marginal vessel. Round the margin are forty close-set purple bulbs, the bases of as many filiform white tentacula. When the bulbs are magnified, their colour is seen to depend upon rich purple ocelli. From the centre of the sub-umbrella hangs a broad and rather short campanulate peduncle, of a fawn colour, including, in its upper part, four double, convoluted, orange brown reproductive glands. The orifice of the peduncle has four pale, tawny, fimbriated lips.

I procured two specimens of this singular *Oceania* in the Sound of Bressay, in 1835. It differs so much from the other British species of the genus, that I had some hesitation in placing it among the *Oceaniæ*. In some respects it approaches more closely *Turris;* but the inconspicuous character of the muscular tissue of the sub-umbrella prevents our assigning it to that highly-developed group. Plate III, fig. 3, *a*, represents it, much magnified, as seen from the side; and 3, *b*, as seen from above; 3, *c*, is the peduncle with the included ovaries; 3, *d*, the bulb of a tentacle with its ocellus; and 3, *e*, the annulated appearance presented by a tentacle when in its most extended state.

ÆQUOREADÆ.

Genus V. Stomobrachium, Brandt (1838).

Umbrella depressed or convex; ovaries 8-12, linear, radiating on the surface of the sub-umbrella in the lines of the vessels. Margin with very numerous tentacula. Peduncle short, with lobed and fimbriated lips.

Stomobrachium octocostatum (sp.), Sars.

Plate IV, Fig. 1.

Synonyms. *Oceania octocostata.* Sars, Besk. aj. Jagt., p. 24, pl. 4, f. 9 (1835).
Melicertum campanulatum. Ehrenberg, Berlin Trans., 1835, pl. 8, f. 5-7.
Æquorea octocostata. Lesson, Acal., p. 312 (1843).
Thaumantias Milleri. Landsborough, Arran, p. 265 (1847).

Of all our British naked-eyed Medusæ, I know least about the family to which the curious and elegant creature before us belongs. As yet we have only two members of it to record—this and a beautiful jelly fish discovered by Mr. Alder. The latter I have never seen myself; the former I have not met with since my first season's study of Medusæ in 1839, when, though I made careful drawings of it, I did not examine its minute structure, trusting to meet with it again, as it seemed to be one of the most abundant of its tribe. Too often do we thus put aside unexamined what seems common and always at hand; too often do we regret our inattention when the opportunity is gone; and this with more serious subjects (some could add with objects even more beautiful) than Medusæ.

The genus *Stomobrachium* was constituted by Brandt for the reception of a Medusa presenting characters intermediate between *Mesonema* and *Æquorea*, and connecting the family of which the latter is the type with the *Oceanidæ*. The only species known to the Russian naturalist had been discovered and delineated by Mertens in the South Atlantic Ocean, near the Falkland Isles, in the month of January, 1827.

In 1835, Sars described and figured a little Medusa of the Norwegian seas under the name of *Oceania octocostata*, with the diagnosis, "Disco campanulato, ore plicato brachiis nullis; intus canalibus 8 clavatis, cirris marginalibus longissimis." He accompanied it by a fuller account in the Norwegian language.

The same species had been excellently figured by Ehrenberg in 1835, under the name of *Melicertum campanulatum* (which had been applied in 1829 by Eschscholtz to a very distinct Medusa from the Pacific), apparently under the impression that the animal in question was the *Medusa campanula* of Otho Fabricius (*Campanella Fabricii* of Lesson).

During the month of July 1839, when cruising with Mr. Smith in the Kyles of Bute, we met with numbers of a little Medusa identical with those figured by Sars and Ehrenberg, and afterwards found it equally common in the bays of the north-west coast of Ireland.

The umbrella is very convex and campanulate, transparent, and smooth. The sub-umbrella is large, and truncated at the summit. Round the margin of the umbrella is a thick fringe of fine, very extensile, tentacula (40—60, according to Sars; if the former number, the formula might probably be $8\times4+8$). Between each of these Ehrenberg represents a very small tentacle, which is borne upwards or obliquely when the larger ones are extended, and he also figures a vesicle (otolitic?) at the origin of each of the small tentacula. Down the sub-umbrella run eight simple vessels, and in the course of each is a conspicuous linear furbelowed ovary or reproductive gland. The ovary and the tentacles are of a golden yellow colour. The peduncle is also yellow, short, but broad, and is suspended from the centre of the sub-umbrella; it is occupied by the stomach, and terminates in four fimbriated lobes or lips, which change their forms so as sometimes to appear as if eight in number.

This account of a beautiful and probably not rare species is evidently insufficient, though enough for its recognition, and I hope on some future opportunity to observe it more completely. Of its aspect and habits in confinement, a graphic account has been given by my friend the Rev. David Landsborough, in his delightful volume on the Island of Arran, not the less graphic for proceeding in part from the pen of Hugh Miller, who could not fail to present a vivid picture of this animated and beautiful bubble, after having endowed the fragmentary and motionless remains of fossil fishes with such vitality, that no reader of his admirable 'Old Red Sandstone' rises from its perusal, without the fond impression of having seen in his mind's eye the Pterichthys and Coccosteus, and their strange companions of the deep, not as shapeless lumps of rock, ranged in orderly rows under sheet-glass, but as living monsters sporting in a primæval sea.

"There was a Medusa," writes Mr. Landsborough, "discovered by my son David, which was quite new to us, and, from its minuteness, probably known to few. We took it home, and put it in a tumbler of sea-water, that we might better observe its structure and graceful evolutions. I would have attempted to describe it, but glad was I, soon after we had seen it, to find this done to my hand by one who is acknowledged in the scientific world as a graphic describer of nature—Mr. Hugh Miller; best known among men of science as the author of the truly interesting work on the 'Old Red Sandstone,' but better known to our countrymen in general as the talented Editor of the 'Witness.' Nothing escapes his scientific eye; and from his 'Summer Rambles,' I learned that he had about the same time discovered it, when aboard the Betsy, off the Island of Eigg. He speaks of two—one scarcely larger than a shilling, 'another still more minute,' (ours, I think, about the breadth of a sixpence), 'and which presenting in the water the appearance of a small hazel nut of a brown-yellowish hue, I was disposed,' says he, 'to set down as a species of *Beroe*. On getting one caught, however, and transferred to a bowl, I found that the brown-coloured, melon-shaped mass, though ribbed like a *Beroe*, did not present the true outline of the animal; it formed merely the centre of a gelatinous bulb, which, though scarcely visible even in the bowl, proved a most effective instrument of motion. Such were its contractile powers, that its sides nearly closed at every stroke behind the opaque centre, like the legs of a vigorous swimmer; and the animal—unlike its more bulky congeners, that, despite of their slow persevering flappings,

seemed greatly at the mercy of the tide, and progressed all one way—shot, as it rolled backward, forward, or athwart.' The transparent tumbler gave me this advantage in observing it, that I could use a magnifying lens when it approached the side. Notwithstanding this advantage, it was some time before I observed the true form of the animal, as Mr. Miller's excellent description had not then been published. The transparent ball that rose above its body was so very pellucid, that it was a good while before I observed it all. It rose to a considerable height above the buff-coloured body of the animal; and it was elegantly shaped, like the fine crystalline shades often placed over stuffed birds, or artificial flowers, or miniature figures formed of pure alabaster. The finest crystal vase was clumsiness itself when compared with it. It was as fine as the transparent soap-bubble blown out of a pipe; and we doubt not that, like this bubble, it would have been iridescent had it been so placed as that the sun could have shone on it. Delicate as its fabric was, the vigour of the little creature was very remarkable, and has been well compared to the efforts of a strong swimmer, as it alternately contracted and expanded its pellucid organization. The margin of its mouth had a close fringe of brownish tentacula. By aid of the lens, I could observe that they were drawn in when the body was contracted, but that at every stroke they were protruded like forked lightning, or like feathered serpents, darting and flashing forth, till they were longer than the body of the animal." (*Landsborough, Arran*, chapter xvi, p. 260.)

When I met with this *Stomobrachium* in 1839, I fortunately made a drawing of it in two states, the one (Plate IV, fig. 1, *a* and *b*) having much wider reproductive glands than the other (Plate IV, fig. 1, *c*), in which they are linear and paler, and reach quite to the margin. The former state is identical with that observed by Ehrenberg, who found ova in the folds of the ovaries; the latter is not improbably the male animal.

Genus VI. Polyxenia, Eschscholtz (1839).

Umbrella spreading, more or less depressed. Ovaries numerous, linear, in the centres of triangular spaces which reach nearly to the circumference. Marginal tentacles between each pair of ovaries. Peduncle very short, terminating in an oral orifice, surrounded by four lanceolate arms.

Polyxenia Alderi, Forbes.

Plate IV, Fig. 2 (under the name of *P. cyanostilis*).

I have ventured entirely to redefine the genus *Polyxenia*, and to regard it as represented by the beautiful Medusa now figured from a drawing of my accomplished and distinguished friend Mr. Alder, who observed it on the coast of Devon, in 1846. The umbrella is expanded, and rather depressed, smooth, and transparent. Its margin is deeply notched by sixteen indentations, out of which spring as many rosy tentacula, alternately longer and shorter. The sub-umbrella is divided into sixteen somewhat triangular spaces, which commence at about two thirds of its height, and terminate near the margin. In the centre of each of these spaces

is a linear ovary. Each space terminates marginally in two truncated lobes, one on each side of the ovary, and always alternately longer or shorter. Each lobe, especially the shorter one, is slightly lobulated. From the centre of the sub-umbrella springs a short peduncle, very soon terminating in four linear-lanceolate, rather long, arm-like lips, white, tipped with rose colour. They project beneath and lower than the umbrella. The breadth of the disk is about two inches.

I had referred this graceful creature to the *Polyxenia cyanostyla* of Eschscholtz, and it is so named in the plate. Anxious, if possible, to retain and illustrate an old species, little known, rather than add a new name, against my better judgment I persisted in this opinion. On more recent consideration, however, I feel bound to abandon it, and do so the more willingly, since it enables me to retain the name of its discoverer as patron-saint of at least one of the new species here described.

It may perhaps be disputed whether the genus *Polyxenia* is its proper place, and whether I do right in changing the characters of the genus as above. An earnest consideration of the probability of the nature of the animal, very imperfectly described by the founder of the genus, induces me to do so. His figure of *Polyxenia cyanostilis* appears to me to represent a mutilated animal, deprived of its lips; and could we restore it, I believe the representation now given (Plate IV, 2, *a*, natural size; 2, *b*, much enlarged) would closely approach the figure of the creature delineated in the 'System der Acalephen.'

CIRCEADÆ.

Genus VII. Circe, Mertens (1838).

Umbrella coinco-campanulate; ovaries eight, placed on the sub-umbrella at a little distance around its summit; vessels eight, simple, passing through the ovaries, and opening into a marginal vessel; tentacula very numerous, and placed in a single series around the margin; peduncle cylindrical, contracting near its extremity to form the small campanulate stomach, the orifice of which is furnished with four lanceolate lips.

Circe rosea, Forbes (1846).

Plate I, Fig. 2.

The genus *Circe* was constituted by Mertens for a remarkable little Medusa found by him on the coast of Kamtschatka. Brandt adopted this group in his 'Prodromus,' and afterwards more fully in the 'Petersburgh Transactions,' where he described the species discovered by Mertens under the name of *Circe camtschatica*, and engraved it from the drawings of its discoverer. Lesson, in his 'History of the Acalephæ,' added two more species to the genus under the names of *C. elongata*, and *C. anais*, both discovered by Rang in the African (west?) seas, and figured from his drawings.

The Medusa which I now figure and describe under the name of *Circe rosea*, is the first of the genus noticed in the European seas. Though very small,—the largest specimens taken not being more than half an inch in height,—its aspect is very beautiful and striking. The umbrella is oblong, and somewhat mitre-shaped, with an apiculate summit. The outer surface is quite smooth. Round the margin is a close and single series of small tentacula, which, however, seem capable of considerable elongation, though usually retracted. Their number varies slightly. They are all similar, and in the examples taken, were 56 in number. Their formula might stand as $6\times8+8$. They are all external to a veil, which guards the orifice of the sub-umbrella, and is marked by sixteen denticulations. I could detect no ocelli at the bases of the tentacula. From the centre of the sub-umbrella depends a long cylindrical peduncle, which reaches nearly to a line with the margin, and is contracted a little above the orifice, so as to form a kind of proboscis terminated by four simple lanceolate lips. The stomach is very short, and terminates almost at the upper point of contraction, where we see eight gastro-vascular canals commence, run up the side of the peduncle, distinct from each other, turn at its base, and descend the sub-umbrella, till they reach and unite with the marginal vessel. In the uppermost part of their course along the sub-umbrella, they pass through as many small ovate, simple generative glands, which, when the animal is seen from above,

appear like so many clubs or spokes round a central axle. The body is of various shades of pink, and the ovaries yellow; consequently, although the creature is so transparent, and unfurnished with brilliantly coloured ocelli to mark its position in the water, it is not unconspicuous nor difficult to see.

The first specimen observed of this species was taken by Mr. M'Andrew and myself in the Zetland seas, in August, 1845, off Vella, seven miles from land. We afterwards met with several in Brassay Sound, on the opposite coast of the mainland.

Compared with Brandt's species, it differs in the form of the ovaries, in general aspect and colour, and in the absence of conspicuous ocelli, eight of which, apparently colourless, are represented in the beautiful drawing by Mertens (Petersburgh Memoirs, Sixth Series, Sc. Nat., t. ii, 1838, pl. 1, f. 1-5). The simple series of tentacula distinguish it from *Circe anais*, also rose-coloured. (Lesson, loc. cit. pl. 5, f. 1.) It is more nearly allied to *C. elongatu*, but differs in form. (Lesson, loc. cit. pl. 5, f. 2.)

The genus *Circe* is evidently closely allied to *Thaumantias*, *Dianæa*, and *Geryonia*, differing mainly in the number of ovaries and of gastro-vascular canals. The generative glands may be said to be those of *Thaumantias*, the peduncle to be that of *Dianæa*. Brandt placed it among the *Oceanidæ*, and Lesson strangely introduces it between his genus *Turris*, and Brandt's genus *Conis*, genera belonging to a very different group, and, as I have shown, scarcely deserving of separation, both being close allies of *Oceania*. With the *Oceanidæ*, however, *Circe* has evidently no affinity.

Plate I, f. 2, *Circe rosea*, natural size; 2, *a*, greatly enlarged; 2, *b*, as seen from above, showing the relative arrangement of the vessels and ovaries; 2, *c*, tentaculated margin and denticulated veil; 2, *d*, an ovary; 2, *e*, portion of the margin, between two of the radiating vessels; 2, *f*, peduncle, and small stomach at its extremity, with the oral orifice; 2, *g*, lips of the oral orifice.

GERYONIADÆ.

Genus VIII. Geryonia, Peron (1809).

Umbrella hemispheric, margin furnished with tentacula in variable number, usually few; radiating vessels five; ovaries four, phylliform, on the surface of the sub-umbrella in the course of the vessels; peduncle rather long, conico-cylindrical, terminating in a small campanulate stomach, opening by four lips.

Geryonia appendiculata, Forbes.

Plate V, Fig. 2.

One of the most phosphorescent Medusa of the British seas is the graceful little animal I have now to describe. The umbrella is smooth, transparent, and of a hemispherical shape, sometimes nearly sub-globose, slightly elongating during the act of ascending, becoming more spherical when descending. The margin is fringed by eight distant tentacula, four of which are of a different structure from the other four; the former being cylindrical, and composed of similar tissue (fibrous cells) throughout, whilst the latter have an outer and inner side of different composition, the fibrous cells being collected in bundles or masses at regular intervals on the inner surface. Both orders of tentacles appear to be tubular. Those of the first kind are highly contractile, and capable of great extension, trailing after the body to twice or three times its length when the animal rises, becoming short and thick when it sinks. The intermediate tuberculated tentacles have not an equal power of extension. At the origin, and by the side of each of the more extensile tentacles, is a globular body within a cavity (otolitic?) produced linearly upwards to terminate in a vesicular body, also with contents (a rudimentary ocellus?). A similar, though smaller and less defined, structure is seen at the bases of the intermediate tentacles. Opposite to each of the longer tentacles is a simple gastric vessel joining a marginal one, and proceeding down the inner surface of the rather conical and truncated sub-umbrella. Towards the summit of the sub-umbrella in the course of the vessels are the bases of four leaf-shaped, cordate, reproductive glands (in the instances examined, ovaries). Round the opening of the sub-umbrella is a rather broad, shelf-like veil. From its centre depends a long conical peduncle, extending for half its length below the orifice of the disk. Its base is thick, and it tapers rather gradually nearly to the extremity, a little above which there is a constriction, marking the commencement of the broad campanulate stomach. The gastric vessels commence at this point, and run up the peduncle. The oral orifice is four-lobed, but these lobes or lips change form considerably, sometimes appearing acute, sometimes obtuse, and occasionally as if six-lobed. They are bordered by a highly contractile tissue composed of fibrous cells. Indistinct bands of similar

tissue are present in the substance of the peduncle, and give it its power of motion, so as to cause it at times to remind us of the proboscis of some pachyderm. With the exception of a tinge of green on the ovaries, and of pink on the tentacles, this animal is colourless. The specimens taken measure, body and trunk, from one inch to one inch and a half.

Two specimens were taken by Mr. M'Andrew and myself in the Reach of Dartmouth, August 31st, 1846. We afterwards took some at a distance of fifteen miles from land, off the coast of Devon and in the west bay of Portland. The peculiar distinctive characters of the tentacula distinguish this beautiful *Geryonia* from any recorded species.

I have adopted the genus *Geryonia* in the limited sense accorded to it by Lesson, restricting it to those pedunculated forms of the group as first named by Peron and Lesueur, in which we find four phylliform ovaries. It thus constitutes a natural and probably extensive assemblage of species. Of the *Geryoniæ*, as restricted by Eschscholtz, four out of his six species, viz. *G. tetraphylla*, *G. bicolor*, *G. rosacea*, and *G. exigua*, will fall under the section so defined. Lamarck had united them with very different animals, such as *Oceaniæ* and *Pelagiæ*, in his very unnatural assemblage, *Dianæa*. De Blainville places it as a section of his extended genus *Geryonia*, distinguished from his *Dianæa* by the presence of phylliform ovaries. The few species recorded of this genus are widely distributed: three are from the seas of the tropics, both Indian and Pacific; one is from Gibraltar; and one from the Adriatic (*G. planata*), briefly but excellently described and figured by Dr. Will. I have found a species in the Ægean.

Geryonia appendiculata, as represented in Plate V, f. 2, is the animal seen in profile during the act of descending and contraction, (2, *a*, indicates the natural size,) and 2, *c*, is the same when ascending and expanding; 2, *b*, represents the position of parts as seen from above; 2, *d*, is an ovary magnified; 2, *e*, represents the two sorts of tentacles contracted, with the vesicles at their bases; these are represented still more highly magnified at 2, *f*, and 2, *g*. The proboscis, with the stomach and its lips, and the commencement of the gastric vessels, is shown in 2, *h*.

Genus X. Tima, Eschscholtz (1839).

Umbrella hemispheric; margin with (rather distant) tentacula; radiating vessels four, simple; ovaries four, linear in the course of the vessels; peduncle cylindrical, terminating in a campanulate stomach with four fimbriated lips.

Tima Bairdii (sp.), Johnston (1833).

Synonym. *Dianæa Bairdii*. Johnston, in Loudon's Magazine of Natural History, vol. vi, p. 320, fig. 41 (1833).

One of the most earnest and enthusiastic of British naturalists, the author of the excellent 'History of British Zoophytes,' discovered the elegant Medusa now to be described, and dedicated it to his friend Dr. Baird, a gentleman whose skill in some of the minutest and least investigated departments of zoology has gained him a high reputation, and who, devoting

his time and sacrificing his professional pursuits to his favorite science, is now one of the unselfish band of worthy assistants in the National Museum.

Dr. Johnston met with the *Tima Bairdii* in Berwick Bay, on the 27th of September, 1832, floating on the surface of the water; and published an account of it in Loudon's Magazine for the following year, illustrating his description by an expressive sketch from the pencil of his accomplished and esteemed lady, to whom, as to her eminent husband, our science owes many debts of gratitude. He describes it as "a semi-globular mass of a perfectly translucent and almost colourless jelly, divided by four opaque, milk-white, narrow ligaments, or bands, into four equal compartments. These bands arise at the angles of the mouth, and are at first very fine, but become broader and somewhat curled in their course towards the upper surface. The very delicate membrane investing the body is folded at the margin, which is furnished with a circle of rather distant, tapered, white tentacula. In our specimen there were thirteen of these. The under side is produced in the middle, so as to form a kind of stalk, at the apex of which is the mouth, of a square form, and encircled by four plumose branchial appendages. When magnified, these are shown to be formed of a thin membrane, beautifully but irregularly folded, like a frill, and edged with a neat thickened border. *Dianæa Bairdii* seems to be invested with two membranes, of great tenuity. The outer one covers all, like as it were a glass inverted over a smaller globe, the intermediate space being occupied with a consistent but colourless jelly, in which neither vessels nor membranes can be distinguished. This coat forms two loose folds around the circumference, from the innermost of which the tentacula arise, and the inner coat is probably a continuation of the outer reflected upwards; but it is not a simple membrane, since several laminæ can be perceived to cross the body. The white conical bands adhere to this inner envelope; they are not muscular, but very probably belong to the generative system. I consider the plumose processes at the oral aperture as subservient to respiration, partly because of their position, and partly because of their folded structure; intended, as it appears to be, to expose the largest possible surface to the action of the water. This Medusa is a luminous species. It gives out a copious light of a whitish colour, when the water in which it swims is agitated, or when it comes in contact with foreign bodies."

Dr. Johnston compares it with a minute phosphorescent Medusa taken by Dr. Baird in the Straits of Malacca, and considers the two identical. In all probability, however, they are quite distinct, though congeneric.

During the winter of 1839, I met with this handsome Medusa in two localities: first, in the harbour at Burtisland, in the Frith of Forth, and afterwards at St. Andrews, where a number of individuals were cast ashore on the sands, along with *Cydippe pileus*, and *C. Flemingii*, and *Aurelia aurita*, after a very stormy night.

The umbrella, in the specimens I examined and drew, was hemispheric, or rather campanulate, with a slight constriction, giving it an elegant undulation about the upper third. It varies, however, much in form. It is smooth, transparent, and colourless. The margin bears sixteen tentacula, usually contracted, and tinged with pale pink. Between the tentacles there is the appearance as of a scalloped veil. The sub-umbrella is truncated, and marked by four radiating vessels, opening into a circular marginal one. In the course of these four vessels appear to be four very narrow, linear, whitish reproductive glands. From the centre of the sub-umbrella depends an ample cylindrical peduncle, extending for about a third of its

length below the opening. Down it run the gastric vessels to the most constricted point, where they join a short campanulate stomach set on as if obliquely, and opening by four ample, triangular, beautiful crimped lips. The breadth of the umbrella was two inches. I saw no ocelli, though very possibly they are present. I placed one of these animals in a tumbler of sea-water with some specimens of *Cydippe* equally alive and active. Before long the Medusa seized one of them with its lips, and made such vigorous exertions to swallow the ciliograde, that I had great difficulty in rescuing its victim.

The peculiar form of the reproductive glands, which, indeed, are difficult to detect, prevent us placing this animal in *Geryonia*, to which genus it has close affinity, or in *Dianæa* (regarding *Dianæa probosciadalis* as the type of the latter). The genus *Tima* of Eschscholtz seems to be its proper place. ["Discus facie infera in conum productus. Ventriculus plicatus in apice coni situs. Canali quaterni cum circulo marginali conjuncti. Cirrhi marginales numerosi."] The figure given by that author of his *Tima flavilabris*, from the neighbourhood of the Azores, bears considerable resemblance to that of the species before us, but the number of tentacula (80) is much greater.

Plate V, f. 1, *Tima Bairdii* during contraction; 1, *a*, during expansion; 1, *b*, as seen from above.

Genus X. Geryonopsis, Forbes.

Umbrella hemispherical; ovaries four, clavate, conspicuous on the sub-umbrella in the course of the four simple radiating vessels; margin of umbrella with numerous short tentacula; stomach at the extremity of a short peduncle, terminating in four large fimbriated lips.

Geryonopsis delicatula, Forbes.

Plate IX, Fig. 1 (under the name of *Thaumantias cymbaloides*).

Anxious to retain, if possible, the names of recorded species in our British lists, I referred to the *Medusa cymbaloides* of the older acalephologists, a very graceful and tender jelly-fish, which is not uncommon on the south coast of England. With much reluctance I abandon the reference, for though the character of the stomach, "voluminous and much exceeding the border," mentioned by Peron, applies only to the animal before us among all the immediate allies of *Thaumantias*, one of which, the *Medusa cymbaloides* of Slabber, must be in the British seas, the other character of "tentaculis sedecim, basi bulbosis," adopted in all diagnoses of that species, cannot by any stretch be made to apply, and is too positive to be founded on imperfect observation, since the bulbs of the tentacula are distinctly stated to be brilliantly ocellated. I trust further research will, before long, make better known to us the original species of Slabber and Modeer.*

The umbrella of my Medusa is hemispheric and rather depressed, smooth, transparent, colourless, and of a singularly delicate texture. The margin is encircled by a row of very

* Plate IX was unfortunately altered and printed off before the name could be corrected.

short tentacula, numerous ($16\times4+4$), but not placed in contact, and irregularly developed. They are of a slightly milky hue, and have slightly bulbous bases, but no coloured ocelli. There appears to be an otolitic mass in the cavity of each bulb, but I could observe no motion The sub-umbrella is hemispherical and depressed; down it run four simple vessels to join the marginal vessels, and in their course are four greenish conspicuous, linear-lanceolate, or rather claviform, reproductive glands, with wavy margins. Round the inner margin of the umbrella is a horizontal, broad, membranous veil or shelf. From the summit of the sub-umbrella depends a conical peduncle, which projects beyond the margin, and, after contracting, suddenly expands into a wide campanulate stomach, with four large, lanceolate, fimbriated lips, whose edges are bordered by a thick layer of fibrous cells, endowing them with a highly motor power. Into the summit of the cavity of the stomach the four gastric vessels are plainly seen opening. The lips are tinged with green. The disk measures one inch and a half across.

Several specimens occurred on the coasts of Dorset and Devon during August 1836, especially in the Reach of Dartmouth. It was usually in company with the *Geryonia appendiculata*.

In 1839, Professor Goodsir and I took a Medusa at Scalloway, in Zetland, presenting many of the characters of the species we have described, but differing in having much longer and more numerous tentacula, more clavate and purple ovaries, and pale fimbriated lips. We announced it at the meeting of the British Association, at Birmingham, as a new *Oceania*, and it has since been quoted as such by Lesson. For the present, however, it is better to abstain from naming it, though in all probability distinct, since the drawing and memoranda made at the time are insufficient; the animal, owing to unavoidable circumstances, not having been submitted to microscopic observation. I may here remark, once for all, that under no circumstances can any of the naked-eyed Medusæ (above all, those belonging to the tribe we are now treating of) be identified without aid of the microscope, and the accident of that instrument not having been employed for the examination of Acalephæ by the greater number of zoologists who have written upon them systematically, has rendered published diagnoses and determinations so imperfect, as, in the majority of instances, to be little better than utterly worthless. The quoting of authorities, synonyms, and localities respecting the subjects of this monograph is, in fact, an act of courtesy to those who have gone before us, rather than of justice to science, which would have thriven better if half the bad figures and worse descriptions of the smaller Medusæ had never seen the light. Too truly in this case might it be said of such describers—

> "They have perplexed,
> With a dark comment, Beauty's clearest text;
> They have not told her face's story true,
> But brought false copies to our jealous view." CAREW.

Of course, there are some honorable exceptions to this censure, especially Sars, Wagner, Milne Edwards, and Will.

The higher Medusæ, probably because larger, have been more fortunate. The *Geryonia pellucida* of Will (Horæ Tergestinæ, p. 70, pl. 2, f. 8) is a *Geryonopsis* not far removed from the species before us. It differs in having more clavate ovaries, simpler lips, and finer marginal tentacula (64). Dr. Will relates of his species that it devoured eggs of *Beroe rufescens*, of which some living specimens kept in the same vessel had laid many eggs,

and states that his friend Dr. Koch observed it eat mutilated fragments of the ciliograde *Eucharis multicornis*. The coarser indigestible parts of its food were ejected by the mouth in doing which the stomach shortened considerably, and everted itself partially.

Plate IX, f. 1, *a*, represents a large specimen of *Geryonopsis delicatula* of the natural size; 1, *b*, shows the structure of the lips, and the origins of the gastric vessels; 1, *c*, is a reproductive gland, the vessel passing through its centre; 1, *d*, a tentacle with its bulb; and 1, *e*, a partially developed tentacle.

Genus XI. Thaumantias, Eschscholtz (1829).

Umbrella hemispherical, in some species almost globular, in others much depressed; ovaries four, varying in form from ovate to linear, conspicuous on the sub-umbrella in the course of four simple radiating vessels; margin of umbrella with tentacula in variable number (from 4 to 200) according to the species, their bulbs always ocellated; stomach sessile, dependent from, and almost always included within the sub-umbrella; mouth with four lips, rarely fimbriated.

This excellent genus was instituted by Eschscholtz for the reception of the *Medusa cymbaloidea* of Slabber, and the *Medusa hemisphærica* of Gronovius. The latter is so much better known than the first, that it may be regarded as the type. They are probably, however, identical. When Lesson published his 'History of the Acalephæ,' in 1843, he enumerated nine species of *Thaumantias*, two of them Norwegian, discovered by Sars, and four British, described by myself in the 'Annals of Natural History.' The ninth was the *Medusa lucida* of Macartney, another name for *T. hemisphærica*.

Of all the naked-eyed Medusæ, those belonging to this genus are most common in our seas, swarming in countless myriads in many of our bays and harbours. They are among the most usual causes of phosphorescence. It might be expected that animals so abundant, when carefully sifted, although so similar, would be found to include several distinct kinds. I have now to describe no fewer than seventeen British species of *Thaumantias*, of which the greater number are all so very distinct from each other, that they cannot be confounded. I believe many more equally distinct will be before long discovered in the European seas.

The characters in common presented by many of these kinds are such as to enable us conveniently to group them in sectional assemblages, dividing them, in the first instance, under two sub-generic heads:—

A. Marginal tentacles of two kinds (Cosmetira).
1. *Thaumantias pilosella.*

B. Marginal tentacles of one order only (Thaumantias).

* Marginal tentacles four.
2. *T. quadrata.*
3. *T. æronautica.*

** Marginal tentacles eight.
4. *T. octona.*

*** Marginal tentacles sixteen and upwards.

† Umbrella very convex or globose.
5. *T. maculata.*
6. *T. melanops.*
7. *T. globosa.*
8. *T. convexa.*
9. *T. gibbosa.*

†† Umbrella depressed.
10. *T. lineata.*
11. *T. pileata.*
12. *T. Sarnica.*
13. *T. Thompsoni.*
14. *T. hemisphærica.*
15. *T. inconspicua.*
16. *T. punctata.*
17. *T. lucifera.*

A. Marginal tentacles of two kinds.

[Cosmetira.]

1. *Thaumantias pilosella*, Forbes.

Plate VIII, Fig. 1.

By far the most beautiful, and among the largest, of the British kinds of *Thaumantias* is that I have first to describe. The umbrella, which sometimes measures nearly two inches in diameter, but more usually one, or one and a quarter, is hemispheric, and shaped like a watch-glass, but much more convex. It is transparent and smooth, except on the sides towards the margin, where it is as if woolly, being invested with minute epidermic hairs composed of fibrous cells. These, though sufficiently conspicuous, may escape the observer who is not aware of their presence, in consequence of their transparency. The margin is fringed by very numerous

(24×4+4), extensile (but usually borne rather short), pale pinkish tentacula, with bulbous bases. The bulbs are ocellated, with dense crescentic masses of purple pigment-cells. When the margin is much magnified, it is seen to be bordered by a narrow band or thread of fibrous cells, from which the tentacles spring, and between each pair there are six or seven short, fine, secondary tentacles, without ocelli at their bases. The coloured bulbs of the larger tentacles are very conspicuous, and appear in the water as a circle of brilliant purple gems. The inner margin of the umbrella is bordered by a shelf-like veil. The sub-umbrella is depressed, and on its surface run the four radiating vessels with a long, linear, somewhat clavate ovary, of a bright pink colour, commencing very near the centre, and terminating close to the margin in the course of each. The stomach is very short, but wide, of a rose colour, and has four lanceolate, fimbriated lips, bordered by a compact edging of fibrous cells.

This beautiful Medusa is very abundant in the bays and harbours of Zetland, especially in the Sound of Brassay, where it is the most common species of its genus. Mr. Alder met with it on the south coast of England, at Falmouth, in 1847.

Plate VIII, fig. 1, *a*, represents its usual appearance, twice the natural size; 1, *b*, as seen from above, of the size of nature; 1, *c*, an ovary; 1, *d*, a lip; 1, *e*, a pair of the larger tentacula with their ocelli, and the smaller tentacula between them.

B. Marginal tentaeles of one order.

[THAUMANTIAS.]

* Marginal tentacles, four.

2. *Thaumantias quadrata*, Forbes.

Plate IX, Fig. 2.

Umbrella campanulate, rather elongated, becoming globose during contraction, smooth, pellucid, colourless; margin with four equidistant tentacula springing opposite to the gastric vessels from large and conspicuous bulbs. The tentacula are rather stout, dusky purple, and conspicuously granulated on the surface. The bulbs are bright yellow, with ocelli composed of vermilion pigment-cells loosely grouped together. A similar ocellated bulb is in the centre of the marginal space between each pair of tentacles, but is not so large as those at their bases, and exhibits no rudiment of a tentacle springing from it. In the interspaces again, between each intermediate bulb and the tentacular one, is a very small yellowish tubercle, without an ocellus. I have no reason to think that tentacula are developed from any of the bulbs, except the four largest. The four ovaries are ovate, pale yellow, and placed in the course of the radiating vessels in the lower half of the sub-umbrella, towards the margin. The inner margin is surrounded by a veil. The proboscis is rather short, but slender and narrow, quadrangular, yellow, lineated with red. It terminates in four simple, triangular, acute lips.

This little species was observed very abundantly in the harbour of Tarbet, Loch Fyne, in the autumn of 1845. The umbrella is scarcely more than two tenths of an inch in length.

Plate IX, f. 2, *a*, represents it of the natural size; 2, *b*, magnified, and seen from the side; 2, *c*, as seen from above; 2, *d*, an ovary; 2, *e*, tentacle and its bulb, with the intermediate bulbs.

3. *Thaumantias æronautica*, Forbes.

Plate IX, Fig. 3.

The umbrella of this minute species, which is still smaller than *T. quadrata*, is oblong, and becomes elongated during contraction. It is smooth, transparent, and colourless. The margin bears four fine, colourless, filiform tentacula, which are often extended to a prodigious length, as compared with the dimensions of the body, or with the small size, both of length and diameter, into which they can contract themselves. When magnified, they exhibit a moniliform appearance. They spring from four large bulbs of a pale yellow colour, with traces of an interior vesicle, but no brightly coloured ocelli. In the interspaces of the margin are yellow tubercles, three between each pair of tentacles, the central one largest, but all very small as compared with the tentacle-bulbs. Down the sub-umbrella, which is of an oblong form, and sometimes, when vigorously contracting, of a pear-shape, run the four gastric vessels, traversing at exactly half its height as many very small ovate reproductive glands, of a pale yellow colour. The stomach is sessile; when contracted, shortly campanulate; when extended, long and quadrangular, reaching nearly to a level with the ovaries. The mouth is surrounded by four simple lanceolate lips.

Small as this pretty creature is, it is evidently adult, and presents its permanent characters. When confined in a glass tube, filled with salt water, it resembles a miniature balloon moored by five silken cables. I met with it in localities far apart, viz. off Brassay, and in Hamna Voe, in Papa, both in the Zetland seas, in July 1845; and during the following month in the Sound of Skye, among the Hebrides. All the specimens were alike. I judged it to be adult, from the defined and firm condition of the reproductive glands, and the microscopic structure of the tentacles and their bulbs.

Plate X, f. 3, *a*, represents it of the size of nature; 3, *b*, magnified, with the tentacles extended; 3, *c*, seen from above, with the tentacles contracted; 3, *d*, the stomach extended; and 3, *e*, contracted; 3, *f*, one of the reproductive glands.

** Marginal tentacles, eight.

4. *Thaumantias octona*, Forbes.

Plate VIII, Fig. 4.

The umbrella of this small and peculiar species, is only about two tenths of an inch in height, globose, or sub-orbicular, smooth, and transparent. The margin presents the peculiar feature of bearing eight exactly similar pinkish tentacles, springing from conspicuous, bright yellow, bulbous bases, each bearing a defined red ocellus. In the marginal spaces, between each pair of tentacles, are two colourless tubercles placed close together. These do not appear ever to give rise to tentacula. The sub-umbrella is short compared with the umbrella, and is hemispherical. In the course of the four vessels, which run to join the marginal vessel opposite to the origins of four of the tentacles, are four small yellow or tawny ovate ovaries, placed on the lower half of the sub-umbrella. The stomach is very small in proportion to the size of the animal, rather elongated, and quadrangular in shape, of a yellowish or fawn colour, with four minute black dots at its base. The four lips are short, acute, and triangular.

Many specimens of all ages, all preserving the peculiar characters mentioned, occurred at Tarbet, in Loch Fyne, in company with *Thaumantias quadrata*, during the autumn of 1845. We had previously taken it by the tow-net at Oban.

Plate VIII, fig. 4, *a* and *b*, represent this species magnified, seen in profile and from above; 4, *c*, is an ovary; 4, *d*, the stomach; 4, *e*, part of the margin and tentacula; 4, *f*, the bulb of one of the tentacles.

*** Marginal tentacles sixteen and upwards.

† Umbrella very convex or globose.

5. *Thaumantias maculata*, Forbes.

Plate IX, Fig. 4.

The umbrella of this very distinct species is globular, smooth, pellucid, and colourless. The margin of its rather contracted opening is ornamented with sixteen jet-black ocelli, (3×4+4), which are alternately larger and smaller, and all very conspicuous, and large in proportion to the body. Between each of these is a small colourless tubercle. From each of the ocelli springs a colourless tentacle. All the marginal tentacles are similar, and very nearly of a size. The sub-umbrella is hemispherical, and divided into four equal segments by the gastric vessels. On its lower half, in the course of the vessels, are four ovate reproductive glands, pale, with yellow or tawny centres. From the centre of the sub-umbrella hangs a short but wide campanulate stomach, with four broad, slightly fimbriated lips. The four lips correspond in position to the four ovaries, and on the sides near the base of the stomach, alternating with the lips, are four patches of black pigment-cells, giving the centre of the animal, when seen from above, the appearance of being marked by four conspicuous black spots. The black bulbs of the tentacles, when compressed and highly magnified, are seen to be coloured by a crescentic series of black pigment-cells, forming the ocellus, bounding a tawny space in which there is seen an otolitic capsule. The tentacula themselves have a highly annulated appearance. The body measures about a quarter of an inch in height. I have met with this curious *Thaumantias* in the Zetland Islands only. It occurred several times in the Sound of Brassay, but was never plentiful. The jet-black eyes and stomachal spots render it a very striking object in the water.

Plate IX, f. 4, *a*, represents it rather more than twice the natural size; 4, *b*, as seen from above; 4, *c*, the ocellated bulbs; 4, *d*, the base and portion of a tentacle highly magnified, showing the distinction between the ocellus and otolitic capsule in the bulb; 4, *e*, the stomach, with its lips, spots, and the origins of the gastric vessels, seen from above; 4, *f*, one of the reproductive glands.

6. *Thaumantias melanops*, Forbes.

Plate X, Fig. 3.

Another black-eyed beauty, though unarmed with such jetty piercing orbs as the sister species last described. Instead of a few conspicuous ocelli, we have here an almost countless number, all, however, of extreme minuteness. Argus, the hundred-eyed, must yield to our *Thaumantias*, for it has twice as many.

The umbrella of the *Thaumantias melanops* is sub-orbicular, inflated, very tender,

transparent, and smooth. Around its margin are ranged in close order more than 200 fine colourless tentacula, ringed and granulated, when highly magnified. At the base of each is a very small but very black and well-defined ocellus. Round the inner margin of the umbrella is a rather wide veil, which, instead of being borne horizontally in all the specimens I met, was lax and dependent. The sub-umbrella is hemispherical, and divided into four equal portions by the four radiating vessels, which traverse through the greater part of their courses four long, clavate, yellow, rather narrow, reproductive glands. I have represented an appearance presented by one of these glands, as if of a much contorted tube within it. This is probably of the male sex. From the centre of the sub-umbrella hangs the short and very broad stomach, opening by four large, triangular, fimbriated lips. It is usually pale, sometimes slightly tinged with yellow.

The umbrella of this species was often more than half an inch in breadth, and of the same height. It has hitherto occurred only in the Zetland seas, and is not very common there.

Plate X, f, 3, *a*, represents the entire animal magnified; 3, *b*, the stomach and lips; 3, *c*, one of the reproductive glands, and some of the marginal tentacula (contracted), with their ocelli; 3, *d*, one of the tentacula magnified when in extension.

7. *Thaumantias globosa*, Forbes.

Plate X, Fig. 4.

Umbrella globular, smooth, transparent, colourless, delicate. Margin with a rather close-set fringe of tentacula. These are tinted with purplish-yellow, and when magnified, present a ringed and granulated aspect. They are highly contractile, and very slender. They spring from reniform tubercles of a pale yellow colour, with a crescentic ocellus formed of tawny pigment-cells, inclosing a cavity in which a vibrating mass of otolites is plainly seen. The tentacular bulbs are very large in proportion to the diameter of the tentacles. The sub-umbrella is small as compared with the body; it is intersected by the four radiating vessels, which traverse in that part of their course nearest the margin four lax, more or less reniform, reproductive glands, firmer and more defined in form, being ovate, in the females. They are pale yellow in the males, tinged with tawny in the females. The gastric vessels present a knob-like enlargement at the point of their union with the marginal vessels. Here and there among the tentacles are little colourless tubercles studding the margin. The number of the former in a large specimen was $7\times4+4$; in a small one $3\times4+4$. They evidently increase with age. The stomach is very short, of a pale yellow colour, and bordered by four lanceolate furbelowed lips. The umbrella, in well-grown specimens, measures about half an inch across.

This delicate species is very abundant in the harbours of both sides of the Zetland Isles, usually in company with *Thaumantias hemisphærica* and *T. pilosella*. It has a remarkable habit of crumpling up, as it were, its tentacula into a confused mass. When very young, as represented at fig. 4, *c*, of plate X, it often extends its tentacles to a great length, and the reproductive glands appear of disproportionate size. Plate X, fig. 4, *a* and *b*, represent its adult state, magnified; 4, *d*, is the stomach and lips; 4, *e*, the reproductive gland of a male; 4, *f*, an ovary full of eggs; 4, *g*, a quarter of the margin, with the tentacular bulbs; 4, *h* (marked *e* by mistake in the plate), a tentacle-bulb greatly magnified, showing the ocellus, the otolitic capsule, and the structure of the tentacle.

8. *Thaumantias convexa*, Forbes.

Plate XI, Fig. 6.

Umbrella very convex, but not globose, smooth, transparent, colourless. Margin fringed with twenty (4×4+4) ringed and granulated colourless tentacula, springing from as many tubercles, each pinkish, with a small red ocellus. Between each pair of tentacular bulbs a smaller coloured tubercle, without any tentacle, is placed. The sub-umbrella is large, and very convex. The radiating vessels which divide it, run in the course of four ovate, or rather paddle-shaped, yellow ovaries, placed very near the margin. The stomach is short and narrow, yellow, and terminated by four lanceolate yellow lips, the margins of which are slightly fimbriated. The height of the umbrella is about one fourth of an inch. This *Thaumantias* is a very common species in the Zetland seas, and among the Hebrides. We have taken it at Oban. It is an active little animal, and very tenacious of life.

Plate XI, fig. 6, *a* and *b*, represent it as seen in profile, and from above; 6, *c*, is an ovary and base of a tentacle; 6, *d*, part of the margin with tentacula.

9. *Thaumantias gibbosa*, Forbes.

Plate XI, Fig. 3.

This curious and very distinct species, which I have hitherto only met with once, has an oblong conical umbrella, not contracted below, smooth, and colourless. The margin bears twenty-eight (6×4+4) pink tentacula, which, in the specimen taken, were habitually borne coiled up. They spring from red ocellated tubercles. The sub-umbrella is very convex; in the course of the four radiating vessels which intersect it, are as many long, linear, pale rose-coloured ovaries, reaching almost to the margin. From the summit of the sub-umbrella hangs a quadrangular, narrow, rather long stomach, opening by four triangular simple lips. The body is about a quarter of an inch in length.

Thaumantias gibbosa was taken in the Hebrides. Circumstances at the time prevented such a minute examination of it as so curious a form deserved. It cannot, however, be mistaken for any other species described in this work or elsewhere, and I hope some future observer will seek for and re-examine it.

Plate XI, f. 3, *a*, represents the body in profile magnified; 3, *b*, as seen from above; 3, *c*, two of the tentacula; 3, *d*, the stomach and mouth.

†† Umbrella much depressed.

10. *Thaumantias pileata*, Forbes (1841).

Plate XI, Fig. 2.

E. Forbes, in Annals of Natural History, April, 1841, p. 84, pl. 1, fig. 3.

Umbrella smooth, transparent, pellucid, shaped like a Chinese hat, being prominent and conical in the centre, depressed and extended at the circumference. Margin bordered by twenty (4×4+4) filiform, colourless tentacles, springing from ocellated bulbs, coloured black

and yellow. Stomach short, with proportionally large, triangular, sharp lips. Ovaries oblong, yellow, placed rather more than half way down the pileated sub-umbrella. Breadth nearly an inch.

This pretty species was taken by Mr. Smith and myself, at Port Rush, on the north coast of Ireland, in June, 1839.

Plate XI, fig. 2, *a*, represents it of the usual size: 2, *b*, magnified, as seen in profile; 2, *c*, as seen from above; 2, *e*, an ovary; and 2, *d*, the stomach and lips.

11. *Thaumantias lineata*, Forbes.

Plate XI, Fig. 1.

This is rather a large species of its division, measuring nearly an inch across the umbrella, which is much depressed, sub-hemispherical, smooth, colourless, and tender. The margin bears thirty-six ($8\times4+4$) filiform, transparent tentacles, springing from as many very small yellowish tubercles, with minute red ocelli. The sub-umbrella is elevated, as compared with the umbrella. It is bounded below by a rather broad veil, and divided by four radiating vessels; in the second third of the length of these are seen the linear, yellow, reproductive glands. The stomach is quadrangular, small, and very short, campanulate, with four fimbriated lips.

Taken in the Zetland seas in 1846, but not found common.

Plate XI, f. 1, *a*, represents it as seen in profile of the natural size; 1, *b*, magnified, and viewed from above; 1 *c*, an ovary; 1, *d*, two of the tentacles at their origins. with their bulbs.

12. *Thaumantias Sarnica*, Forbes (1841).

Plate XI, Fig. 4.

E. Forbes, in Annals of Natural History, April, 1841, p. 84, pl. 1, fig. 6.

Umbrella hemispherical, regularly convex, smooth, transparent, and colourless; margin with twenty ($4\times4+4$) transparent tentacles, with colourless bases, which do not present conspicuous eyes. Sub-umbrella rather convex, divided by the four radiating vessels. In the lower half of the course of the latter, occupying nearly one half their length, are the linear or slightly clavate, bluish, reproductive glands. The stomach is of the same hue, and is small, quadrangular, with four, rather large, simple, triangular lips. Breadth about half an inch, or rather more.

I took this apparently distinct species between Guernsey and the Island of Herm, in the autumn of 1839. It is very closely allied to *Thaumantias pileata*—perhaps too closely.

Plate XI, fig. 4, *a* and *b*, represents it as seen from one side, and from above; 4, *c*, is the stomach and lips; 4, *d*, an ovary.

13. *Thaumantias Thompsoni*, Forbes (1841).

Plate XI, Fig. 5.

E. Forbes, in Annals of Natural History, April, 1841, p. 88, pl. 1, f. 6.

Among the most phosphorescent of the smaller Medusæ on the coast of Cornwall, and elsewhere in the south, is a little *Thaumantias*, which several years ago (in 1840) was met with, for the first time, by Mr. W. Thompson, Mr. R. Ball, and myself, in Clifden and Roundstone Bays, on the coast of Connemara, in Ireland. When irritated, it gives out a brilliant light from the bulbs of its tentacula.

The umbrella of *Thaumantias Thompsoni* is hemispherical and rather depressed, smooth and colourless. It measures about a quarter of an inch across. Round its margin are sixteen ($3\times4+4$) white tentacula, springing from rather large yellow tubercles, each bearing a very small, dark red or nearly black ocellus. These tentacles, when highly magnified, appear annulated, and their bulbs distinctly exhibit an ocellus separate from an otolitic mass. The sub-umbrella is rather more depressed than the umbrella. On its sides, rather more than half way down, are the four reproductive glands, ovate, and of a clear yellow colour. In the centre is the small, rather slender, quadrangular stomach, also yellow; it terminates in four triangular lips, margined with a thick band of fibrous cells.

Plate XI, f. 5, *a* and *b*, represents this species magnified; 5, *c*, one of the ovaries full of egg, and the bulb of a tentacle, greatly magnified; 5, *d*, part of the margin with three tentacula; 5, *e*, a lip, with its border of fibrous cells.

14. *Thaumantias hemisphærica* (sp.), Müller (1776).

Plate VIII, Fig. 2.

Synonyms. *Medusa hemisphærica.* Gronovius, Acta Helv., 438, t. iv, f. 37 (1760).
——— O. F. Müller, Prod. Faun. Dan., No. 2822 (1776).
——— O. F. Müller, Zool. Dan., pl. 7, f. 1-4 (1788), (fig. Cop. in Enc. Meth., pl. 93, f. 8-10.)
——— Lin., Syst. Nat. Cur. Gmelin, p. 1098 (1789).
——— Modeer, Kong. Vet. Ac. Nya Kand. vol. xii, p. 251 (1791.)
Oceania hemisphærica. Peron, Ann. de Mus., vol. xiv, p. 347 (1809).
Medusa hemisphærica, var. *lucida.* Macartney, Phil. Trans. (1810), p. 264, pl. 14, f. 3.
Geryonia hemisphærica. Fleming, Brit. Animals, p. 500 (1828).
Thaumantias hemisphærica. Eschscholtz, Syst. der Acal., p. 103 (1829).
——— Blainville, Man. d'Act., p. 285 (1834).
——— (Lamarck), An. sans Vert., 2d Ed., p. 162 (1840).
Medusa (*Geryonia*) *hemisphærica.* Thompson, Annals of Nat. Hist. vol. v, p. 248 (1840).
Thaumantias hemisphærica. Lesson, Acal., p. 335 (1843).

It is very probable that, under the name of "*Medusa hemisphærica*," the older and most of the more recent writers on *Acalephæ* confounded many, or at least more than one, species of *Thaumantias;* and, as very few of their notices extend to more than characters obvious at first glance, and common to a majority of members of the genus, it is difficult or impossible to ascertain what form or forms were meant when the name in question was cited. The figures given by Müller and Gronovius were evidently at such times borne in mind; but, as the importance of ascertaining the number and structure of the bulbous bases of the tentacula was not understood by any of the naturalists from whom I have given citations, unless Peron and Lesson be excepted, the reference to those figures cannot be received without suspicion.

I feel sure that the animal I am about to describe and figure as *Thaumantias hemisphærica*, is identical with that which was delineated by Müller in the Zoologia Danica, and clearly characterised by Peron, whose description, which I here cite, applies to no other, and was probably drawn up after a study of Müller's account and figure, for the French naturalist gives no other locality than "des côtes de Danemarck." He characterises the species thus: "un ombrelle hémisphérique, déprimé à son centre; ovaires pédicellés et claviformes; rebord entier, garni de trente-deux tentacules très-courts et de trente-deux petites glandes; ombrelle gris-bleuâtre, parsemé de petits points plus gris; ovaires jaunâtres, glandes marginales rouge; 1 centimètre." The short diagnosis of Eschscholtz, "canalibus versus marginem disci clavatis," founded on his misapprehension of the nature of the reproductive organs, would apply equally well to half the allied species here described, and his account of the number of marginal tentacles, "ihr Rand ist mit 16 bis 24 kurzen Fangfäden besetzt," leaves us in no more certain position. The tentacles, however, as I have found by examination of very numerous specimens, do vary greatly in the several stages of the animal's growth, though I have never seen them fewer than twenty. When full grown, the number is, as Peron has stated, thirty-six. This variation of number of tentacles with age is seen in several species of *Thaumantias*, especially in those with depressed umbrellas. Many species, however, present exactly the same number in their earliest and their oldest stages. Fortunately, the large conspicuous red or orange ocelli, and brightly coloured claviform reproductive glands, afford features combined with form, which will always enable us to recognise the true *Thaumantias hemisphærica* without much difficulty.

The individuals which I have examined in Zetland, where they abound in the bays and harbours, have a hemispheric, slightly depressed, transparent, smooth umbrella, sometimes measuring nearly three fourths of an inch across. The margin in adult specimens usually bears thirty-two (sometimes more) tentacles, springing from as many large tubercle-like ocelli, which are vividly coloured with orange and red, and when magnified, are seen to present a small black dot. The formula for the ocelli and tentacles in the adult is probably $7\times4+4$. The tentacles are composed of granular tissue; they are often carried short, not by contraction, but by coiling up in a spiral. The sub-umbrella is moderately convex, and divided by the four gastric vessels, which pass in the lower half of their courses through four linear, claviform, purplish or yellowish ovaries, marked with purple or orange lines. The stomach is short, rather broad, purplish, or tinged with pink, terminating in four lanceolate fimbriated lips.

The abundance of individuals of this species in all stages of growth enabled me, when

in the Zetland Isles, to observe the mode of formation of their tentacula, a point of considerable physiological importance. The results may be summed up as follows :—

1st stage. The first indication of the tentacle is in the form of a minute lobe at the margin of the body, in the immediate neighbourhood, and in contact with the motor band and marginal vessel.

2d. This lobe becomes a closed cell, which then rapidly enlarges in every direction, but chiefly superiorly and inferiorly.

3d. It next presents a contraction, which is the commencement of its division into two cells, the superior being largest.

4th. The inferior cell grows rapidly, and divides itself into two, the lowermost of which does the same, and this process is continued until the tentacle has elongated considerably in one direction. In the mean time the superior vesicle of all enlarges, but does not divide. All present the aspect of nucleated cells.

5th. The partitions between the cells begin to be lined with minute, translucent granules, which give the tentacula a moniliform aspect ; and from this time those organs become contractile.

6th. The minute translucent granules (which are themselves cells of a secondary order) multiply until they fill up the primary cells, and give the tentacula the aspect of homogeneous bodies, composed of highly contractile granular tissue.

7th. When the tentacle has far advanced towards its perfect state, the bulb-like vesicle at its base also begins to be filled with granular tissue, many of the minute cells of which become pigment-cells.

8th. In the middle of this mass of cells, one cell appears larger than the last, and which, increasing with great rapidity, divides in the end the mass of minute secondary cells into two pad-like bodies, constituting together the conspicuous ocellus.

9th. When this division has taken place, there appears in the central cell a new and free mass of minute cells, in which are secreted crystals (of carbonate of lime). These are the otolites. The tentacle is now complete.

The *Thaumantias hemisphærica* is an active little animal, gregarious. It is exceedingly tenacious of life, as the tortures to which it was submitted by Dr. Macartney, quoted in my introductory remarks, show. It is very abundant in the Zetland seas, and occurs also in the east and west sides of the mainland of Scotland. It is also, according to Mr. W. Thompson, found on the north coast of Ireland. " In October, 1838, I obtained one of these Medusæ in Belfast Bay, and a day or two afterwards many specimens were brought to me by Mr. Hyndman from the same locality ; in size they rather exceed Müller's, measuring five lines in diameter in their most depressed state. Mr. R. Patterson informs me that he obtained the *M. hemisphærica* at Larne, in the summer of 1835."

Plate VIII, f. 2, *a*, represents this species seen in profile, magnified ; 2, *b*, seen from above, a very large specimen (too many tentacles and tubercles are introduced in the figure, by mistake) ; 2, *c*, is one of the reproductive glands ; 2, *d*, those of the tentacles and their bulbs.

15. *Thaumantias inconspicua*, Forbes.

Plate VIII, Fig. 3.

A very delicate, and rather large species, measuring usually about three fourths of an inch across. Its umbrella is hemispherical, smooth, and colourless. The margin bears from sixteen to twenty colourless tentacles springing from pale yellow, inconspicuous bulbs, each tinged with a faint tawny spot. Between each pair there is a rudimentary marginal tubercle. The sub-umbrella is much more depressed than the umbrella; its opening is bordered by a rather broad veil. The ovaries are long and linear, and of a faint lilac or greenish hue, with a central fulvous line. They occupy more than half the course of each radiating vessel. The stomach is narrow, quadrangular, and of a yellow colour. It terminates in four lanceolate lips. The inconspicuous ocelli and pale reproductive glands easily distinguish this species from its congeners. It is common in the Hebrides.

Plate VIII, fig. 3, *a* and *b*, represent it magnified as seen from the side, and from above; 3, *c*, is an ovary; 3, *d*, a portion of the margin, showing the tentacular bulbs, and the intermediate tubercles.

16. *Thaumantias lucifera*, Forbes.

Plate X, Fig. 2 (under the name of *T. lucida*).

This minute and curious Medusa is one of the most phosphorescent of all the naked-eyed species. Small as it is, I have not seen it more than one fifth of an inch across; it presents such very distinct characters, that I do not hesitate to describe and name it as a separate species, although specimens presenting truly adult characters have not as yet occurred.

The umbrella is very much depressed, smooth, and transparent. The margin is fringed with a close-set series of tentacula, of which I reckoned no fewer than eighty-four ($20\times4+4$) in several examples, but very small specimens had rather fewer of these organs. Their bases present a very minute ocellus, and there is a club-shaped, transparent organ, projecting, as it were, into the umbrella above it. This is probably the auditory vesicle in an early stage of development. The structure of the tentacles also indicates an immature condition of the tissues. The sub-umbrella is rather high in proportion to the umbrella. On its lower half are the four reproductive glands, sub-orbicular, lax, and yellow. The stomach is rather large, quadrangular, yellow, with imperfectly developed lips, whose margins are not fimbriated.

I have met with this species in Zetland and the Hebrides, and in vast abundance off the Lizard Point, on the coast of Cornwall; also at Dartmouth, and in the west bay of Portland. When swimming, it carries its tentacula stiffly, and at nearly a right angle with the body. The *Thaumantias plana* of Sars (Beskrivelser og Jagtagelser, p. 28, pl. 5, fig. 13) bears a close resemblance to it, and is of the same size, but the tentacula are described as being more than one hundred in number. It is also evidently an immature species. The only other described form of *Thaumantias* with a depressed umbrella, and very numerous tentacles, is the *T. multicirrata* of Sars (Op. cit. p. 26, pl. 5, fig. 12), but that has linear or clavate ovaries, more than 200 tentacles, and very few and distinct ocelli in proportion to the number

of tentacula. Both these species of Sars are from the coast of Norway, and will very probably be found hereafter in Zetland and on the coast of Scotland.

Plate X, fig. 2, *a*, represents the *Thaumantias lucifera* of the natural size; 2, *b*, as seen from above; and 2, *c*, in profile, much magnified; 2, *e*, the stomach; and 2, *f*, its mouth; 2, *g*, one of the tentacles with its bulb and vesicle; 2, *d*, an ovary.

The name *Thaumantias lucida* has been adopted by Lesson for Macartney's animal, under the impression that the latter was intended to be distinct from *T. hemisphærica*.

17. *Thaumantias punctata*, Forbes (1841).

Plate X, Fig. 1.

E. Forbes, in Annals of Natural History, vol. vii, p. 85, pl. 1, fig. 5 (1841).

The last of the species of *Thaumantias* which I have to describe, is one of which I gave an account some years ago in the 'Annals of Natural History,' under the name of *Thaumantias punctata*.

The umbrella is hemispherical, and rather depressed, smooth, and colourless. Its margin is bordered by thirty-two filiform, colourless tentacula, each with a rather swollen bulbous base, marked by a dark, almost black, ocellus. The sub-umbrella is convex, and divided into four parts by the radiating vessels which traverse, on its lower half, four short, linear, purplish ovaries. The stomach is very small, and purplish. It terminates in four short lips. This is a large species, measuring nearly an inch in diameter. It occurred abundantly off the Isle of Man, where it was taken in the month of June, 1839, by Professor Goodsir, Mr. Henry Goodsir, and myself. I regret not having encountered it since, as it requires to be submitted to more minute observation than time then permitted.

Plate X, f. 1, *a* and *b*, represents this species magnified, in profile, and seen from above; *c*, is the stomach; and *d*, a tentacle with its bulb.

Genus XII. Slabberia, Forbes (1846).

Umbrella campanulate; ovaries four, linear, in the course of the four simple, gastro-vascular canals; peduncle proboscidiform, highly extensile, oral orifice circular; a marginal tentacle springing from an ocellated bulb, and terminating in a coloured globular body, placed opposite each of the gastro-vascular canals.

Slabberia halterata, Forbes.

Plate VI, Fig. 1.

Umbrella deeply campanulate, smooth, colourless; sub-umbrella large, divided into equal parts by four simple vessels, which open into a circular marginal vessel. On the upper third of the sub-umbrella are seen in the course of the vessels four small linear ovaries or reproductive glands, pointed at each end. The border of the general cavity is provided with a shelf-like veil. The tentacula are strong, four in number, and colourless, except at their bases and lips.

The bulbs at their bases are more or less triangular, coloured above with bright verdigris green, and across the centre with a band of deep orange, below which, on the root as it were of the tentacle, is seen a conspicuous and rather large jet-black ocellus. The extremity of each tentacle is likewise swollen into a bulb, which is of a rich orange hue. From the centre of the sub-umbrella hangs a long and highly extensile peduncle or stomach, capable of being contracted entirely within the general cavity, but more usually elongated beyond the length of the tentacula. It is of a denser tissue than the other parts, and terminates in a circular orifice. The termination is not unfrequently swollen into the shape of a bell. The summit projects slightly above the surface of the sub-umbrella. The diameter of the disk does not exceed one eighth of an inch.

This curious Medusa was observed in August, 1836, in Mount's Bay, Cornwall, where great numbers of them were taken. It swims with its four tentacles either stretched out straight, or at a slight angle, and as if quite stiff, so that they seem with their loaded extremities to serve as poisers. The brilliant terminal bulbs, following at equal distances the conspicuous ocellated bulbs of their bases, give the creature a very striking aspect, and at first glance seem as if they belonged to two Medusæ, one of which had partially enveloped the other. The *Slabberia halterata* is a very active, and apparently hardy little animal. This remarkable combination of characters, and the features quite peculiar to itself, render it well worthy of generic distinction. The position and form of its ovaries indicate a relationship with *Thaumantias*, whilst the peduncle is that of a *Sarsia*. It thus links together genera, which, were it not for such a connecting form, would seem to be far apart. I have dedicated the genus to Martin Slabber, an ingenious Dutchman, who amused himself with the microscope, and published an account of his observations at Haarlem, in 1778. He was one of the first to direct attention to the minuter forms of Medusæ inhabiting the German Ocean, and therefore has good claim to preside over a sound generic group.

Plate VI, f. 1, *a*, represents *Slabberia halterata* of the natural size; 1, *b*, magnified; 1, *c*, disposition of vessels and ovaries, as seen from above; 1, *d*, ovary; 1, *e*, a tentacle with its bulbs; 1, *f*, proboscis when most dilated.

SARSIADÆ.

Genus XIII. Sarsia, Lesson (1843).

Umbrella hemispherical; radiating vessels four, simple; no conspicuous ovaries, four marginal tentacles opposite the point at which the radiating vessel joins the marginal one; ocelli four, more or less conspicuous; stomach in a very extensile, cylindrical, proboscidiform peduncle, with a simple orifice.

This genus was instituted by Lesson for a very remarkable Medusa discovered by the eminent naturalist of Norway, whose name it bears—a philosopher who, pursuing his researches far away from the world, buried among the grand solitudes of his magnificent country, where the pursuit of science is his recreation, and the holy offices of religion his sacred duty, has nevertheless gained name and fame wherever the study of nature is followed. The unpretending writings of this parish priest have become models for the essays of learned professors in foreign lands, and his discoveries the texts of long commentaries by experienced physiologists. The French naturalist, in seeking to be the first to honour the name of Sars, has done himself honour by his recognition of high and modest merit. With peculiar pleasure, therefore, do I offer a testimony to the value and permanency of the genus before us, by announcing three very distinct species additional to the only recorded type, confirmatory of the excellence of its constitution.

1. *Sarsia tubulosa* (sp.), Sars (1835).

Plate VI, Fig. 2.

Synonyms. *Oceania tubulosa.* Sars, Besk. og. Jagt., p. 25, pl. 5, fig. 11 (1835).
——— Thompson, Ann. N. H., vol. v, p. 249 (1840).
——— Dujardin, in 2d Ed., Lamarck, An. s. Vert., t. iii, p. 165 (1840).
Sarsia tubulosa. Lesson, Acaleph., p. 333 (1843).

This is the type of the genus. The umbrella, which is sometimes nearly an inch in length, is smooth, colourless, and of an oblong hemispherical shape. Its margin bears four equidistant tubercles, of a bluish or purplish colour, each marked with a well-defined dark ocellus. From each tubercle arises a tentacle, lilac, or greenish, or blue, extremely extensile, often elongated to three times the length of the body. The structure when magnified is seen to be moniliform and granular. The sub-umbrella is hemispheric and very convex, divided into four equal parts by as many radiating simple vessels, which join the marginal vessel

opposite the bases of the tentacula. The margin of the sub-umbrella is bounded by a rather broad membranous veil. From its centre hangs the long, cylindrical, fleshy, proboscidiform peduncle, of a blue or lilac, sometimes greenish colour, and fleshy substance. It is highly contractile, being often extended, like a long tube, so as to be twice the length of the body; sometimes contracted within the bell, and then assuming a bottle shape; the central part being inflated, and suspended by a slender portion formed by its base. Its fixed point rises conically for a little way above the summit of the sub-umbrella. The free extremity is more or less claviform, and terminates in a round or indistinctly four-lobed orifice, the lips of which are sometimes everted. The vessels do not appear to run down the peduncle, the interior of which is occupied throughout by the stomach.

In a note, communicated by my friend Mr. Patterson, he describes the tentacular bulbs, in some specimens met by him at Larne, as exhibiting brilliant crimson ocelli. and the central peduncle as of a dirty pinkish yellow, with a bright crimson spot at its junction with the body. "The peduncle," he writes, "was ever changing its form; sometimes flung out beyond the body, and then becoming proportionally thin." The animals were from a quarter to three eighths of an inch in length, and other specimens afterwards taken measured two, five, and seven lines in the body. The tentacula extended so much, that on one occasion they measured two inches and a half, by a rule applied to the sides of the glass jar in which they were confined.

In his "Additions to the Fauna of Ireland," published in the 'Annals of Natural History' for 1840, Mr. W. Thompson has the following note respecting this species, in which it was first announced as a British animal, though, as I have remarked before, when describing *Oceania turrita*, it is probable that the *Peliscelotus vitreus* of Templeton, figured in the ninth volume of Loudon's 'Magazine of Natural History,' was our *Sarsia* turned inside out.

"April 11, 1840. I had the satisfaction to-day of identifying with the *Oceania* (*?*) *tubulosa* of Sars a Medusa of which several individuals were brought to me by Mr. Hyndman, just after their capture in Belfast Bay. On calling the attention of Mr. R. Patterson to them, a reference to his notes on Medusæ showed that he had procured the same species at Larne, county Antrim, in May 1835, and June 1838; and again at Bangor, county Down, in July 1839. As my friend could not find the species described—Sars's work he had not, for reference—he drew up a detailed and interesting account of the animal, accompanied by several characteristic sketches of it in various positions. Having remarked that one of my specimens, which was in a phial containing one ounce and a half of sea-water, appeared as lively after four days' captivity as at first, although the fluid had not been changed, nor any nutriment added, I, before leaving home for some days, handed it over to Mr. Patterson, that the period the animal would live, under such circumstances, might be noted. From him I learn that this individual lived thus for twelve days (from the 18th to the 30th of April) and that for the first ten, it retained its ordinary vivacity." (Thompson, loc. cit., p. 249.)

The first time I had the pleasure of seeing this elegant little Medusa, was at Scalloway, in Zetland, where it was taken by Professor Goodsir and myself in 1839. During the month of June in the same year, I met with it again abundantly when dredging with Mr. Smith of Jordanhill, in the Kyles of Bute. On visiting Zetland in 1845, in company with Mr. Mac Andrew, we found it very abundant in the bays and harbours on both east and west coasts. Some we took at Hillswick were exceedingly lively and active, swimming obliquely through the water with great rapidity. Being kept in a jar of salt water with small crustacea, they

devoured these animals, so much more highly organized than themselves, voraciously; apparently enjoying the destruction of the unfortunate members of the upper classes with a truly democratic relish. One of them even attacked and commenced the swallowing of a *Lizzia octopunctata*, quite as good a Medusa as itself. An animal which can pout out its mouth twice the length of its body, and stretch its stomach to corresponding dimensions, must indeed be "a triton among the minnows," and a very terrific one too. Yet is this ferocious creature one of the most delicate and graceful of the inhabitants of the ocean—a very model of tenderness and elegance.

Plate VI, fig. 2, *a*, represents the *Sarsia tubulosa* of natural size; 2, *b*, magnified; 2, *c*, a tentacle, bulb, and ocellus; 2, *d*, the peduncle retracted and inflated.

2. *Sarsia pulchella*, Forbes.

Plate VI, Fig. 3.

A much smaller species than the last; none of the specimens which I have met exceeding a quarter of an inch in length of body. The umbrella is sub-orbicular, and very convex, transparent, colourless, and smooth. The margin is quadrate, each angle bearing a large ocellated tubercle, from which a rather thick tentacle springs. The tentacle is of a pale pink colour; the tubercle at its base transparent, with a mass of pink or orange pigment-cells at its upper part, from which depends a brilliant green pedicle, with a jet-black ocellus at its extremity. The sub-umbrella is prominent, and rather conic. Down its sides run the four gastric vessels, coloured pale pink. Round its opening is a four-lobed veil. From its centre hangs the proboscidiform peduncle, which is rarely protruded beyond the umbrella, and more frequently contracted into various flask-like shapes. Its point of affixment rises as a short pink cone above the sub-umbrella; its orifice is round. It is of a brownish-red colour, with a green-tinged oral extremity.

It is a very active animal, and very tenacious of life. It never extends its tentacula so far as the preceding species, and often carries them coiled up spirally. I found several specimens in Brassay Sound, Zetland, in 1845.

Plate VI, fig. 3, *a*, represents this species of the natural size; 3, *b*, magnified; 3, *c*, the bulb of a tentacle; 3, *d*, a tentacle coiled up.

3. *Sarsia gemmifera*, Forbes.

Plate VII, Fig. 2.

The very remarkable animal which I have now to describe, was discovered in the Zetland seas by Mr. M'Andrew and myself in 1845; several specimens were taken. It was the first *Sarsia* which we found exhibiting a distinct mode of reproduction, and that by gemmation from the walls of the peduncle.

The *Sarsia gemmifera* is a very small species, scarcely a quarter of an inch in length of body. Its umbrella is pyriform, smooth, and colourless. The aperture of it is rather contracted and quadrangular. At each angle there is a conspicuous ocellated tubercle of a pear shape, its upper part pale tawny, its middle dark orange, and its base colourless, with a well-defined, jet-black ocellus. Round the orifice of the sub-umbrella, which is pyriform, is a four-

lobed veil, festooning, as it were, the spaces between the ocellated tubercles. From each of the latter arises a tentacle, rather short, thick, cylindrical, moniliformly granulated, and of an orange colour. Each tentacle is placed opposite the point at which one of the four gastric vessels joins the marginal one. From the centre of the sub-umbrella is suspended the peduncle, perforating its summit, and terminating there in a small conical process of granular tissue. The peduncle is shorter than the umbrella, but may be extended slightly beyond it. It is slender, cylindrical, and tubular, but is capable of changing form greatly, and often swells out into a club- or bottle-shaped extremity, ending in the mouth, which is round. The peduncle is of an orange colour, like the tentacles, but much paler.

The peduncle presented the appearance of being ramified, or rather pinnated, variously-shaped processes projecting from the sides. When several individuals were compared, it was found that these pinnations did not correspond, and a closer inquiry made it evident that they were in reality young individuals, in various stages of development, budding from the pedunclular tissue. They are not distributed over its surface in any regular order according to their degree of advancement, but intermingled, as may be seen in the much magnified representation of the peduncle in an individual, different from that which is drawn entire. (See 2, *e*, and compare it with 2, *b*.) At the same time there is an indistinct spiral arrangement to be observed, and the peduncle has a tendency to assume angular bendings at the points from which the buds spring. The earliest stages of one of these buds is that which I have represented at 2, *f*, where the tissue of the surface of the peduncle simply bulges out as a small wart, whilst there is a corresponding indentation in the tubular cavity beneath. This indentation increases with the growth of the wart, which takes upon itself a club shape, and, at the same time, there is a notch-like appearance towards the base at the upper part of the club (2, *g*). In a stage more advanced, the club begins to assume a globular form, and the excavation, if anything, decreases, not projecting beyond the notch, but a new cavity has appeared independently within the club, and has possibly been formed by the division of the old cavity into two parts, and the isolation of its upper part (2, *h*). In the stage represented at 2, *i*, the development has advanced rapidly; the club begins to present a four-lobed aspect, and the internal cavity has greatly enlarged. An assemblage of small dots, indicative of an ocellus, appears opposite each lobe. After this it would appear, that correspondent with the increase of the lobes, is the opening of the cavity and the formation of a peduncle; for, in the highest condition of these gemmæ which I have had an opportunity of examining, the bud presents the appearance of a little bell (3, *k*), open, and having a rudimentary proboscis within it; the lobes are much more elongated, and at their bases are seen not only the little ocelli present in the last stage described, but others below them of a jet-black colour. It is evident that the former are the orange portions of the tentacular bulbs, and the latter, the black ocelli beneath them, whilst the lobes, which have already become of a conspicuous orange colour (as well as the peduncle), are the tentacles in course of development. The four gastric vessels are also now manifest, so that we have a young *Sarsia* nearly ready to drop from its parent, and shift for itself.

Plate VII, fig. 2, *a*, represents this interesting animal of the natural size; 2, *b*, the same, magnified; 2, *c*, the summit of the peduncle; 2, *d*, a tentacular bulb with its ocelli; 2, *e*, the peduncle of another individual, with its bulbs; and 2, *f* to 2, *k*, the various stages of development of the buds as just described.

4. *Sarsia prolifera*, Forbes.

Plate VII, Fig. 3.

Equally remarkable with the Medusa I have just described is that now before us—indeed more so, for the last was an instance of gemmation from the peduncle, a phenomenon, as we shall hereafter see, previously discovered by Sars in another genus (*Lizzia*); but in *Sarsia prolifera* we have gemmation from the tentacular bulbs, an entirely new and most remarkable mode of reproduction.

On the 21st of August, 1846, we found great numbers of minute Medusæ in Penzance Bay. Among them was one which, whilst it presented the simple cylindrical proboscis and four tentacula of a *Sarsia*, differed from all the members of that genus hitherto seen, in having at the base of each tentacle a supplementary bulb, or a bunch of little tubercles suspended like a bunch of grapes. Fortunately, individuals of this curious little creature—it is even less than the last species—were plentiful, so that we were soon enabled to unriddle the anomaly by a careful examination of numerous specimens under the microscope. The supplementary bulbs and grape-like tubercles proved to be young *Sarsiæ*, sprouting by gemmation from the bases of the tentacula.

The *Sarsia prolifera* is a very delicate little animal, so faintly coloured as to be inconspicuous in the water, in that respect differing from the other members of its genus. Its umbrella is campanulate, and somewhat inclined to a sub-globose form, smooth, and colourless.

The opening of it is quadrangular, the spaces between the angles curtained by a veil, the angles themselves bearing each a pale yellow tentacular bulb, marked with a minute black ocellus. From the four bulbs spring as many pale yellow, moniliformly-granulated, slender, coiling tentacula. The sub-umbrella occupies about two thirds of the length of the umbrella, and to about a third of its length is suspended the pale yellow tubular peduncle, which is very changeable in form, sometimes inflating itself into a bottle-shape, but apparently never protruded beyond the umbrella. Its summit projects slightly above the sub-umbrella; its orifice is round, and bounded by a highly contractile rim of fibrous cells.

In every specimen we found a different arrangement or degree of development of the little buds at the bases of the tentacula; and not only did each individual differ from the other, but rarely were the arrangements of the germs at the bases of the four tentacles alike in the same example. I have accordingly figured the four bunches of a single specimen to show how they differ, and what the nature of the curious bud-like bodies is.

In fig. 3, *e*, all the buds are in a low state of advancement; the bulging above the coloured ocellus indicates the lowest and most rudimentary stage, corresponding to the wart-like condition described in the account of the buds in the peduncle of *Sarsia gemmifera*. To the left of the ocellus, a bud more advanced, and exhibiting traces of an interior cavity, is seen, and dependent from the bulb at its right side is a gemmule already presenting traces of lobation. In fig. 3, *g*, these two stages are repeated, with the advance in one that four dark masses of pigment-cells indicate the bases of the rudimentary tentacula, and the formation of ocelli. In fig. 3, *h*, whilst two of the gemmæ are rudimentary, a third shows not only ocelli, but the tentacula distinctly in course of formation, as yet, however, folded in. In 3, *f*,

one of the gemmæ has attained a stage of development far beyond that of the other children of its parent, for it has assumed a distinct campanulate form; its sub-umbrella is lineated by the gastro-vascular canals; its tentacular bulbs are defined, and separated from the margin, and present large and conspicuous ocelli, and its tentacles have assumed a definite form and ample dimensions. The whole hangs by a very short and slender peduncle to the tentacular bulb, which exhibits besides three other buds in early stages of development, ready to advance when the firstborn of the parent finger has loosened its ties, and embarked on a free voyage of its own. A youthful *Sarsia*, which has just cast off its leading-strings, is represented at 3, *i*. The funiculus still remains projecting from its summit, and its stomach is so rudimentary, that, for its own sake, we must wish it a rapid accumulation of new tissue, since at present it can scarcely hope to live very long, unless it provides itself with a more efficient receptacle for nourishment. Perhaps it was undutiful, and left its mother too soon; all the worse for it, and the better for us, since we learn from its examination, that the little process at the summit of the sub-umbrella is the remains of the funiculus, and that the umbrella does not attain its true shape and dimensions till after the sub-umbrella has been formed, and the tentacula and organs of sense comparatively advanced. The great size of the ocelli in these young animals, as compared with the entire body, is very striking, especially in the species before us, where the ocellus is eventually very small and inconspicuous, though well defined. The order of formation of tissues and organs in the *Sarsiæ* seems to be as follows:—1st, the motor tissue begins; 2d, the cavity of the disk is outlined, though closed; 3d, the pigment cells of the ocelli commence to appear; 4th, the cavity opens, and the tentacula grow as lobes; 5th, the vessels are formed, and the distinction between the tentacle-bulbs and tentacles appears; at this time the veil between the tentacle-bulbs is indicated by lobes, and the peduncle appears; and 6th, the mass of the cellular tissue of the umbrella is formed, and the peduncle completed after the bud has become free.

What strange and wondrous changes! Fancy an elephant with a number of little elephants sprouting from his shoulders and thighs, bunches of tusked monsters hanging epaulette-fashion from his flanks in every stage of advancement! Here a young pachyderm almost amorphous, there one more advanced, but all ears and eyes; on the right shoulder a youthful Chuny, with head, trunk, toes, no legs, and a shapeless body; on the left an infant, better grown, and struggling to get away, but his tail not sufficiently organized as yet to permit of liberty and free action! The comparison seems grotesque and absurd, but it really expresses what we have been describing as actually occurring among our naked-eyed Medusæ. It is true that the latter are minute, but wonders are not the less wonderful for being packed into small compass. The multitude, being muddle-headed, love magnitude, but the philosopher does not estimate a whale above a minnow for his mere bigness. "Nosci digna hæc animalcula, non quia Deus maximus in minimis est, æque enim magnus in omnibus, at ob eximiam membrorum exilitatem, miram organorum diversitatem, varia Creatoris eundem finem obtinenda media et pulchritudinem et proportionem quam nihil excellit." So wrote Otho Frederic Müller—filled, by his studies of minute life, with a deep spirit of reverence and admiration of his monoculi; so might we write of our Medusæ. But when to all the wonders of their structure are added such surprising physiological facts as those which we have just been narrating concerning their reproduction, the spirit of reverent astonishment fills us fuller and fuller. "La force qui développe, l'intelligence qui spécifie et co-ordonne, l'amour

qui unit et vivifie"*—the triune powers manifested in each and every being, in each single and all combined, are revealed as clearly in our little *Sarsia*, as in the mightiest monster of the ocean, beneath whose shadow it may swim invisible to the unarmed eye. And when we behold how its perpetuity in that ocean is secured, we are tempted to explain with Spenser—

> "Wonder it is to see
> How diversly Love doth his pageaunts play,
> And shewes his powre in variable kinds."†

Plate VII, fig. 3, *a*, represents *Sarsia prolifera* of the natural size; 3, *b*, magnified; 3, *c*, its peduncle; 3, *d*, a tentacle, with the ocellated bulb at its base, and a gemmule beside it; 3, *e*, to 3, *i*, gemmæ in various stages of development.

Genus XIV. Bougainvillea, Lesson (1829). Hippocrene, Mertens (1835).

Umbrella spherical; ovaries in the form of four equal lobes, on the sides of the short peduncle; margin of the umbrella, with four fasciculi of tentacular bulbs, sending forth one or many tentacles, each fasciculus opposite one of the four single radiating vessels; stomach shorter than the sub-umbrella; mouth with four ramifying tentaculated lips.

This very remarkable group was first strictly defined by Brandt from the drawings and notes of Mertens, who had recognised its generic value, and assigned a name to it in his manuscripts. Lesson, who appears to have been the first naturalist who observed any species belonging to it, had equally perceived its importance, and claims priority for the name which he gave, dedicating it to the honour of the distinguished French voyager, Admiral Bougainville. Both Lesson and Brandt appear to have met with the same species, the former, in the bays of the island of Soledad; the latter, in Behring's Straits. I had the good fortune, in 1839, to add a second and representative form, inhabiting the North Atlantic. Since then a third has occurred, and it is not improbable that before long many species may be discovered of this beautiful genus, seeing that its characters are peculiarly susceptible of specific modifications. Dr. Gould mentions one as occurring on the coast of the United States.

The peculiar structure of the lips in the species of this and the following genus, appears to bear some relation to the grouping of the marginal tentacula in fascicles, and to constitute a character of sufficient value to cause in the end the establishment of a family distinct from *Sarsiadæ*, for the reception of *Bougainvillea*, *Lizzia*, and a genus as yet undefined, of which the Medusa described by Rathke, under the name of *Oceania Blumenbachii*, is the type.

* Lamennais, Esquisse d'une Philosophie, B. v, ch. i.
† Faerie Queen, canto v.

1. *Bougainvillea Britannica*, Forbes (1841).

Synonyms. *Hippocrene Britannica.* E. Forbes, in Annals of Nat. Hist., vol. vii, p. 84, pl. 1, fig. 2 (1841).
Bougainvillea Britannica. Lesson, Acalephes, p. 291 (1843).
Medusa duodecilia. Dalyell, Animals of Scotland, p. 70, pl. 11, figs. 11, 12 (?) (1847).

This beautiful little animated bubble is nearly globular, and usually not much larger than a marrowfat pea. Its umbrella is transparent, colourless, and quite smooth, therein differing essentially from the *Hippocrene Bougainvillii* of Brandt, which has pilose sides resembling, in this respect, *Thaumantias pilosella.* (See Brandt, in Petersburg Memoirs, Sixth Ser., Sc. Nat., vol. ii, pl. 20, figs. 2, 3, 4, and 6.) The opening of the umbrella is contracted and quadrangular. At each angle is an oblong group of tentacle-bulbs, closely packed together, six to eight in each group. Each bulb is particoloured, orange below, and white above, with a red eye-dot on the white portion. The bulbs seem all united into one mass or pad at their lower part, so that the tentacles are more close together at their origins than the ocelli. The tentacles are as many as the bulbs, not very long, yet slender, white towards their bases, orange towards their tips. The outer ones are usually borne curled upwards. The sub-umbrella is small as compared with the umbrella, less than half its size. It is divided into four sections by four simple gastric vessels, which join the marginal vessel opposite the groups of tentacular bulbs. From its centre hangs the massy peduncle, consisting in its upper part of four equal, compressed, quadrate lobes, of a bright orange colour, contracting below into a short, tubular, orange stomach. The latter terminates in a mouth surrounded by four very curious lips, for each is prolonged into a white filiform tentacle, which twice dichotomously divides; each division terminates in a bulbiform extremity of an orange colour, with dark specks. The structure of these singular appendages to the mouth reminds us of the root-like cotyledonary tentacles of *Cephea* among the higher *Medusæ*, and serves to bear out the view that those bodies are not substitutes for stomachs, absorbent roots, as it were, as formerly supposed, but only a modified form of fimbriated lips. The gland-like appearance of their extremities in *Bougainvillea*, seems to depend on terminal accumulations of fibrous and pigment-cells.

The *Bougainvillea Britannica* is a very active little animal, and very tenacious of life. Its tentacula are continually in motion, and sometimes so contracted, that none appears to be present. It is abundant, but probably not gregarious, in various localities in the north. I have taken it in the Kyles of Bute, whence it was first described, at the entrance of the Frith of Forth, in Zetland, and in Ballycastle Bay, on the north coast of Ireland. It has also been taken on the east coast of Scotland by Mr. Henry Goodsir, and Mr. Patterson has communicated a memorandum of a little Medusa, evidently this species, procured by him at Portaferry, Strangford Loch, on the 7th of August, 1838, so that he had met with and observed it before I had the same good fortune.

Plate XII, fig. 1, *a*, represents this *Bougainvillea* of the natural size; 1, *b*, magnified, and seen in profile; 1, *c*, as seen from above; 1, *d*, the lobes of the peduncle. Between

these lobes will probably hereafter be found young *Bougainvilleæ* produced by gemmation, in the manner described as occurring in the following genus. The appearance of eight peduncular lobes represented in Mertens's drawing of *Hippocrene Bougainvillii*, (*Bougainvillia Macloviana*, Lesson,) is probably due to this cause; the four intermediate ones being gemmæ, symmetrically developed, in this respect differing essentially from the unsymmetrical development so strangely exhibited by *Lizzia*. Those who have opportunities of hereafter examining our British *Bougainvillea*, should let no specimen pass until the mode of reproduction be discovered. When found, I feel quite confident it will prove to be of the order now indicated. 1, *e*, represents one of the ramified lips, with its gland-like extremities; 1, *f*, is one of the four fasciculi of tentacles and tentacular bulbs.

2. *Bougainvillea nigritella*, Forbes.

A second British species of *Bougainvillea*—one, too, remarkably distinct from the first—was discovered by Mr. M'Andrew and myself in the Sound of Brassay, Zetland, during the autumn of 1845.

It is very minute, not more than half the size of its congener. The umbrella is globose, smooth, transparent, and colourless. It is contracted at its opening, which is quadrangular, each angle bearing a compact, oblong, or almost kidney-shaped mass of tentacular bulbs, apparently four in number, closely united together, so that, but for indications of lobation at the lower part of the pad, the number of these bodies would be indeterminable. The upper half of the pad is yellow, the lower jet-black, the two colours separated in a very defined manner. On one side of each pad arises a very short, thick, yellow tentacle, and one only. The sub-umbrella, which occupies about two thirds of the body, is divided into four parts, the simple gastric vessels, each of which unites with the marginal vessels opposite the centre of one of the ocellated pads. The peduncle is short, and divided above into four rather thick oblong lobes, of a yellow colour; below it is produced into a short, campanulate, yellow stomach, terminating in four tentacle-shaped, white lips. Each lip becomes suddenly filiform, proceeds for some distance simple, and then divides into two, again bifurcating before it terminates. The end of each division is a conical gland-like body, white speckled with black.

Plate XII, fig. 2, *a*, represents *Bougainvillea nigritella* of the natural size; 2, *b*, magnified in profile; 2, *c*, seen from one side; 2, *d*, the peduncle and lips; 2, *e*, one of the lips with its sucker-like terminations; 2, *f*, one of the masses of tentacle-glands, and the single tentacle.

Genus XV. Lizzia, Forbes (1846).

Umbrella spherical or campanulate; ovaries in the form of four lobes, on the sides of the short peduncle; margin of the umbrella with eight unequal, compound, tentacular bulbs, all tentaculiferous, the four larger opposite the four radiating, simple, gastric vessels; stomach shorter than the sub-umbrella; mouth with four, simple, or ramifying tentaculated lips.

I founded this genus for the reception of the remarkable Medusa described and figured by Sars under the name of *Cytæis* (*?*) *octopunctata*. I had previously referred it to *Hippocrene* (i. e. *Bougainvillea*), and had been followed in such reference by Lesson, but the discovery of several true *Bougainvilleæ* with four fascicles of tentacles, and of more than one form with eight fascicles, indicated the propriety of separating the two types, and of assigning each a generic value. Further observations have rendered it probable that the one genus produces its young by gemmation symmetrically, and the other unsymmetrically, which difference, if constant, would of itself be sufficient to induce a generic separation of the two groups.

1. *Lizzia octopunctata* (sp.), Sars (1835).

Plate XII, Fig. 3.

Synonyms. *Cytæis (?) octopunctata.* Sars, Besk. og Jagt., p. 28, pl. 6, f. 14 (1835), and Fauna Littoralis Norwegiæ, t. iv, figs. 7-13 (1846).

Hippocrene octopunctata. Forbes, Annals of Nat. Hist., vol. vii, p. 84 (1841).

Bougainvillea octopunctata. Lesson, Acalephes, p. 292 (1843).

Among the many important discoveries which have rewarded the patient observation of Sars, that of the power of Medusæ to reproduce by gemmation is not the least significant. The animal now to be described was that in which the Norwegian naturalist met with the phenomenon. Hitherto it has been found only on the coasts of Scandinavia; I have now the pleasure of making it known as a member of the British Fauna. To add a new form, even though of little interest, in a class with so few recorded native members as the Acalephæ, is a pleasure; much more so, to increase our lists with one of such curious physiological import as the *Lizzia octopunctata*.

This little Medusa—it is scarcely a quarter of an inch in length—swarms in the bays of the eastern and western coasts of Zetland. I have not met with it elsewhere. Its umbrella is sub-globose or elongato-convex, smooth, transparent, and colourless. On the margin there are eight, jet-black, triangular ocelli, four of which are larger than the other four. All are compound, being composed of the united bulbs of several tentacula. Three of those organs

spring from each of the larger bulbs, and either two or three from the smaller, the number varying in different specimens. These tentacles when contracted are rather short in proportion to the body, colourless, and not usually very extensile, though Sars has observed them extended to a great length. The animal, when swimming, often turns them up and curls them. The sub-umbrella occupies not quite two thirds of the body; it is divided into four parts, by the four vessels running to join the marginal canal opposite the larger tentacular bulbs. Its upper part often appears as if truncated. The peduncle is short, thick, and four-lobed. It is marked with four patches of black pigment-cells. Between the lobes are seen, in the majority of specimens I have examined, four budding gemmules, one of which is invariably in a stage of advancement far beyond the others, and usually exhibits distinctly the black ocellated tentacular bulbs. The stomach occupies the lower part of the peduncle; it is narrower than the upper, and more extensile. It is colourless, and terminates in four tentaculiform lips, each one bifurcating.

In St. Magnus Bay I took specimens similar in every respect to those just described, except in being a little larger, having slightly smaller ocelli, and no buds on the peduncle. These may possibly have been males. I have never seen the process of gemmation in the females advanced beyond the stage noticed above. Sars, however, traced all its stages, and as his account is of great interest, and contained in a work probably accessible to very few of my readers, I extract it entire :—

"I considered the short cylindrical knots or appendages on the stomach (which hangs free in the cavity of the campanulate disk) of the Acalephæ, described by me under the name of *Cytæis octopunctata*, as very remarkable even at the moment of the discovery of the species. I could not at the time state their purport with certainty, but supposed that they had some connexion with the mode of procreation.

"In the spring, 1836, I had an opportunity of observing a number of individuals of this species of Acalephæ; and I then discovered, to my astonishment, that the parts mentioned are nothing else than the young ones produced by gemmation,—a phenomenon hitherto unknown among the class of the Acalephæ. I have briefly mentioned this interesting discovery in Wiegmann's Archives for 1837, Part V, p. 406.

"I observed in some individuals, which I examined on the 5th of May, that these knots are all placed in a horizontal position (viewing the animal erect or with the mouth downwards), at the sides of the square-formed stomach. They are usually four in number, and are seated opposite one another. There are likewise frequently seen an additional two or four much smaller ones, placed beneath the former number. They are, moreover, usually of uneven dimensions, the two seated opposite one another being larger than the other two, and one of the larger pair is larger than the other. In one of these individuals a knot was developed into a perfect young animal, with a bell-shaped, colourless, transparent disk, in the cavity of which the oblong, pear-shaped, brownish-gray stomach was quite distinct. At the margin of the disk there were eight brownish-black, marginal granules, and the marginal fibres that spring forth from them, of which I counted sixteen, as long as the disk. The marginal fibres moved and bent slowly, and the entire disk was contracted occasionally. The young one was attached by means of a very short and rather thick peduncle (which issued forth from the back or from the convex surface of the disk) to the stomach of the mother, whilst it otherwise projected with its entire body independently. The young one seated opposite it had probably

already dropped off, for traces of the peduncle were perceived at the place where it had grown. Of the two other buds issuing forth from this individual, the one was round at the independent extremity, and had only four brownish-black marginal granules, without traces of marginal fibres; whilst the other exhibited very short, thick, prominent, marginal fibres, and traces of stomach internally.

"In another individual the two opposite knots were small, rounded, and as transparent as water, without traces of stomach, marginal granules, or marginal fibres; of the two other larger ones, the one was simple, without marginal fibres, but furnished with four marginal granules; the other and largest of all also did not exhibit any marginal fibres, but had eight marginal granules, of which four were much larger than the rest, the latter being evidently those that had latest budded forth, owing to which circumstance they were seated alternately with and between the larger ones.

"The number of these knots I found unequal in different individuals, depending upon the circumstance whether several or few young ones had already severed themselves, namely, from one to three, independent of the small knots seated farther below on the stomach, which become smaller the nearer they are to the mouth. The form of the latter, however, is quite the same as that of the others, excepting that they are as transparent as water, and without visible organs.

"Among the larger young ones, which possess eight distinct, equally large, marginal granules, marginal fibres are likewise always found to grow forth, being equally long or even longer than the young one itself; they are, however, generally found to be lying together in a bent position, and only become visible when they are unfolded by the aid of a needle, or when the young one severs itself forcibly from the body of the mother, in which latter case they begin to unfold and to move spontaneously. Their number is usually twelve, (viz. three grow from each of the marginal granules that first show themselves). Sixteen, however, are found with the largest young ones, or those that are about to sever themselves from the mother, (viz. one marginal fibre grows from each of the four subsequent marginal granules). In the last mentioned young ones, the stomach as well as the short mouth-tentacles are distinctly developed.

"On the same day I remarked, in one of the largest of the individuals of this Acalephe, a young one, which was from five to six times smaller in diameter that the mother; it appeared recently to have been severed, and still was slightly glued to the stomach of the mother, but separated from it immediately as soon as I touched it with a needle, swam about in the water, and exhibited the same phenomena of life as its parent. It had eight marginal granules and sixteen marginal fibres.

"On the 10th of May, I found in such a large individual a perfectly-developed young one, of the size of the one that I have just mentioned, and which was still glued to the body of the mother. I observed it with great attention, with a view, if possible, to see the process of separation. The disk, the stomach, the mouth-tentacles, marginal granules, and the four radiating canals, running from the stomach towards the margin of the disk, each of which corresponded exactly with the same parts in the mother, were evident. It was moreover as colourless as water, excepting the brownish-gray stomach, and the brownish-black marginal granules. Occasionally it would violently contract, and again expand (just as the mother when swimming), a systole and diastole by which it strove to sever itself; its contractions were quite independent

from those of the mother, and indeed evinced a distinct individual life. The marginal fibres, the number of which were sixteen, viz. three and one alternately issuing from the marginal granules, were of the length of the disk or a little larger, and moved themselves, worm-like, in every direction.

"I placed this individual by itself in a vessel filled with sea-water. On the very evening of the same day I found that the young one had severed itself from the mother, swimming about rapidly in the water. The bell-formed disk (from five to six times smaller in diameter than that of the parent) was more rounded at the upper part, and not so high as in the mother; every trace of the locality of adfixture, which, as already mentioned, is at the back of the disk, had already disappeared. At its stomach I observed two small knots of an unequal size, being probably the first commencement of the issuing young ones of the second generation. In other young ones (that had not yet freed themselves from their progenitor), of about the same size as this, I have found four such unequally-sized little knots,—otherwise growing young ones—issuing forth from the stomach.

"On the morning of the following day I had another rather smaller young one, which had been attached to the same mother, swimming about merrily with the above-mentioned one, the latter having grown to $\frac{1}{4}$—$\frac{1}{3}$ of the size of the mother in diameter."

The *Lizzia octopunctata* is a gregarious species. It is very conspicuous, owing to the jetty colour of its ocelli and ovaries. It moves much less gracefully than most of its allies, jerking itself through the water with sudden and vigorous leaps. It is lively, vigorous, and tenacious of life.

Plate XII, fig. 3, *a* and *b*, represents it seen in profile, and from above, magnified; 3, *c*, is the peduncle with a budding young one far advanced, and the curious bifurcated lips of the stomach; 3, *d*, is the same seen from above; three of the buds in this instance are very rudimentary; 3, *e*, represents two of the tentacular bulbs. The variety figured is that with only two tentacles springing from the intermediate bulbs; that with three, as figured by Sars, is equally, if not more, abundant. I have no reason to suppose them to be specifically distinct.

2. *Lizzia blondina*, Forbes.

Plate XII, fig. 4.

Rather smaller than the last species, not so common, and of solitary habit, is another *Lizzia* inhabiting the Zetland seas, and met with first in the Sound of Brassay, and afterwards off Fitful Head, during the autumn of 1845.

The umbrella of the *Lizzia blondina* is sub-conical, smooth, inflated, and colourless. Its margin is ornamented with eight oblong, yellow, compound, tentacular bulbs, alternately small and large, each of the latter giving origin to three yellow tentacula, the former to only one, equally yellow, however, and not different from the other tentacles in dimensions. Their substance, when highly magnified, appears minutely and granularly ringed. The sub-umbrella is rather small in proportion to the umbrella, conic, and truncated above. Four simple marginal vessels run down its sides, opposite the four larger fascicles of tentacula. A broad veil borders its opening. From the centre hangs a short, four-lobed, yellow peduncle, producing gemmules unsymmetrically, exactly as the last species does, in the intervals of the lobes.

Stomach very short; mouth bordered by four tentaculiform lips, which do not bifurcate, but terminate with simple, gland-like, black-spotted, conical extremities. The motions of this very distinct species are jerking, and its habits, except in being solitary, like those of its congener.

Plate XII, fig. 4, *a* and *b*, represents the *Lizzia blondina* much magnified, seen in profile and from above; 4, *c* and *d*, are similar views of the peduncle, tentacula, and gemmules; 4, *e*, is one of the larger fascicles of tentacula, with the compound bulb from which they spring; 4, *f*, the appearance of a portion of one of the tentacles, greatly magnified.

I have met, both on our southern and northern coasts, with several little Medusæ in an immature state, presenting the essential characters of *Lizzia*, and evidently distinct from either of the preceding, but have abstained from describing or figuring them as species until they shall have been observed in an adult condition. I do this the more willingly, as it would seem that the intermediate stage of several hydroid zoophytes appears to be similar to, if not identical with, this genus. Thus the Medusa state of the *Eudendrium ramosum*, figured by Van Beneden in the 'Memoirs of the Brussels Academy' (vol. xvii, pl. 4, figs. 10-13), is closely related to both *Bougainvillea* and *Lizzia*, nor is the Medusa produced by *Tubularia* far removed. Sir John Dalyell has recognised this affinity of forms, in his account of the probable Medusa of *Tubularia*, under the name of *Medusa ocilia*, and his comparison of it with a *Bougainvillea* (apparently *B. Britannica*), denominated by him *Medusa duodecilia*. His description is so interesting, and bears so importantly on the history of the *Lizzia* and its allies, that I venture to extract it from his most valuable and beautiful work 'On Remarkable Animals of Scotland,' in the hopes of attracting the attentive observer to a subject evidently prolific in future discoveries:—

"*Medusa ocilia*. Minute pyriform bodies, as above specified, are dispersed on the stalk of different parts of the Tubularia at considerable intervals; sometimes three are together, sometimes two are opposite to each other, or only one terminates a twig, where it might be readily supposed a regenerating hydra. Each *pyrulum* is affixed by its own distinct pedicle, at first of some length, but gradually shortening as the remainder becomes more globular, or flattens. In a few days, the whole may be compared to the opening bud of a white rose.

"Now the dilatation and collapse of the subject commence; convulsive struggles ensue; four pair of long, rough, muricate organs resembling tentacula, or ciliary processes, are gradually unfolded, and after what seems repeated, severe, and protracted exertions, a perfect animal of great transparence is liberated as a Medusa, suspended amidst the waters.

"This Medusa resembles a large transverse section of an ovoid, not half a line in diameter, the sides of excessive tenuity, the tentacula, or ciliary organs, four or five times as long as the diameter of the ovoid, and quite flexible. I conjectured there might be an orifice in the upper surface, and that some stump or particular organization by which it was penetrated, and remaining behind, the animal, amidst its struggles, was kept in its place. It is the upper surface which is that in application or adhesion, as may be seen of others; the lower portion whence the cilia originate, is meantime free. Here, as we know, the mouth or proboscis of the Medusarian race is situated. In the under surface, four cruciform organs were apparent. But the difficulty of ascertaining relative position is never to be forgot; and, in fact, organs apparently below, in such creatures may be in the middle, or actually above.

"As in some other Medusæ, the ciliary or tentacular organs resemble knotted cords. Each pair originate from a prominent knob or button on the margin of the cavity in the under part; and a black speck, like an eye, is conspicuous at the root of each tentaculum: there are, therefore, eight in all. The transparent convex surface of the animal is crossed by two darker lines at right angles, as if dividing it into quarters, and terminating in the four buttons or knobs on the margin.

"The opacity of this creature, during its earlier stages, is not such as entirely to intercept the light, though its transparence refines in proportion to the evolution of its organization. Thus, the cross lines running from what was conjectured an orifice are discovered to be four vessels, wherein a fluid carries a number of black particles down to the marginal knobs below. It rather appears also, though I could not satisfy myself of the fact, that the current may pass in another course around the margin.

"We should be much deluded, as well as our fellows, in believing that sufficient opportunities are afforded for similar observations by the Medusa free of the zoophyte, and swimming at large. On the contrary, they can be effected only while immaturity yet restrains the animal to its pristine site; and where, during progressive evolution, the microscopical focus can be accurately adjusted for distinct vision. The motion of so restless a being, when liberated, renders correct observation incompatible with that condition.

"One of the pyrula seemed to be united to a hydra, just at the orifice of the twig from which it issued. Circulation manifestly advanced in both. Black particles were carried up as well as down the neck of the former, the pyrulum, and during their descent, a current was obviously conveying black particles up the body of the hydra; something similar seemed to be going on in an isolated pyrulum, where there was no hydra.

* * * * * * *

"The preceding animals originated and disappeared without leaving any traces behind. Indeed the smaller Medusæ never leave anything that I have seen.

"Another species (*Medusa duodecilia*) has sometimes appeared and decayed mysteriously, without affording obvious indications of its origin. This animal occurs in April; the former is developed from June until August. It is an eighth of an inch in diameter, with sixteen long, slender, tentacular, or ciliary organs, disposed in four bundles, which issue from four marginal prominences. At the base of each set is a black speck. The transparence of the Medusa is such, that while suspended in equilibrium in the water it is scarcely perceptible.

"The evolution of the *Medusa ocilia* is progressive, accelerated perhaps by external temperature. It has occurred to me under no other conditions than as above specified. A number of whitish corpuscula seem to be generated rather suddenly among the hydræ, either singly, in pairs, or in clusters of three, four, or five, as already stated. Each is affixed by an independent pedicle, and generally about the orifice of a twig of the zoophyte. One, wherein no subordinate organic parts were visible, on first inspection, was observed to unfold in three hours.

"There is reason to believe that this Medusa is confined in a diaphanous vesicle or involucrum, remaining in its place after the animal has escaped. If actually so, which requires confirmation, we cannot but recognise strict analogy to the vesicles of the Sertularia, some being hardly perceptible after discharging their contents, from extreme transparency.

"A colony, computed at 130 individuals, of the *Medusa ocilia* was produced in four or

five days; and there are grounds for assuming that successive colonies come from the same specimens of the zoophyte.

"I cannot presume to affirm that any connexion, immediate or remote, connects the *Medusa ocilia* and the *Tubularia ramosa;* far less to conclude that the former shall be metamorphosed in progress of time to the latter, with its numerous and beautiful appurtenances. I have not seen both the beginning and the end; nor does the fugitive existence of so delicate a creature seem well adapted for permanent observation. (Dalyell's Rare and Remarkable Animals of Scotland, vol. i, p. 66, pl. XI.)

Genus XVI. Modeeria, Forbes, (1846).

Umbrella globose; radiating vessels four, simple; four marginal tentacles opposite the four simple vessels; ocelli conspicuous; peduncle inflated, balloon-shaped, contracted below, and terminating in four lanceolate lips.

I have dedicated this very distinct genus to Adolph Modeer, a naturalist of no mean eminence, whose name has hitherto remained without such association in zoology. No one has a juster right to preside over a good genus of Medusa than Modeer, since to him we owe the first attempt of any value towards systematising the knowledge of the tribe acquired up to his time. This is contained in the twelfth volume of the 'New Transactions of the Swedish Royal Academy,' published in 1791, and is a very elaborate and masterly treatise for its day. The author was a Swede. He was a man of considerable and varied acquirements, and brought a mind exercised in comprehensive and practical thought, to bear beneficially upon natural history. As secretary to the Patriotic Society of Stockholm, he worked advantageously for the benefit of his native country, especially directing his attention towards the improvement of its agriculture and industrial arts. He wrote a 'History of the Commerce of Sweden,' and was the author of a 'Bibliotheca Helminthologia,' published at Erlangen in 1776. He died at the age of 60, in 1799.

Modeeria formosa, Forbes.

Plate VII, Fig. 1.

The largest objects are not always the most beautiful. Little diamonds may sparkle brighter than the monster gems of a regal crown. There is not a Medusa in all the ocean which can match for beauty with the minute creature now before us, though its smallness is such, that a split pea would overtop it. Yet small though it be, it has shape, colour, and substance so disposed, that as yet no explorer of the sea has met with another like it. It is gorgeous enough to be the diadem of the smallest of sea-fairies, and sufficiently graceful to be the nightcap of the tiniest and prettiest of mermaidens.

The umbrella is globular, or slightly elliptical, smooth, and transparent. Its inner margin is bordered by a membranous veil. On the outer edge are four conspicuous tubercles, each

with two crimson lateral pads, and an ocellus of the same colour between them. From each springs a tentacle, long, translucent, slender, curling, pale, or colourless. Centrally on the margin, between each pair of tentacles, is a smaller tubercle ocellated with crimson, but bearing no tentacle. On each side of this are three colourless tubercles, all very small, but the central one slightly larger than the others. The marginal vessel is rather large and conspicuous. The sub-umbrella occupies about two thirds of the umbrella, and is slightly conic in form. From its centre hangs an ample balloon-shaped peduncle, obsoletely four-lobed, the lobes of a brilliant crimson hue, the interspaces yellowish-white. I think it probable that the young are produced by gemmation from the crimson spaces. The peduncle terminates in a contracted neck, widening into a campanulate mouth, with four, rather short, lanceolate lips. This orifice is white, with four crimson lines. The peduncle sometimes contracts into a distinctly four-lobed form, and the lips are then more distinct than usual.

The *Modeeria formosa* was taken by Mr. M'Andrew and myself off Mull, in the Hebrides, during the autumn of 1845.

Plate VII, fig. 1, *a*, represents it of the natural size; 1, *b*, magnified; 1, *c*, seen from above; 1, *d*, the stomach or peduncle contracted; a slight inequality of the ovarian lobes may be observed; 1, *e*, a portion of the crimson bands of the peduncle much magnified, showing the structure of the supposed germinal membrane 1, *f*, two of the tentacles, and the tubercles of the interspace (by mistake the small tubercles are represented as too few by four); 1, *g*, structure of a tentacle and its bulb.

Genus XVII. Euphysa, Forbes.

Umbrella globose, inflated; ovaries in the base of a flask-shaped peduncle, with a simple orifice at the end of a proboscidiform stomach; vessels four, simple, joining the gastric vessel opposite four conspicuous ocellated tubercles, from each of which arises a short, slender, recurved cirrus, and from one a supplementary large tentacle.

Euphysa aurata, Forbes.

Plate XIII, Fig. 3.

I have constituted this genus for the reception of a very beautiful little Medusa taken in 1835, in Brassay Sound, Zetland. At first I included it in my genus *Steenstrupia*, and it is one of the three species of that group announced at the meeting of the British Association at Southampton. But although bearing a close affinity with *Steenstrupia* through the arrangement of its tentacles, and the form of the stomach, it presents characters, such as the construction of the umbrella, the presence of conspicuous ovaries, the absence of an apical appendage, and the freedom of its lesser tentacles, which must be regarded as generic. It is indeed evidently of higher rank in the series than *Steenstrupia*, which, we shall presently see, has many of the features of a rudimentary animal, a stage in the metamorphoses of some creature in a different order.

The *Euphysa aurata* has a smooth, inflated, globose, transparent umbrella. The orifice is rather contracted, and square. At each of the four angles is a large diamond-shaped ocellus, the upper half of which is bright golden yellow, and the lower vivid scarlet or crimson. From each of the ocelli springs a short, reflexed, cylindrical, yellow tentacle, which I have never seen to extend itself. From one of the ocelli, below the short tentacle, arises a long and thick one, highly extensile, and of a golden colour, usually presenting a club-like shape. The smaller and larger tentacles are identical in structure. A marginal vessel and veil bounds the opening of the umbrella. The peduncle is flask-shaped, the neck of the flask being the stomach, and terminating in a contracted, simple, round opening, which I never saw protruded beyond the disk, though often moved about in various directions; the walls of the peduncle are apparently banded with motor tissue. The orifice of the stomach is tinged with red. The remainder is yellow, with four slightly-marked tawny bands on its lower part. Within the centre, and at the base of the peduncle, is a pyramidal cluster of reproductive cells, constituting the ovary. The size of the body scarcely exceeds one sixth of an inch. It is an active and lively little animal.

Plate XIII, fig. 3, *a*, represents it of the natural size; 3, *b*, magnified; 3, *c*, is one of the smaller tentacles and ocellus; 3, *d*, the same seen in front; 3, *f*, the extremity of the larger tentacle; 3, *e*, the peduncle and ovaries as seen under compression.

Genus XVIII. Steenstrupia, Forbes (1846).

Umbrella conical, apiculate; apex connected by a cord with the sub-umbrella; four marginal elongated glands opposite the four simple radiating vessels; a single tentacle developed from one of the glands only; peduncle proboscidiform, with a simple round orifice.

Whatever may be thought of the other genera of *Sarsiadeæ*, there can be no question that this is intimately related to zoophytes of the hydroid order, and is, in all probability, an intermediate stage. Yet animals, so singular and significant as those which I have brought under *Steenstrupia*, cannot be left unnamed until their larva or final conditions, as the case may prove, be determined. Nor, I trust, will the illustrious naturalist of Denmark, in honour of whose genius I have ventured to designate the group, disdain it, even though it prove to be only provisional, since whatever may become its eventual rank, in all probability the creatures it includes will yield valuable illustrations of the ingenious and important theory which he first presented in definite shape.

Indeed several of the figures which Steenstrup has given in the first plate of his 'Essay on the Alternation of Generations,' representing the hydroid polype *Coryne fritillaria*, and those in the first plate of Sars's 'Beskrivelser, &c.' delineating the gemmules of that exquisitely beautiful zoophyte, the *Corymorpha nutans*, bear so close a resemblance to the two forms of *Medusæ* which I am about to describe, that I can scarcely doubt their close affinity. It is not impossible that my *Steenstrupia rubra* may eventually prove to be the full-grown medusoid of the *Corymorpha*,—a supposition rendered the more probable by the

circumstances that both animals as yet have been found only in the Zetland and Orkney seas, where that giant zoophyte was first enrolled among British species by Professor Goodsir and myself, in 1839. The specimens taken by us had, however, their buds too immature to permit of our perceiving the close resemblance and affinity of those bodies to true Medusæ. The apical process, which is so striking a feature of the following animals, is almost certainly the remains of a funiculus by which the young animals were attached to its parent—but whether that parent was a "nurse," guised as a hydriform *Coryne*, or a Medusa, like the offspring, as we have seen to be the case in the gemmiparous *Sarsiæ* and *Lizziæ*, is a point which fortunate future observations only can determine.

1. *Steenstrupia rubra*, Forbes.

Plate XIII, Fig. 1.

The umbrella of this strange little Medusæ is conical, rather elongated, transparent, smooth, and colourless. Its summit bears a little tentacle-like, fleshy, red appendage. Its orifice is rather contracted and quadrangular. At each angle there is an elongated, slanting, tentacle-like ocellus, fixed throughout, and terminating above in a bulb. This body is entirely of a vermilion red. From the side and lowest part of one of them springs a very long, thick, fleshy, bright-red tentacle, which twists and coils like a worm, and under the microscope, presents a ringed and granulated structure. The sub-umbrella is oblong. It is comparted by four simple gastric vessels, running to the tentacular bulbs. Its orifice is surrounded by a veil. From its centre depends a thick, tubular, very contractile, fleshy, red peduncle, terminating in a round or imperfectly quadrate mouth. This peduncle is capable of great changes of form, and sometimes presents an appearance as if it had a nucleus denser than the substance composing its walls. Though highly extensile, it does not appear even to be voluntarily produced beyond the opening of the disk. Its base is connected with the little finger-like process on the apex of the umbrella, by a rather tortuous colourless cord, presenting a tubular appearance.

The length of the body is about a line and a half. Small as this Medusa is, it is very conspicuous in the water, owing to the brilliant colouring and fleshy substance of its tentacles and stomach. It is very active and tenacious of life; before dying, assuming all manner of strange shapes, doubling itself up, and turning its organs inside out in a terrific manner, giving up the ghost with convulsions as fearful as those of a popular actor in the death-scene of a tragedy. One of the least strange of these moribund attitudes is represented in Plate XIII, fig. 1, *d*, where the creature has constricted its body so as to assume the aspect of some twin Acaleph, such as *Diphyes*. At such times, if we had not seen the animal previously in a healthy state, it was very difficult to perceive any resemblance between it and the other genera of its family. But when well and uninjured, it is an extremely active and regularly formed creature, though, owing to the weighty and unbalanced tail which it is doomed perpetually to drag as its train, it cannot advance through the water with the easy grace and rapidity for which its allies are remarkable, but struggles forward with frantic energy, contracting and expanding rapidly, and without ceasing, reminding us of an escaped felon impeded in his course by the dragging of his heavy fetters. When I first saw how the weight and

one-sidedness of the simple tentacle arrested the motions of this *Steenstrupia*, I fancied that the animals before me had by accident been deprived of their corresponding marginal appendages. But among hundreds of specimens secured in the bays of both sides of Zetland, there was never the slightest sign of a symmetrical arrangement by the development of more tentacles than one.

Plate XIII, fig. 1, *a*, represents *Steenstrupia rubra* of the natural size; 1, *b*, magnified, as seen in profile; 1, *c*, the arrangement of tentacular bulbs and tentacle, as seen from below; 1, *d*, the distorted specimen noticed above; 1, *e*, structure of the tentacle when very much elongated; and 1, *f*, its usual appearance when contracted.

2. *Steenstrupia flaveola*, Forbes.

Plate XIII, Fig. 2.

Umbrella conical, mitrate, transparent, colourless, not exceeding a line in length. Its summit is produced into a mucronated termination, which, though transparent and colourless, appears to be of a different tissue from the rest of the disk, which, besides, is quite smooth, whilst the apex is as if pilose. The margin is contracted as in the last species, and quadrangular, each angle bearing a similar elongated ocellus or tentacle-bulb, in this instance of a fawn yellow colour. One only of these bulbs gives origin to a tentacle, very slender, long, and moniliformly granulated. From the summit of the sub-umbrella, a cord or tube runs to the apex. Its sides are marked by four simple, radiating vessels. The peduncle is very changeable in form: sometimes contracting into a very short, thick, quadrate mass; at others, assuming the shape of that of *Sarsia*, but not protruding beyond the disk. It is also of a pale yellowish, fawn colour. The mouth has no produced lips.

This singular little animal was taken in Penzance Bay towards the close of August, 1846. Plate XIII, fig. 2, *a*, represents it of the natural size; 2, *b*, magnified, its peduncle contracted; 2, *c*, with the peduncle extended; 2, *d*, the apex of the umbrella; 2, *e*, one of the tentacle bulbs.

Having now enumerated and described those naked-eyed Medusæ, which have come under my notice* in the British seas, I shall proceed to offer a few remarks on their systematic relations with other animals of their class, and on the affinities of the Pulmograde Acalephæ, with the members of other sections of Radiata. But before I do so, I think it best for the convenience of my readers to enumerate very briefly the higher or Steganopthalmatous Pulmograda, known to me as inhabiting our coasts, in the hope of directing attention to the study of the larger species, which afford fine materials for original research. I look forward at some future time to describe and figure them in a companion Monograph to this, but require many more observations and drawings before that can be done in a satisfactory manner.

Being so much larger than the subjects of this volume, they are much more familiar to frequenters of the sea-side; and as several of the species are gregarious and very generally distributed, they present good opportunities for the acquirement of a knowledge of the structure of Medusæ in general. Every person who has been in a boat on a calm day, or looked over the side of one of our harbours when the tide was flowing in summer, must have seen large transparent gelatinous disks, with fringed margins, contracting and expanding, making their way beneath the surface of the water. All who have walked much along the wet sands when the tide is out, must have met with great pads of transparent jelly, marked in the centre with purple circles, or edged and rayed with brown. The latter, when handled, sting severely; the former are harmless. They are the two most common kinds of covered-eyed Medusæ, members of the genera *Aurelia* and *Cyanæa*. The following brief notices will enable the reader to distinguish between our native species of *Pulmograda Gymnopthalmata*.

Genus Aurelia, Peron. Medusa, Eschscholtz.

1. To this genus belongs the commonest of our native species, the *Aurelia aurita*, a hemispherical, translucent, bluish, gelatinous disk, margined with a close fringe of fine filiform tentacula, interspersed at eight points by as many ocelli, each composed of an egg-shaped, pedunculated, black body, with a red speck above it. The sub-umbrella is marked by numerous radiating vessels, dichotomously dividing and most of them anastomosing in their course towards the margin. Sometimes these vessels present a deep purple hue, and then we have the spurious species *Aurelia lineolata* of Peron, *A. radiolata* of Lamarck, and *Medusa purpurata* of Pennant. Borlase first noticed this variety, and correctly considered it such, and not distinct from the ordinary form. Four long arms, with membranous and fringed edges, spring from the centre of the sub-umbrella. In the middle of them is the mouth. In particular states of the animal, the fringes and margins of the arms serve as marsupia for the eggs. Between each pair of arms is a raised cartilaginous tubercle, with an

* Notices of doubtful or imperfectly described forms, will be found in the Bibliographical Appendix.

opening at its inner side entering the cavities of the body in which we find the ovaries. These are four in number, shaped like horse-shoes or half-moons, of a bright purple colour. They are the four purple crescent-like marks which shine through the disk of the jelly fish as we see them swimming in the water. In some monstrous varieties they become united, and form a circle round the disk, or are multiplied, or, more rarely, aborted. The disk often measures nearly a foot across. It is very minutely granulated; when more coarsely so than usual, we have the variety which has been called *A. granulata.* The specific names *rosea, Surirea, lineolata, radiolata, purpurata,* are all so many synonyms of the *Aurelia aurita;* and, judging from the description, the *Biblis Aquitaniæ* of Lesson was, in all probability, nothing more than this common Medusa cast high and dry on the sands! It is everywhere abundant around our coasts, and sometimes occurs in vast numbers, impeding the course of boats through the water. Figures of it may be found in the Zoologia Danica, in the Berlin Transactions for 1837, and in the commemorative edition of the Règne Animal.

2. A second species of *Aurelia,* for which I propose to retain the name *Campanula,* occurs abundantly in Southampton water, and some other confined localities. It appears to be the *Medusa campanula* of Otho Fabricius, and is a much more delicate animal than the *Aurelia aurita,* differing from it also in size, proportions, and ocelli. The umbrella is much more shallow, and never attains one fourth of the dimensions. The margin and arms are fringed with white tentacles, so that when the animal is seen in the water it appears as if conspicuously marked by a white cross. The ovaries are of a pale or tawny purple. The egg-shaped bodies of the ocelli are white, with a red spot above. This is probably the *Medusa cruciata* of some authors. There is no figure of it published.

Genus Pelagia, Peron and Lesueur.

3. Until the autumn of 1826, no example of *Pelagia* had occurred in the British seas; in August of that year, several specimens of the *Pelagia cyanella,* one of the most beautiful and phosphorescent Medusæ of the Atlantic, were taken by Mr. M'Andrew and myself, off the coast of Cornwall. The disk is sub-globose, and measures nearly three inches across. It is tinged with a rich rose colour, and is speckled over, especially at the sides, by small orange warts. Its margin is scalloped into sixteen lobes, from beneath eight of which spring as many highly contractile, purple, tubular tentacula, and in the notches of the other six, are eight red, protected, pedunculated ocelli. From the centre of the sub-umbrella hangs a thick peduncle, which soon divides into four lanceolate, winged and furbelowed, rose-coloured, orange-spotted arms, nearly four inches in length. Around the bases of the arms are the openings above the four purple ovaries. A full description and figure of this beautiful species, will be found in the Annals of Natural History, vol. xix, p. 390, pl. 9, fig. 5.

When the *Pelagia* phosphoresces, it seems like a great globe of fire in the water, an appearance familiar to those who have sailed on the coast of Italy, where animals of this genus are common.

Genus Chrysaora, Peron.

4. The *Medusa fusca* and *M. tuberculata* of Pennant, described by him after Borlase, are varieties of the animal called *Medusa hysoscella* by Linnæus, and belong to the genus *Chrysaora* of Peron. The umbrella is hemispherical and expanded; its margin is festooned, and furnished with more than eight tentacula. The arms beneath are long, simple, and all separate; the mouth is centrally in the midst of their bases. Four openings conduct to the ovaries. Our British species has a yellowish or reddish disk, marked with more or less distinct pale rays, and often spotted with brown at the margin. It attains considerable dimensions. It varies much; Peron constituted seven spurious species out of its varieties. A good figure after an original drawing by Milne Edwards, may be found in the commemorative edition of Cuvier's Règne Animal.

Genus Rhizostoma, Cuvier.

5. The *Rhizostoma pulmo* (*R. Aldrovandi* and *Cuvieri* of Peron) is one of the largest of European Medusæ, its disk growing to two feet, or even more, across. The umbrella is hemispherical, thick, and of a bluish hue, scalloped at the margin. Beneath is a thick peduncle, dividing into eight, long, tapering arms. At their bases are great, fringed, ovarian lobes, tinted with yellow and purple. It is usually stated to be plentiful on the English shores, but I have seldom met with it.

Genus Cassiopea, Peron.

6. The *Medusa lunulata* of Pennant, *Urtica marina octopedalis* of Borlase, is a species of *Cassiopea*. It is the *Cassiopea Borlasea* of Peron, and *C. rhizostomoidea* of Tilesius. The disk is large, wide, depressed, and campanulate; the margin scalloped, but not tentaculated. There are eight ovaries below, opening by as many orifices, and eight pinnated arms with furbelowed appendages at their bases. A good figure of this species is given by Tilesius, in the Act. Acad. Nat. Cur. vol. xv, pl. 71. It is named on the plate *C. anglica*.

Genus Cyanæa, Peron.

7. Next to the *Aurelia aurita*, the commonest Medusa of our seas, is the large *Cyanæa capillata*, formidable on account of its stinging power. The disk is wide, and nearly flat, of a pale yellow or tawny colour, deeply scalloped at the margin into sixteen quadrate lobes, between each pair of which, in a deep notch, is a conspicuous pedunculated ocellus. Eight brownish rays proceed towards these ocelli, from a circle of reticulated, quadrate, brown markings, giving the whole disk a beautifully stellate appearance, depending on the arrangement

of the organs on the sub-umbrella, which is furnished with long, plicated, and furbelowed membranous arms, and fasciculi of extremely extensile, stinging, filamentary tentacles. The varieties of this *Cyanea* have been made into numerous spurious species by Peron.

8. *Cyanæa Lamarckii*, Peron. Not quite so common as the last, though very frequent in the Irish sea. It is easily distinguished by its more convex disk, of a deep ferruginous hue in the centre, and divided at the margin into eight four-lobed triangular lobes, the eye notches at their apices. The ovaries are of a rose colour. It stings equally severely with *C. capillata*. Better figures of both these Medusa are wanted. For one of the former, the memoir of Gaede, in the 'Bonn Transactions,' may be consulted; the latter is represented in the 92d plate of the 'Encyclopédie Méthodique, Vers' (copied from Dicquemare).

All the genera and species of higher Pulmograda are distinguished from the lower forms, to the description of which this treatise is devoted, by a much greater complexity of structure, especially in the vascular system and organs of sense, and also in the arrangements of the reproductive system. The vessels branch and anastomose; the ocelli are protected by complicated coverings, and are themselves of more perfect organization; the generative glands are more highly developed in the *Steganopthalmata* than in the *Gymnopthalmata*. We have no instance of the Medusa or perfect state of the former propagating itself by gemmation, whilst such a mode of procreation occurs in several cases, as we have seen, among the latter. Taking one character with another, then, we cannot doubt that the *Pulmograda Steganopthalmata* are higher in the series than the *Pulmograda Gymnopthalmata*. This is borne out by an examination of the phases of development and metamorphosis of the larva in the latter. The observations of Sars, Dalyell, Reid, and Steenstrup indicate that the early stages of the *Aureliæ* and *Cyaneæ*, correspond closely structurally with the perfect condition of the naked-eyed Pulmogrades.

Hitherto the genera of these two very distinct, yet proximate, tribes have been grouped together, without much respect to their natural affinities or serial order. Among the more important attempts at arrangement of the Acalephæ, are the systems of Peron and Lesueur, of Lamarck, Eschscholtz, Cuvier, Blainville, Brandt, and Lesson. In the first of these, all the *Pulmograda* are grouped under two tribes, termed *agastric* and *gastric*, the latter being subdivided into *monostomous* and *polystomous*. Such a division is founded on a complete misapprehension—one which prevailed generally among zoologists, until Milne Edwards carefully examined the anatomy of *Carybdea marsupialis*, which, however, in the arrangement under consideration, was placed in the gastric division, owing to the naturalists who proposed it having mistaken the whole concavity of the sub-umbrella for a stomach! *Geryonia* was, on the contrary, enumerated among agastric genera, the nature of the true stomach, situated at the extremity of the peduncle in that group not having been recognised. We find *Oceania*, which included a heterogeneous assemblage of naked-eyed species, placed side by side with *Pelagia*, in a division of the Monostomous Gastric Medusæ. The greater number

of the Steganopthalmata are included in the Polystomous section, and the association as a natural assemblage indistinctly recognised.

The arrangement of Lamarck was no better than that of Peron and Lesueur, and, in some of the details, inferior, as for instance, in the comprising of the species of *Pelagia* in his genus *Dianæa*, associated with numerous forms of *Geryonidæ*. All the *Pulmograda* were grouped under two great sections, the one characterised by a single mouth, the other by the presence of several mouths; Lamarck, like Peron, having mistaken the ovarian orifices in certain Steganopthalmatous species for so many digestive openings.

Eschscholtz, whilst he greatly improved, through his personal experience of the Medusæ, the generic and specific arrangements, went astray as widely as his predecessors when he attempted their classification. For, as we have already seen, he mistook the ovaries in many genera for appendages of the digestive system, and regarded such forms as constituting a great cryptogamic section. Hence he divides all his *Discophoræ*—a happily chosen term by which he designates the *Pulmograda*—under *Discophoræ phanerocarpæ* and *Discophoræ cryptocarpæ*. But though this was a classification based on false notions of structure, so true was Eschscholtz's perception of the natural affinities of the genera, that the covered-eyed forms are all assembled under his first division, and the naked-eyed under the second. His minor groups are generally very excellent, though throughout all their characters the great mistake just mentioned prevails, and consequently nullifies them.

Cuvier assembled all the Pulmograda in the section of *Acalephæ*, which he termed "Méduses Propres," dividing it into five groups, of which the first, "les Equorées," is characterised by the presence of a simple short mouth, without tentacula; the second, "les Pélagies," by the mouth being prolonged into a peduncle, which becomes divided into arms: the third, "les Cyanées," in which the mouth is central, and there are four lateral ovaries; the fourth, "les Rhizostomes," in which there is no conspicuous mouth, nourishment being derived through the ramifications of the peduncle, the ovaries four or more; and the fifth, "les Astomes," without central mouth, or ramified peduncle, or distinct cavities for the ovaries. His first and last tribes included the naked-eyed species. The whole arrangement is a mistake, founded on misapprehension of the value of characters in the order. The groups are neither natural nor of equal systematic value. The classifications of Peron and of Eschscholtz, though founded on mistakes as great, if not greater, are much superior to those of Cuvier and Lamarck, doubtless owing to the superior practical acquaintance of the former naturalists with the objects under arrangement. Cuvier's personal knowledge of the Discophoræ seems to have been limited to two or three of the higher species; Lamarck had probably no experience in this tribe. Peron, Lesueur, and Eschscholtz had observed and studied numerous forms in the living state, and consequently, though of inferior order of mind to the former great naturalists, came nearer the truth in their systems, because their knowledge was sound and practical, and not gained at second-hand.

The arrangement of the *Pulmograda* proposed by De Blainville, is likewise the result of book-study, and not of sea-research, and is consequently objectionable. He divides them

into simple, tentaculate, sub-proboscidean, proboscidean, and branched. In the last section are assembled the covered-eyed species. The juxtaposition of *Æquorea* and *Obelia* in the second section, of *Thaumantias* and *Conis* in the third, and of *Hippocrene* and *Dianæa* in the fourth, are instances of the unnatural way in which the genera are distributed in this otherwise ingenious system.

Brandt, who appears to have founded his studies among Medusæ chiefly upon the drawings and notes of Mertens, divided the *Discophoræ* into Monostomous and Polystomous, subdividing the former into *Oceanidæ*, in which we find *Circe* and *Conis* placed together, *Æquoridæ* and *Medusidæ*, the latter including the covered-eyed species very naturally assembled, except the *Rhizostomidæ*, which, along with the *Geryonidæ* (in which tribe he includes *Hippocrene*), constitute the polystomous section; so that it is evident this eminent author did not clearly perceive the affinities of the several groups.

Lesson, who, besides an extensive acquaintance with living forms, had the advantage of being last in the field, arranged the *Discophoræ* under four groups: 1st, "*Les Méduses non-proboscidées*," in which we find several families, including genera, juxtaposed, having no immediate affinity; 2d, "*Les Océanides ou Méduses vrais*," including *Æquorea* and its allies, with a heterogeneous assemblage of forms in the genus *Oceania*; 3d, "*Méduses agaricines ou proboscidées*"—here are *Sarsia*, *Dianæa*, *Geryonia*, *Tima*, *Thaumantias*, &c., the group being in the main equal to my *Geryonidæ*, though some genera, as *Saphenia*, are brought into it far away from their fellows; and 4th, "*Méduses à pédoncule central ou Rhizostomées*," consisting entirely of the covered-eyed species, much more naturally assembled together than in any of the preceding classifications, except those of Peron and Eschscholtz, a personal familiarity with the objects he describes, having led Lesson, as it did them, to similar arrangements of the more conspicuous tribes.

All the authors I have just cited, regard the *Discophoræ*, or *Pulmograda*, as a separate division of the *Acalephæ*, or *Arachnodermata*, the whole class being distinct from the *Zoophyta*. Recent discoveries, however, would go far to show that such a separation is unnatural, and that the hydroid Zoophytes, at least, are very closely allied, if not belonging, to the same natural order with the Pulmograde Medusæ.

On the side of the Zoophyta, the facts bearing on this question have been chiefly derived from the families *Corynidæ*, *Tubulariadæ*, and the genus *Campanularia*. More than a century ago, when the nature of Zoophytes, whether animal or vegetable, was under discussion, Bernard de Jussieu, who pronounced rightly for their animal origin, described certain little round, red, pedunculated bodies, encircling the head of the *Tubularia*. Nearly half a century after, Otto Frederic Muller observed similar bodies around the head of the *Coryne*, and maintained that they were eggs, and for an equal period this view of their nature was generally received. In the year 1833, Professor Rudolph Wagner gave an account* of the production of medusiform bodies in a Zoophyte of the Adriatic, the *Coryne aculeata*, which bodies he regarded as the young of the animal, although they themselves contained

* In Oken's Isis, for 1833.

eggs. In 1835, Sars represented medusiform bodies similarly produced, from the bases of the tentacula of the *Corymorpha nutans;* in this case the Medusoids closely resembled *Steenstrupia.** In the same year, Dr. Loven observed the formation of Medusoids on the *Syncoryne*, the animals produced being very similar to Medusæ of the genus *Sarsia*. About the same time, Sir John Graham Dalyell described the formation of Medusa-like buds on *Tubularia*. In 1840, Professor Steenstrup, when in Iceland, found a polype, which he named *Coryne fritillaria*, from whose head bell-shaped bodies, closely resembling our *Steenstrupiæ* in form, hang, and were regarded by him as individual animals.† In 1843, M. F. Dujardin communicated to the 'Annales des Sciences Naturelles' a short but interesting paper, "On a New Genus of Médusaires, proceeding from the Metamorphosis of *Syncoryne*." He calls the parent animal *Stauridia*, and the medusoid, which he saw detach itself and swim away, *Cladonema*. He remarks, that it is closely allied to the genera *Oceania*, *Thaumantias*, and *Cytæis*. In 1844, Professor van Beneden, of Louvain, published his 'Researches on the Embryogeny of the Tubulariæ;' and in his memoir described and figured medusiform-bodies produced from species of *Tubularia*, *Eudendrium*, and *Syncoryna*. Those of the last-named genus resembled *Sarsiæ;* those of the two former had close affinities with *Lizzia*, especially the medusoid of *Eudendrium*. In 1846, Sars, in his 'Fauna Littoralis Norwegiæ,' figured the medusoids of *Syncoryna Sarsii*, *Podocoryna carnea*, and *Perigonymus muscoides*, all closely resembling *Sarsiæ*. That of the *Podocoryna* comes very near the *Medusa papillata* figured by Abildgaard in the 'Zoologia Danica.'

Similar observations have been made, from time to time, on the *Campanulariæ*. Ellis appears to have been the first to notice the productions of Medusoids in that tribe, though he evidently did not understand what he saw. In 1834, Mr. Lister communicated his valuable microscopic observations on Zoophytes to the Royal Society, and in his paper describes and figures Medusa-like animals in course of production from *Campanulariæ*. In 1836, Sir John Graham Dalyell distinctly proved and made known the production from *Campanulariæ* of free animals like true Medusæ. He named the creature "Animalculum tintinnabulum."‡ In 1839, Nordman announced his observation of the free Medusa condition of young *Campanulariæ*.§ In 1843, Van Beneden, in his 'Memoirs on the Campanulariæ of the Coast of Ostend,' entered into full details on the subject. The figure which he gives of the medusoids in this tribe reminds us strikingly of *Tima* and *Geryonia*. He remarks that the *Medusa marina* of Slabber, the type of the genus *Obelia* of Peron and Lesueur, is a young *Campanularia*. During the same year, similar phenomena were observed by Kölliker.

Various interpretations were offered of these phenomena. Many zoologists followed Muller, and regarded them as eggs. Others held them to be gemmules. Ehrenberg put forth the strange theory that they were female polypes, a view supported by Löven and Krohn. Van Beneden considered them young budding polypes, a notion held previously by

* Besk. og Jagt., pl. 1, fig. 3, *g*, 3, *f*.

† Steenstrup, Alternation of Generations, Mr. Busk's Translation, p. 27, pl. 1, fig. 41-3. (Ray Society.)

‡ Ed. New. Phil. Journ., vol. xxi.

§ Comptes Rendus, 1839.

Dalyell, and supported by Kölliker. Dr. Johnston maintained the same view of their nature. Steenstrup struck out a most original and distinct speculation, holding them to be alternate generations, produced by gemmation from a dissimilar parent, and producing eggs from which should spring dissimilar children.

In all instances where a Medusa has been observed originating from a hydroid polype, the new animal bears the closest resemblance to a naked-eyed Medusa,—a resemblance not merely of external form, but also of internal structure. Indeed, in many cases it would be impossible to draw a line between the two.

Is it desirable to draw such a line? Are not the so-called Zoophytes and Medusæ animals of the same section? Discoveries exactly comparable, and still more wonderful, have shown that the higher Medusæ themselves afford instances of parallel phenomena. We now know for certain—all the stages of the history having been demonstrated—through the researches of Sars, Dalyell, Siebold, Steenstrup, Price, and Reid, that the ova of the covered-eyed Medusæ, belonging to the genera *Aurelia, Chrysaora,* and *Cyanæa*, give rise to polypoid animals, which in their turn originate individual Medusæ by fission—or, more properly, as Dr. Carpenter has well suggested, by a peculiar process of gemmation. The higher genera of *Discophoræ*, therefore, are closely linked, anatomically and physiologically, with the *Anthozoa hydroida* among the polypes. Assuredly any separation of such nearly allied animals, especially the placing of them in different classes, is exceedingly unnatural.

In what light are we to regard the relationship between the Medusa and the Polype? The one is not the larva of the other, as often improperly said, because there is no metamorphosis of the one into the other. The first is the parent of the last, and the last of the first, but neither is a stage of an individual's existence destined to begin life as a Medusa and end it a Polype, and vice versâ. The notion that the Medusoid of the *Campanularia*, or *Coryne*, or *Tubularia*, fixes itself, and changes into the typical forms of those zoophytic groups, is as inadmissible as the supposition that the hydroid product of the *Aurelia* is metamorphosed into a Medusa of that genus. Facts show that such is not the case. These facts may be summed, in the abstract, in the following formulæ:—

1st. *The case of Tubularia and Campanularia.*

a. The medusoid produces eggs.
b. The eggs produce infusoria.
c. The infusoria fix and become polypidoms.
d. The polypes of these polypidoms produce medusoids.

2d. *The case of Aurelia, &c.*

a. The medusa produces eggs.
b. The eggs produce infusoria.
c. The infusoria fix and become hydroid polypes.
d. The hydroid polypes produce medusæ by gemmation.

3d. *The case of Coryne, &c.*

a. The zoophyte produces medusæ by gemmation.
b. The medusæ produce eggs.
c. The eggs produce infusoria.
d. The infusoria fix and become zoophytes.

4th. *The case of Lizzia and Sarsia.*

a. The medusa produces medusæ by gemmation.
(The remaining stages as yet unobserved, but probably)—
b. The medusæ produce eggs.
c. The eggs produce infusoria.
d. The infusoria fix as polypes, and produce medusæ.

With such facts—unquestioned facts—before us, it seems to me that we have no choice between theories, and that we must admit the idea of "Alternation of Generations" to be true. Steenstrup was assuredly the first naturalist who announced that idea as a *general fact dependent on a law.* "The special subject of this Essay"—I quote from the author's preface to the German version of his celebrated work, as translated by Mr. Busk—"is the fundamental idea expressed by the words '*Alternation of Generations*,' or the remarkable, and till now inexplicable, natural phenomenon of an animal producing an offspring, which at no time resembles its parent, but which, on the other hand, itself brings forth a progeny, which returns in its form and nature to the parent animal, so that the maternal animal does not meet with its resemblance in its own brood, but in its descendants of the second, third, or fourth degree of generation; and this always takes place in the different animals which exhibit the phenomena in a *determinate* generation, or with the intervention of a *determinate* number of generations. This remarkable *precedence* of one or more generations, whose function it is, as it were, to prepare the way for the later succeeding generation of animals destined to attain a higher degree of perfection, and which are developed into the form of the mother, and propagate the species by means of ova, can, I believe, be demonstrated in not a few instances in the animal kingdom."

The main position thus stated appears to me sound and true: the assumption of a definite regularity in the alternations is a secondary and non-essential one, and true probably when disturbing conditions are not at work. But numerous observations, especially those of Dalyell,* Reid,† and Price,‡ show that under peculiar circumstances, in what may be termed unnatural situations, the polype generations may go on continually producing polype generations; and those of Sars and myself, on the other hand, that a Medusa generation may go on producing Medusa generations; although, under normal conditions in each instance, there is every reason to suppose that zoophytic and Medusoid forms would have regularly alternated.

I am anxious to bear testimony to the value of the idea enunciated by Steenstrup, because I believe it has given a strong impulse in a right direction to Invertebrate Zoology.

* Remarkable Animals of Scotland.
† Annals of Nat. Hist., Second Series, vol. i.
‡ British Association Report, 1846, p. 86.

It is not a vague generalization founded merely on book-reading, but an induction interpreted by a naturalist combining the philosophic spirit with the requisite observing power,—equally capable of, and practised in, minute specific research and speculative studies. The Ray Society did great service to British science when it sent out a translation of the remarkable essay alluded to under the able superintendence of Mr. Busk. This, I am sure, the most severe critic upon Steenstrup who has yet appeared—my distinguished and learned friend Dr. Carpenter—would be the first to admit, and it were greatly to be desired that some other critics on the publications of our Society had a tithe of his knowledge, reasoning power, and gentlemanly spirit.

In a review, "on the Development and Metamorphoses of Zoophytes,"* devoted chiefly and most honorably to rendering justice to the untiring labours of Sir John Graham Dalyell, the worthy representative of Spallanzani among living naturalists, Dr. Carpenter has opposed in strong terms the views of Steenstrup, and, it seems to me, has not done justice—unintentionally without doubt—to the labours and theory of the Danish naturalist.

Thus the omission *in limine* of the name of Steenstrup† in the list ("Sars, Siebold, Loven, and Van Beneden") of principal practical continental observers of the phenomena upon which the theory of that author, and the new interpretation proposed by Dr. Carpenter, are based, is not right, since it conveys the impression to the reader that the Danish zoologist theorized on this subject from the researches of others only; whereas, in reality, some of the most valuable observations on the polypiform transformations, were those made by Steenstrup himself, detailed in the second chapter of his Essay—that on the "development of the claviform polypes." In fact, so far as the subject of this Monograph is concerned, the observations referred to, and those of Dujardin (whose name has also been inadvertently omitted by the reviewer), are more important than any others in establishing the affinity of the naked-eyed Medusa with the Corynoid Polypes. Moreover, the discoveries and researches among the Entozoa, announced in the 'Essay on the Alternation of Generations,' are the fruits of its author's special observation, and among the strongest pillars of the edifice which he has built. Let not any one suppose, then, that Steenstrup ingeniously constructed a mere closet-theory. I doubt much whether any hypothesis or theory in natural history of any value in fostering the progress of the science—and may it not be said, too, of other sciences of observation?—was ever eliminated, otherwise than as a dim dream,—dimmer to its author often, than even to other men,—by any one not a practical worker in the field where he would raise his speculations; not merely an occasional visitor, but a day-labourer in science. Goethe has been cited as an objection, but Goethe himself would have rejected with indignation the reputation of being a discoverer of laws in natural history, without having undergone a severe apprenticeship of practical study. The great poet who so clearly enunciated the morphology of the vegetable individual (unaware of the previous and clear, though premature as to time, announcement of the law by Linnæus), and attempted to work out a like idea in the vertebrate skeleton, warmly contended that the doctrines he put forth were not sudden inspirations and lucky guesses, but the results of long continued and laborious study. The names which shine brightest in our science for their elucidation of its philosophy from the time of Aristotle to that of Linnæus,

* British and Foreign Medico-Chirurgical Review, No. I (1848).

† Loc. cit., p. 10.

and from that of Linnæus to the epoch of Robert Brown and Cuvier, are those of practical naturalists. In their names, and in the names of many eminent men, happily enrolled in the list of the Ray Society, I protest against the doctrine that naturalists (properly so called) are only to "record exactly what they see, and leave it to others to estimate the value of their facts, and to build upon them such inferences as they may think proper."*

Dr. Carpenter remarks, on the theory of Steenstrup, as follows: "We regard this as a very premature, erroneous, and limited expression of the real facts; and shall endeavour, in the course of our exposition, to show what is the real truth of the matter. The proposition, in the form enunciated by Steenstrup, is totally inapplicable to the vegetable kingdom; and a strong suspicion of its incorrectness is suggested by that simple circumstance, inasmuch as it is chiefly based upon the phenomena presented by those tribes of animals which have most in common with plants in their general structure and history."

The reader of this passage might suppose, if he had not previously read Steenstrup's Essay, that the Danish naturalist had not taken the phenomena of the vegetable kingdom into consideration when stating his proposed law; nor do I find in the review, although the phenomena of vegetation are abundantly cited in favour of the reviewer's opinions, any reference made to the fact, that Steenstrup had not only cited them in illustration of his theory, but regarded them as presenting the strongest evidences in its favour. The last passage of his concluding chapter—that "on the real nature of the alternating generations," runs as follows:—

"I conclude with the remark, that, inasmuch as in the system of '*nursing*,' the whole advancement of the welfare of the young is effected only by a still and peaceful organic activity, is only *a function of the vegetative life* of the individual, so also, all those forms of animals in whose development the '*nursing*' system obtains, actually remind us of the propagation and vital cycle of plants. For it is peculiar to plants, and as it were their special characteristic, that the germ, the primordial individual in the vegetation or seed, is competent to produce individuals which are again capable of producing seeds or individuals of the primary form, or that to which the plant owed its origin, only by the intervention of a whole series of generations. It is certainly the great triumph of morphology, that it is able to show how the plant or tree (that colony of individuals arranged in accordance with a simple vegetative principle or fundamental law) unfolds itself through a frequently long succession of generations, into individuals becoming constantly more and more perfect, until, after the immediately precedent generation, it appears as *calyx* and *corolla*, with perfect male and female individuals; stamens and pistils—and after, the fructification brings forth seed, which again goes through the same course. It is this great and significant resemblance to the vegetable kingdom, which, in my opinion, is presented by the *entozoa* and all *nurse* generations (*amme*), and to which I have alluded in the preceding Essay; I might almost say, that the condition of continued dependence incidental to the animal life, is, to a certain extent, one of less perfection than that which is presented in the progressive elevation in development effected by the agency of the vegetative life."†

This remarkable passage had surely escaped the notice of the reviewer; for in it the

* Loc. cit., p. 7.

† Ray Society's Translation of the Alternation of Generations, p 114.

argument drawn from analogy between the animal and vegetable kingdom, is as clearly and fully expressed as in the sentences I am about to cite from the review itself. Indeed it was very unlikely that a Lecturer on Botany* would allow such obvious analogies to escape him.

The theory enunciated by Dr. Carpenter, and proposed to be substituted for that of Steenstrup, has special reference to the Medusæ and Polypes, and is stated in the following passages:

"The fertilized ovum of the medusa-parent is like the seed of the plant; and the polype that grows from it resembles the first leaf-bud into which the embryo expands. From this bud are at first produced others, by the process of continuous growth, which are repetitions of itself; these in the plant usually remain connected with each other so as to form a compound structure, and so they do also in the ordinary zoophyte; but in the common hydra, and in the hydraform medusa-larva, they become detached like the bulbels of the marchantia or lily. But under certain conditions, a new and different set of buds, containing a sexual apparatus, are produced; these, too, become detached, and, by their inherent powers of movement, they convey the germs of a new generation to a distance from the parent stock. The whole of these phenomena appear to us to constitute but a *single* generation, instead of *two*, as represented by Steenstrup. We are not in the habit of speaking of the leaf-buds and the flower-buds of a plant as of two distinct generations; nor, if our comparison be correct, have we any ground for giving such a designation to the polypoid larva, and the medusa-imago, which are continuous developments from the same germ. Hence the whole doctrine of the 'alternation of generations,' falls to the ground, so far as this individual case is concerned; the phenomena being simply those of metamorphosis or change of form, attending the evolution of successive products from the same original germ. The metamorphosis is not really so great as that which presents itself in the course of the development of any one of the higher organisms, the several parts of which depart more widely from each other, and from the early embryonic cell-cluster, than do the polype-buds and medusa-buds we have been describing. The chief difference lies in the capacity of the latter to maintain a separate and independent existence; a capacity which is evidently connected with their low type of organization." (Review cited, p. 23.)

And again, in the recapitulation (at p. 29)—"The true *Hydra*, which may be regarded as uniting the general form and structure of the polype with the locomotive powers and dispositions of the medusa, propagates in both the modes characteristic of the vegetable kingdom; namely, by *gemmation*, and by the production of *ova*. The *buds* are not destined to remain in continuity with the parent, but are thrown off like the bulbels of certain plants; having previously acquired, however, the form of the parent. The *ova* also are developed into polypes resembling the parent. The usual mode of propagation is here by bulbels; the ova being destined apparently to continue the race through the winter season, the cold of which might be fatal to the parents.

"In other cases, however, we find a greater specialization of characters; the locomotive and proper generative apparatus being especially developed in the *Medusæ*; whilst the true polypoid condition presents its most complete evolution in the plant-like *Sertularidæ*, yet these two groups are not to be dissociated from one another; for each of them, in one of its

* Professor Steenstrup was Lecturer on Botany and Mineralogy in the Academy of Soröe.

stages of development, presents the characters of the other. The *Medusa* begins life as a polype; as a polype it is attached; as a polype it grasps and digests its food; as a polype it reproduces parts that have been removed; and as a polype it propagates by gemmation; the buds being detached from the parent as soon as they have acquired the form of the latter, and are capable of maintaining an independent existence. But in this condition it forms no ova. A new and distinct series of buds (flower-buds) is produced for this purpose; these buds are detached like the preceding; they become developed into perfect Medusæ, in which state alone they have been known until recently; and from these Medusæ are produced ova by a true sexual process, which are first evolved into the polypoid form, and go through the series of changes just enumerated." (p. 30.)

In this theory, proposed by Dr. Carpenter for adoption instead of that of Steenstrup, I can see only verbal differences. The main facts upon what Steenstrup built his proposed law are not denied. It is admitted that a polype may produce a Medusa by gemmation, and that the egg of the Medusa may produce an animal altogether different from itself, but like the polype which produced it. The reviewer admits an alternation of forms, but he denies that they are *generations* which alternate. Yet in the ordinary sense of the word *generation*, as here applied by Steenstrup, they must either be such or be the same individual. A father belongs to one generation, a son to a second, a grandson to a third—at least, this has been the case hitherto, as far as my knowledge goes. Surely the first polype represents one generation, the offspring of that polype a second, and the offspring of that offspring a third. And if so, the middle term here being a Medusa and not a polype, and its offspring a polype again, which produces a Medusa, we are warranted to speak of an alternation of dissimilar generations. It does not affect the question, if they be regarded as individuals, whether they are produced by gemmation or from ova; nor whether we hold with Sars that we have not an alternation of animals of distinct classes, but of fixed and free animals of the same class. It is not the less an alternation of dissimilar generations.

But when Dr. Carpenter says that the phenomena are simple metamorphoses not really so great as those which present themselves in the course of the development of any one of the higher organisms—"the several parts of which depart more widely from each other, and from the early embryonic cell-clusters, than do the polype-buds and Medusa buds we have been describing"—he may mean, that the Medusæ produced by gemmation are not distinct individuals, but parts of some one capable of maintaining a separate and independent existence. If so, he has certainly enunciated a new theory altogether distinct from that of Steenstrup, but one so opposed to ordinary notions of individuality among the lower animals, that few, if any, naturalists will assent to it until more fully and satisfactorily stated.

To argue that, because "we are not in the habit of speaking of the leaf-buds and the flower-buds of a plant as of two distinct generations," we are, therefore, not to regard the alternations of polypes and Medusæ as such, is to bring the common, popular, unscientific, and untrue notion of the nature of a plant into a scientific discussion on the nature of animals. We are not in the habit of regarding a leaf as an individual—popularly, we look upon the whole plant as an individual. Yet every botanist knows that it is a combination of individuals, and if so, each successive series of buds must certainly be strictly regarded as generations. The first generation of a Lupine, for instance, is the pair of individuals constituting the cotyledons of the embryo, dissimilar from the second generation, which consists of the several

phytons comprising the first bud or plumule. A series of similar buds may be produced until one of different aspect is developed, composed of a generation of altogether different individuals, through whose agency the foundation of a new series of generations is laid in the formation of the ovum or seed. Whether we style the members of one generation *nurses*, or call them all by the same name, does not matter so far as the fact and law of an alternation of generations is concerned.

I see no reason therefore to dissent from the theory of Steenstrup; it is the simplest and most intelligible, as well as most original expression hitherto offered of the astonishing facts which he was the first to generalize. Granting it, we can no longer adopt the usually accepted classification of Radiate animals, nor separate them into *Echinodermata*, *Acalephæ*, *Zoophyta*, and Sponges, as so many distinct and equal orders; but must unite the *Acalephæ* with the *Zoophyta*, excluding from the latter the *Bryozoa* which are polypoid *Tunicata*. The *Acalephæ* or *Arachnodermata* must undergo reconstruction, for the Polypes cannot even be regarded as forming a primary division when united with the usual members of this great section. They evidently form part of a sub-class with the *Discophoræ*, equal to the sub-classes, *Ciliograda*, *Cirrhigrada*, and *Physograda*. The *Discophoræ* must again undergo subdivision into orders. The *Anthozoa* will stand first, next the *Steganopthalmata*, then the *Gymnopthalmata*, and lastly the *Hydroida*. That the *Anthozoa* are intimately related to the Medusæ is evident to any unprejudiced naturalist who has studied the structure of *Lucernaria*, or of the *Actineadæ*, especially of any floating form of the last tribe, such as the *Arachnactis* of Sars. The close affinity of these tribes has been excellently treated of in an Essay by Drs. Frey and Leuckart, who, after comparing organ with organ in the *Anthozoa*, the several usually received orders of *Acalephæ* and the Polypes, observe, in conclusion, that these various tribes ought no longer to be placed apart in a natural system. "They rather go towards constituting a larger section, having one common type of structure—a type chiefly characterised by the peculiar arrangements of the viscera and the stomachal cavity." They propose to designate such division by the name of COLENTERATA.*

Even among the animals figured and described in this Monograph, we see abundant evidences of the close affinity of the Medusæ, on the one hand, with hydroid polypes; on the other, with the Anthozoa. The *Steenstrupiæ* are in all probability Medusa-generations of some corynoid polype, yet, through *Euphysa*, they are intimately related with *Sarsia*, and through *Sarsia* with *Slabberia*, whence the affinities upwards are easily traced. The *Turris digitalis*, on the other hand, closely reminds us of an *Actinea;* so nearly, that when I first found a specimen, I mistook it for an animal of that genus.

Thus, in the end, we revert, curiously enough, to the views of the affinities of these animals proposed by Aristotle, who plainly included, under the designation of ακαλήφη, both *Actineæ* and *Medusæ;* not from any vague guess, or in compliance with the popular recognition of their resemblances, but from a careful study of their structure and habits, as the varied notices of them preserved to us in the first, fourth, fifth, eighth, and ninth books of the 'History of Animals,' prove beyond question.

* Frey and Leuckart's Beitrage, p. 38.

I shall conclude with a few remarks on the best methods of studying and preserving the Naked-eyed Medusæ.

They are to be sought for in summer and autumn, when the weather is warm and dry, and the sea calm and clear. They abound, within reach, mostly in the afternoon and towards night-fall—probably also during the night, though not then so near the surface of the water. A small bag of fine muslin, attached to a metal ring, is the best instrument by which to take them, and may be used either as a hand-net fixed to the end of a stick or pole, or as a tow-net suspended over the stern of a vessel, when at anchor, or making very gentle way through the water. My friend Professor Acland took great numbers at Oban, by attaching a tow-net to the buoy in the bay, and leaving it there during the night. They abound most in sheltered bays near strong tideways or headlands projecting into the Atlantic. The majority being oceanic, they are most numerous and varied on those parts of our shores which are touched by oceanic currents. Hitherto the Zetlands, Hebrides, and coasts of Cornwall have yielded the greater number of species. Many new forms may be expected to occur on the Atlantic coasts of Ireland. Indeed, I fully expect that the number of British species will be doubled within the next ten years, now that attention is directed to these beautiful little animals.

When the tow-net is taken out of the sea it is to be carefully reversed, and its contents gently emptied into a basin or glass jar, filled with clear salt water. It is best to plunge the net beneath the surface when being emptied, as thus the Medusæ are enabled to detach themselves from the threads, and swim away without injury. When the net is out of the water, they appear like little, adhering, shapeless masses of clear jelly, and exhibit no traces of their elegant form and ornaments. When in the jar or basin, they are often, on account of their extreme transparency, very difficult to distinguish, but by placing the vessel in the sun, or beside a strong artificial light, we see their shadows floating over the sides and bottom of the basin, like the shadows of flitting clouds on a landscape. These soon guide us to the creatures themselves, and before long we distinguish their ocelli and coloured reproductive organs. The next step is to secure such as we wish to examine closely, and transfer them to watch-glasses or small glass tubes. To do this is often not an easy task, for when alarmed they are extremely agile and alert; so that if we attempt to capture them with a teaspoon, they usually escape us, or if taken, by their slippery nature, slide out of the spoon whilst we pour away the superabundant water. This difficulty may be got over by using a small but deep glass spoon, with its handle set very obliquely. When we have placed some in a glass tube with a little water, or in a small compressed glass jar, which I find an excellent aid in examining them, we can observe their profile, the changes their body undergoes when contracting and expanding, and the extent to which the creature can lengthen its tentacula. We then place them in a watch-glass and submit them to microscopic examination, carefully noting the number, colour, form, and structure of the ocelli and tentacula, the arrangement of the gastro-vascular canals and reproductive glands, and the form and

structure of the central peduncle. Conveying our prizes then to a dark place, we irritate them, and observe whether they phosphoresce or not, of what colour the light is, and how long it endures.

In every case a drawing, as careful and detailed as possible, and always coloured, should be made at the time. This is the more necessary, since they are animals extremely difficult to preserve, shrivelling up into indistinguishable curd-like masses in spirits, and most preserving fluids. In fact, the only specimens which I have seen preserved in a distinguishable state, have been so by means of one of Mr. Goadby's fluids. When Mr. Goadby accompanied Mr. M'Andrew, in 1837, on a cruise among the Hebrides and Zetlands, he made many experiments on the preservation of these delicate creatures, and succeeded so well that I have been able to distinguish among them even the several species of the critical genus *Thaumantias*. I do not despair of seeing, before very long, a series of these creatures so preserved exhibited in the British Museum, and contributing to render more perfect the finest natural-history collection in the world. The indefatigable director of the zoological department in that truly national establishment, will yet, I trust, sanction such an addition, and, as he no longer remains a sceptic in bones or disbeliever in spirits, may consistently extend his faith to Goadby's fluid.

NOTE.—KINDLY COMMUNICATED BY MR. GOADBY.

To preserve the Acalephæ.—These animals contain so large a quantity of water, that they require great care and attention to preserve them.

The B fluid of itself is not enough for the purpose, the assistance of alum being imperatively necessary to give firmness and support to the several tissues.

The plan that I adopted with great success was the following: i. e.

Make a saturated solution of bay salt, and when cold, test it with a specific-gravity bubble prepared for that purpose.

When required for use, dilute it (with water) to 1148, indicated by another bubble so marked. To this latter fluid add alum, at the rate of ℥ij to every quart of fluid, and dilute the whole to $\frac{1}{2}$ strength with water. Pour this into a dish, and empty the contents of the tow-net (containing the well-drained specimens of Acalephæ) into it, and let them macerate therein for twenty-four hours, by which time they will be found saturated with the fluid, and at the bottom of the dish. If the specimens be small, they should now be moved, and placed in fluid consisting of dissolved bay salt, only to the strength of 1148, as the alum destroys transparency.

Large specimens of the Acalephæ, as *Aurelia*, &c., offer exceptions to this rule; they may be allowed to remain in aluminous fluid (to be changed daily) of the strength described, or somewhat increased by additions of stronger saline fluid, for a longer period (two or three weeks), but ultimately they, too, must be removed from the continued influence of alum, and kept in the bay salt fluid, of not less strength than before described, viz. 1148.

The fluid should be tested with the bubble *daily*, and its strength made up by additions of the saturated solution, until it *obey the test for several consecutive days*, when endosmose and exosmose being at an end, the process of preservation may be considered complete.

For permanent preservation, corrosive sublimate should be added to the preserving fluid, in the proportion of grains ij per quart of fluid, but its use is unnecessary in the early stages of preservation. I did not employ it until the collection of last summer was complete, and on shore. Neither is it essential to filter the fluid if time be pressing: at sea, of course, it cannot be done. Finally, marine animals require for their preservation saline fluid of the specific gravity of 1148. Fresh water and terrestrial animals are preserved at the diminished strength of 1100; fluids of less strength (respectively) are insufficient, and greater strength is injurious.

BIBLIOGRAPHY.

In order to facilitate the studies of those among my readers who may be inclined to pursue researches among the *Pulmograda Gymnopthalmata*, I have drawn up the following catalogue raisonné of authors, works, papers, and figures bearing upon the subject, not confining the notices to British species only, but extending them to all described or figured forms of Naked-eyed Medusæ.

1739. Janus Plancus. 'De Conchis minus notis Liber.' 4to, Venice.

In this is contained the first figure of the *Carybdea marsupialis*,—and a very miserable representation it is,—in Plate iv, f. 5, *f*, under the description of "Urtica soluta Marsupium referens et motus vitaleis manifestissime edens Maris Ariminensis." The figure, plate xcii, fig. 9, of the 'Encyclopédie Méthodique,' is sometimes quoted as if it had been taken from Plancus, and represented the same species (2d ed. of Lamarck, An. sans Vert., vol. iii, p. 131), but is really copied from Slabber, and represents in all probability an *Oceania*.

1746. Linnæus. '*Fauna Suecica*,' 1st Ed.

In the first edition of this work three Medusæ are enumerated, of which the third is a naked-eyed species. "1288. Medusa orbicula cruce alba picta. Hæc omnium minima est, tota gelatinosa vitrei coloris, discum pingit crux magna alba, ad margines usque extensa, margo integer est: caret appendicibus omnibus, sc. cavitatibus, pistillis, staminibus, branchiis." p. 368.

In the second edition the specific name *Cruciata* is added.

1758. Linnæus. 'Systema Naturæ.' 10th Ed.

Medusa cruciata, *M. pilearis*, and *M. marsupialis*, are the naked-eyed species enumerated.

1758. The Rev. W. Borlase published his 'Natural History of Cornwall,' in which there are some of the earliest figures of British Medusæ, but no naked-eyed species is represented by him.

Pennant (British Zoology, vol. iv, 1787) and Turton (British Fauna, 1807) contented themselves with following Borlase, making no additions to his list.

1760. L. T. Gronow (Gronovius). "Observationes de Animalculis aliquot Marinæ Aquæ Innatantibus atque in Littoribus Belgicis obviis," in the 'Acta Helvetica,' vol. iv, p. 38.

In his paper is contained the first notice of *Thaumantias hemisphærica*. The description is full and good for its time; the figure bad, and scarcely recognisable. *Cydippe pileus* is described and figured in the same paper.

1775. P. Forskal. 'Descriptiones Animalium quæ in Itinere Orientali observavit Petrus Forskal. Post mortem auctoris edidit Carsten Niebuhr.' Havniæ, 1775.

Forskal observed and described twelve pulmograde Medusæ during his voyage. Of these, five were inhabitants of the Red Sea, and the remainder of the Mediterranean. Among the

latter are four naked-eyed species, viz. *M. proboscidalis* (i. e. *Dianæa proboscidalis*) *M. mollicina* (Genus?), *M. pileata* (*Oceania pileata*), *M. æquorea* (i. e. *Æquorea Forskalina*). His descriptions and drawings are very characteristic. The latter were published in a separate volume, of 'Icones.'

1776. Otho Frederie Müller. 'Zoologiæ Danicæ Prodromus, seu Animalium Daniæ et Norvegiæ Indigenarum Characteres Nomina et Synonyma.' 8vo, Havniæ.

Eight species are enumerated under the genus *Medusa* in this work. One of them is the *Medusa palliata* of Bohadsch, which is an *Actinea*, being the *Adamsia maculata* of British naturalists. Three appear to be naked-eyed Medusæ, viz. *M. hemisphærica*, *M. bimorpha*, and *M. digitale*. The first is the *Thaumantias hemisphærica*; the second and third were communicated to Müller by Otho Fabricius, the latter being our *Turris digitalis*.

1778. Martin Slabber. 'Natnurkundige Ver-Gustigingen.' 4to, Haarlem, 1778.

This work contains several figures of Medusæ. Plate ii, figs. 1 and 2, are very bad figures of *Saphenia dinema*: six vessels are represented instead of four. Plate xii, figs. 1 and 2, is the *Thaumantias cymbaloidea* of authors, and in all probability a bad representation of *T. hemisphærica*. Plate xii, fig. 13, is either *Turris neglecta*, or an allied species. Plate xiv, fig. 1, appears to be an *Oceania*. The two latter are the *Oceania tetranema*, and *O. sanguinolenta* of Peron and Leseuer.

1780. Otho Fabricius. 'Fauna Groenlandica,' 8vo, Hafniæ et Lipsiæ.

Of the Medusæ described in this excellent work, *M. digitale* is our *Turris digitalis*; *M. bimorpha* and *M. campanula* appear also to have been naked-eyed species, though the latter may possibly have been a young *Cyanæa*.

1788. Olof Swartz, on "*Medusa unguiculata* and *Actinea pusilla*," in the 'New Transactions of the Royal Swedish Academy,' vol. ix.

The *Medusa* here described is probably a naked-eyed species, though I confess I do not clearly understand the figure (not badly executed) given. It is the *Linuche unguiculata* of Eschscholtz. *Actinea pusilla* appears to be a floating animal of its tribe, and possibly a species of *Arachnactis*. Eschscholtz and Lesson make a Medusa of it under the name of *Melicertum pusillum*.

1788. J. F. Gmelin. The 13th edition of 'Systema Naturæ,' of Linnæus.

The Medusæ are contained in vol. i, part 6 of this compilation. Such naked-eyed species as are given (viz. *Medusa marsupialis*, *M. hemisphærica*, *M. dimorpha*, *M. campanula*, *M. digitale*, *M. proboscidalis*, *M. mollicina* (?) and *M. pileata*), are taken from Plancus, Müller, Otho Fabricius, and Forskal.

1788-9. O. F. Müller. 'Zoologia Danica.'

A good figure of *Thaumantias hemisphærica* is contained in this excellent and most useful work.

1791. Adolph Modeer. "Om Slagtet Siokalf, *Medusa*," in the 'Nya Handlingar,' of the Royal Swedish Academy, vol. xii.

A synopsis of the Medusæ known up to that time, and a very valuable one for its date. The naked-eyed species described by Forskal, Otho Fabricius, &c., are enumerated and characterised with great acuteness.

1791. The collection of figures of Medusæ in the six plates (pl. xc-xcv) devoted to *Acalephæ*, in the 'Encyclopédie Méthodique,' contains several naked-eyed species.

Plate xcii, figs. 9 and 10, are copied from Slabber, and represent a *Turris* and an *Oceania*; fig. 11 is *Oceania pileata*, copied from Forskal; figs. 12-15 are copies of Slabber's figure of *Obelia sphærulina*, and figs. 7-8 of his *Medusa perla*, both, however, evidently, as we have seen, the figs. of higher Medusæ. In plate xciii, we have fig. 1 representing *Dianæa proboscidalis*, copied from Forskal; figs. 2-4 is *Thaumantias cymbaloidea*, from Slabber; and

8-11, *Thaumantias hemisphærica,* from Müller; 5, 6, 7, are copies of the "*Medusa cruciata,*" of Forskal. In plate xciv, figs. 4, 5, are copies of the figures given by Baster, of the Medusa which has received the name of *Callirhoe Basteriana.* Plate xcv, figs. 1 and 2, are the *Æquorea mollicina;* fig. 4, *Mesonema cælum-pensile;* and fig. 3, *Æquorea Forskalina,* all copied from Forskal.

1809. Peron et Lesueur. "Tableau des Caractères génériques et spécifiques de toutes les espèces de Méduses connues jusqu'à ce jour," in the 'Annales du Muséum d'Histoire Naturelle,' vol. xiv.

A standard paper. Unfortunately the plates and figures referred to in this valuable memoir have never been made public, so that it is beyond the power of the British naturalist to determine the species mentioned as inhabitants of the Channel, for the descriptions are too often insufficient. The following genera of naked-eyed Medusæ, are characterised for the first time in this paper: *Eudora, Berenix, Orythia, Favonia, Lymnorea, Geryonia, Carybdea, Phorcynia, Eulimenes, Æquorea, Foveolia, Pegasia* (?), *Callirhoe, Oceania, Aglaura, Melicerta* (?), *Euryale.* The names of the species will be found in the table which I have constructed from Lesson, further on. An issue of the original plates would be a great boon to science, as few naturalists have had such opportunities of observing the Medusæ in all parts of the world.

1816-18. De Lamarck. 'Animanx sans Vertèbres.'

The Medusæ are described at second-hand. The naked-eyed species are arranged under the genera *Eudora, Phorcynia, Carybdea, Æquorea* (?), *Callirhoe, Orythia,* and *Dianæa.* Peron and Lesueur are evidently the chief source of the descriptions.

1821. A. de Chamisso, and C. G. Eysenhardt. "De Animalibus quibusdum e Classe Vermium Linneana in circumnavigatione Terræ, auspicante Comite N. Romanzoff, duce Othone de Kotzebue, annis 1815-18 peracta, observatis;" in the 'Acta Academiæ Naturæ Curiosorum,' vol. x.

Several Medusæ are represented in the plates to this paper. Of these, one, the *Geryonia tetraphylla,* is a naked-eyed form, allied to our *G. appendiculata,* and resembling it in having eight tentacles alternately differing in size. Their structure is not given. The extremity of the peduncle is represented as having a round orifice, which is a mistake, as in the description, the peduncle is said to be "bipollicaris, cylindricus, flexilis, apice (ore) truncato dilatato *quadrivalvato* membranaceo, maculis quatuor viridibus notato." It inhabits the Indian Ocean. (Loc. cit., t. xxvii, f. 2.)

The "*Medusa campanulata*" of this paper (pl. xxx, f. 1) seems to me to be a mutilated animal, doubtfully of this division, and the *M. mucilaginosa* is possibly a mutilated *Polyxenia.* Both are from the Pacific Ocean, and the imperfection of the drawings is due to the specimens, and not to the describers, as they expressly state their doubts respecting the generic affinities of both forms, and suggest the necessity of fresh observations.

1824. Quoy and Gaimard. 'Zoology of Voyage of the Urania and Physicienne' (under Freycinet). Plates lxxxiv and lxxxv are devoted to the Medusæ.

Of naked-eyed species there are figured *Æquorea grisea* (Admiralty Isles), *Æquorea cyanogramma,* from the same locality, *Æquorea punctata,* from between the Philippines and Sandwich Isles, and *Æquorea semirosea,* from New Guinea; all species well marked by peculiarities of colour. *Dianæa balearica* (a *Geryonia* ?), from the western Mediterranean, a two-tentaculated species, remarkable for its thick peduncle (?). *Dianæa endractensis,* a six-tentaculated species of a reddish tinge, from New Holland. In neither the figures nor descriptions of these are the ovaries definitely stated. The introductory remarks show that the authors did not very clearly comprehend what they saw.

1826. Risso. 'Histoire Naturelle de l'Europe Méridionale.'

The Medusæ of the neighbourhood of Nice are enumerated in the fourth volume, including several known naked-eyed species. The author's knowledge appears to have been very slight.

1827. MM. Quoy et Gaimard. 'Observations Zoologiques faites à bord de l'Astrolabe, en Mai 1826, dans le détroit de Gibralter.'

In this valuable paper a number of radiate animals, chiefly pelagic, are described, and among them several naked-eyed Medusæ. The species are all figured, though mostly with few or no anatomical details.

1. *Dianæa rotunda*, p. 181, pl. vi, A, figs. 1 and 2.
   Judging from the view given of the peduncle, this appears to be a true *Oceania*, with a globular umbrella and eight marginal tentacula.
2. *Dianæa conica*, p. 182, pl. 6, A, figs. 3 and 4.
   The form of the body indicates a *Circe*, but the appearance of the peduncle is nearer that of *Oceania*, and the remark of the describers, that it approaches the *Medusa* (*Oceania*) *pileata* of Forskal, would confirm such a view. The umbrella is mitrate, and acute above. The margin appears to have twenty tentacula, with red ocelli. The peduncle is reddish.
3. *Dianæa exigua*, p. 183, pl. vi, A, figs. 5 and 6.
   A small *Geryonia*, with very small cordate ovaries, and four marginal tentacula.
4. *Dianæa exigua*, Var., p. 183, pl. vi, A, figs. 7 and 8.
   Exactly like the last, but wanting the ovaries. Is this a male animal, or is it a *Tima?* It is the *Liriopa cerasiformis* of Lesson (Acal. p. 332), who strangely associates it with *Dianæa proboscidalis*, in his genus *Liriopa*.
5. *Dianæa bitentaculata*, p. 184, pl. 6, A, fig. 9.
   A minute *Geryonia* or *Tima*, having two long tentacles and twelve short ones. This is the *Saphenia bitentaculata* of Lesson.
6. *Dianæa funeraria*, p. 184, pl. vi, A, figs. 10-15.
   This appears to belong to a genus closely allied to *Circe*, and is certainly a member of the family *Circeadæ*. It is the *Tholus funerarius* of Lesson.
7. *Æquorea capillata*, p. 185, pl. vi, B, fig. 1.
   Too imperfectly described and figured to be assigned to any well-defined genus with certainty.
8. *Phorcynia pileata*, p. 186, pl. vi, C, fig. 1.
   A mutilated or badly-observed species, of what genus? It is the type of Lesson's genus *Pileola*.

1828. Dr. Fleming. 'History of British Animals.'

Under the genus *Geryonia* are enumerated "*G. æquorea*," "*G. hemisphærica*" (*Thaumantias*), and "*G. octona*" (*Oceania*). The last previously described by Dr. Fleming, in the eighth volume of the 'Edinburgh Philosophical Journal.'

1829. F. Eschscholtz. 'System der Acalephen.' 4to, Berlin.

A standard work upon this class, founded on extensive personal research. I have already commented on the errors of the classification. The illustrative figures are in outline, but strikingly faithful, so far as they go. The naked-eyed species represented are *Melicertum penicillatum*; *Eurybia exigua*; *Tima flavilabris*; *Cytæis tetrastyla*; *Cunina campanulata* and *globosa*; *Æquorea ciliata*; *Polyxenia cyanostylis*; *Æquorea globosa* (a *Stomobrachium*?); *Ægina rosea*, and *citræa*; *Mesonema abbreviata*; *Geryonia bicolor* and *rosacea*. The descriptions are in German, each prefaced by a Latin diagnosis, too slight in most instances to serve the purpose of identification. No student of the Medusæ should be without this book.

1830. Lesson. 'Zoology of the Voyage of the Coquille' (under Duperrey).

Most of the figures of Medusæ in this work represent covered-eyed species. In plate xiv of the Zoophytes, a few naked-eyed species are represented, but though the plates are beautifully engraved and coloured, the original drawings must have been sadly defective, judging from the *Cyanæa Bougainvillii* (*Bougainvillea Macloviana*), the first that attracts our notice, every organ of which is misunderstood, and wrongly delineated. Fig. 4 of the same plate represents a *Turris*, under the name of *Æquorea mitra*; the peduncle and ovaries strangely misunderstood. Fig. 1. *Bursarius Cytheræ* may be a naked-eyed form, but after the manner in which the two previously-cited species are represented, I cannot

venture to offer an opinion with any approach to certainty. The *Dianæa cerebriformis* of plate x is possibly a *Cyanæa*. The *Eudoræ* are evidently mutilated disks.

1830. 'Magazine of Natural History,' vol. iii.

Dr. Baird, in an interesting paper "On the Luminousness of the Sea," figures a small Medusa (*Geryonia ?*) from the Straits of Banca: the figure and notes are insufficient.

1831. 'Magazine of Natural History,' vol. iv, p. 285.

In a note on the "Luminosity of the Sea," by Mr. Samuel Woodward, a very minute Medusa of this order is figured from specimens taken between Lowestoft and Yarmouth. The figure represents either a young *Sarsia* or the medusoid of *Tubularia*.

1833. Quoy and Gaimard. 'Zoology of the Voyage of the Astrolabe.' (Expedition of Dumont d'Urville.)

The Medusæ are described in the fourth volume of the text, and figured in plate xxv. They are *Carybdea bicolor*, possibly an imperfect animal, but well figured; *Carybdea bitentaculata*, and a covered-eyed species, *Orythia incolor*. Of the two former, the first was found near the Cape de Verde, the second, in the roads of Amboyna.

1833. Milne Edwards on "*Carybdea marsupialis*."

A valuable and excellently illustrated paper in the 28th volume of the 'Annales des Sciences Naturelles.'

1833. Dr. Johnston. Description and figure of "*Dianæa Bairdii*" (*Tima Bairdii*, mihi), in the sixth volume of the 'Magazine of Natural History' (Loudon's).

1834. De Blainville. 'Manuel d'Actinologie.'

The account of the pulmograda in this useful manual is a very full and excellent compilation of the knowledge up to the time, and among the plates are many useful figures copied from other works. De Blainville combines the genera *Æquorea*, *Mesonema*, *Polyxenia*, *Ægina*, and *Cunina* in one genus, *Æquorea*. He refers *Melicerta penicellata* of Eschscholtz to the genus *Aglaura* of Peron. Under *Geryonia* he unites *Saphenia*, *Geryonia*, and *Dianæa* proper; regarding *Dianæa endractensis* as the type of that genus.

1834. J. T. Brandt. "Prodromus Descriptionis Animalium ab H. Mertensio observatum," in the 'Recueil des Actes de la Séance publique de l'Académie Impériale des Sciences de St. Pétersbourg,' 1833-4.

In this valuable paper Brandt gives a synopsis of the radiate animals observed by Mertens during his voyage. The following naked-eyed Medusæ are enumerated:

Circe, Mertens (the genus characterised).

1. *C. camtschatica*, Brandt. Kamtschatka.

Conis, Brandt (the genus characterised).

2. *C. mitrata*. Pacific "ab insulis Boninimensibus."
3. Æquorea *rhodolema*, Brandt. Conception, in Chili.

Stomobrachiota, Brandt (the genus characterised).

4. *S. lenticularis*, Brandt. Atlantic, "ab insulis Malvinensibus.
5. Mesonema *macrodactyla*, Brandt. Southern Ocean.
6. Mesonema *cærulescens*, in 50° lat., and 144° long. W.

Æginopsis, Brandt, (the genus characterised).

7. *Æ. horcnsis*, Brandt. In Behring's Straits.
8. Polyxenia *flavobrachia*, Brandt. 5° lat., 127° long. W.
9. Geryonia *hexaphylla*, Peron. Pacific Ocean, in 36° 30′ lat. and 211 long., ab ins. Boninsimensibus.
10. Proboscidactyla *flavicirrhata*, Brandt. Camtschatica.
11. Hippocrene *Bougainvillii*, Brandt. Behring's Straits.
12. Staurophora *Mertensii*, Brandt. North Pacific.

1835. H. Rathke, (Professor, of Dorpat). "Beschreibung der *Oceania Blumenbachii*, einer bei Sevastopol gefundenen leuchtenden Meduse," in the 'Mémoires présentés à l'Académie Impériale des Sciences de St. Pétersbourg,' vol. ii, with an excellent plate.

The animal figured and described in this paper is a very remarkable one, and evidently *sui generis*. It is not a true *Oceania*, nor a member of the family *Oceanidæ*, but of that section of the *Sarsiadæ* which will probably eventually assume the position of an independent group including *Bougainvillea* and *Lizzia*. The umbrella is hemispherical, bordered by eight compound tentacular bulbs, of a bright yellow colour, from each of which rise three filiform, highly extensile, white tentacula. The peduncle is four-lobed, broad, striped with white and yellow, and opens by a mouth surrounded by four lips, with tentacular and gland-tipped prolongations arranged in a pinnate fashion.

1835. M. Sars. 'Beskrivelser og Jagttagelser over nogle mœrkelige eller nyei havet ved den Bergenske kyst lebende dyr af Polypernes, Acalephernes,' &c. 8vo, Bergen.

This very interesting work is in the Norwegian language. In it *Phorcynia cruciata* and *Thaumantias hemisphærica* are mentioned as Norwegian species, and the following new species described and figured:

1. *Oceania ampullacea*, p. 22, t. iv, fig. 8.
2. *Oceania octocostata*, p. 24, t. iv, fig. 9. This is our *Stomobrachium octocostatum*.
3. *Oceania saltatoria*, p. 25, t. iv, fig. 10. This appears to be a *Circe* by its form. No ovaries are shown in the figure. It has sixteen tentacula. It is the *Pandea saltatoria* of Lesson.
4. *Oceania* (?) *tubulosa*, p. 28, t. iv, fig. 11.—*Sarsia tubulosa*.
6. *Thaumantias multicirrata*, p. 25, t. viii, fig. 12.
7. *Thaumantias* (?) *plana*, p. 26, t. v, fig. 11.
8. *Cytæis octopunctata*, p. 28, t. vi, fig. 14.—*Lizzia octopunctata*.

1836. In the ninth volume of the 'Magazine of Natural History' (Loudon's) is a "Catalogue of the Species of Rayed Animals found in Ireland, as selected from the papers of the late J. Templeton, Esq., of Cranmore, with notices of Localities, and with some Descriptions and Illustrations by Robert Templeton, Esq."

This list is of considerable value, and shows that the distinguished naturalist, from whose papers it was compiled, had taken great interest in the Acalephæ. Of the species he enumerates, the following appear to belong to the *Pulmograda Gymnopthalmata*. "*Piliscelotus*. Body hyaline, hemispherical, the apex somewhat produced, and terminating in a fleshy, elongated, spindle-shaped appendix. Margin of the body with four moderately long tentacula, each tentaculum arising from a small tubercle. *P. vitreus* (p. 302, f. 48). Hyaline, bell-shaped, with four brown tentacula arising from the margin, nearly equidistant; the centre produced into a long, dark brown appendage, somewhat thickened in the middle. Found in the pools on the limestone rocks, at the Whitehead, June 25th, 1812. Moving with a pretty quick but steady motion, by expanding and collapsing the body, which was so extremely transparent, that scarcely any part was visible but the dark brown appendage and the marginal tentacula. The marginal tentacula were dilated at their base." Anomalous as this creature is represented, I hardly doubt that it is other than *Sarsia tubulosa* accidentally turned inside out, as I have elsewhere observed. A curious Medusa, having a simple umbrella without tentacula at the margin, is figured at Cut 47. It is described as "Ocyrhoæ (?), *Peron* (Cassiopeia (?), *Lam.*) cruciata. Hyaline, four arms, pale purple, corrugated; eight darker, fine rays, and numerous dusky obsolete ones." The figure seems to represent a naked-eyed species, but it may be some mutilated Pulmograde of higher rank. It would be unsafe, without new observations, to admit this form into systematic lists. All the other forms mentioned by Templeton (except "*Medusa scintillans* of Macartney," which probably refers to *Thaumantias hemisphærica*) are members of higher groups, and some of them, such as his "*Æquorea* (?) *radiata*," monstrous and mutilated *Aureliæ*.

1837. Cuvier's 'Règne Animal,' Commemorative Edition, illustrated by his pupils.

Among the plates of this beautiful work are thirteen representing Medusæ. Eight of these are devoted to undoubted steganopthalmatous species. The following naked-eyed forms, or else doubtful, are copied from the unpublished plates of Peron:

Phorcynia istiophora; Eulimenes cyclophylla; Equorea purpurea; Lymnorea triædra (covered-eyed?); *Favonia hexamena; Geryonia hexaphylla* (*Dianæa proboscidalis*?); *Berenix carisochroma, B. euchroma* (this genus seems to have affinities with *Willsia*, but the structure of the pedunele and ovaries is not indicated in the drawing); *Geryonia dinema* (possibly belonging to a genus of the *Sarsiadæ*, as well as *Orythia viridis*); *Orythia minima* (this appears to be an immature *Cyanæa*); *Eudora undulosa* (steganopthalmatous?); *Carybdea periphylla* (surely not of this genus, and possibly steganopthalmatous).

Figures are also given of *Geryonia bicolor*, copied from Eschscholtz; *G. Dubautii* (*balearica*) [possibly an *Orythia*], after Quoy and Gaimard; *G. tetraphylla*, after Chamisso and Eysenhardt; *Carybdea marsupialis*, and *Æquorea violacea*, after Milne Edwards.

1837. Lesson. 'Prodrome d'une Monographie des Méduses.'

I have never seen this work. Was it ever printed?

1837. Ehrenberg, in the 'Transactions of the Berlin Academy,' for the year 1835, vol. viii, gives two good figures of naked-eyed Medusæ, the one "*Oceania pileata*," and the other "*Melicertum campanulatum*" (really *Stomobrachium octocostatum*), both from Norway, and already noticed in the account of our native species of the genera to which they belong.

In the same paper there is a catalogue of the Medusæ of the Red Sea, but all the species enumerated are steganopthalmatous.

1838. J. F. Brandt. "Ausführliche Beschreibung der von C. H. Mertens auf seiner Weltumsegelung beobachteten Schirmquallen, nebst allgemeinen Bemerkungen über die Schirmquallen überhaupt," with 34 coloured plates, in the 'Memoirs of the Imperial Academy of St. Petersburg,' 6th series, 'Sciences Naturelles,' 2d vol.

One of the most valuable and beautifully illustrated memoirs upon the Medusæ extant. The naked-eyed species figured in it are *Circe Camtscatica, Conis mitrata* (*a Turris*?), *Æquorea rhodolema, Stomobrachium lenticulare, Mesonema macrodactyla, cærulescens* and *dubium, Æginopsis Laurentii*, (if the *Polyenia Alderi* of this work prove not to belong to that genus to which I have referred it, *Æginopsis* may prove its proper place,) *Geryonia hexaphylla, Proboscidactyla flavicirrhata* (a genus of *Willsiadæ*), *Hippocrene Bougainvillii*, and (?) *Staurophora Mertensii*. The figures are from the drawings of Mertens, and bear every mark of being faithful representations. The remaining species are *Steyanopthalmata*, and are by far the best figures hitherto published of Medusæ of that order.

1840. The second edition of Lamarck's 'Animaux sans Vertèbres,' edited by Deshayes and Milne Edwards.

The Medusæ are contained in the third volume of this edition, and have been revised by M. F. Dujardin. The additional notes are very good, and serve to make the work a useful manual, as they embody the labours of recent writers, especially Eschscholtz and Brandt.

1841. Milne Edwards described and figured with admirable accuracy the *Æquorea violacea*, in the 16th volume of the second series of the 'Annales des Sciences Naturelles.'

1841. Augustus A. Gould, M.D. 'Report on the Invertebrata of Massachusetts,' Cambridge, U. S., 8vo.

Three species of naked-eyed Medusæ are enumerated as inhabiting the shores of the United States, viz., "*Oceania tubulosa*" (i. e. *Sarsia tubulosa*), "*Hippocrene Bougainvillii*" (more probably *Bougainvillea britannica*), and "*Stomobrachium lenticulare*:" the two latter identified with Brandt's species of those names.

1841. Dr. Davis on "*Cyanæa coccinea,*" (*Turris neglecta,*) in the Seventh Volume of the 'Annals of Natural History.'

1841. E. Forbes, on a new *Hippocrene,* and some new species of *Thaumantias* in the 'Annals of Natural History.'

1843. Lesson. 'Histoire Naturelle des Zoophytes; Acalephes,' a thick 8vo volume, forming part of the 'Nouvelles Suites à Buffon.'

This work is one of the most useful, and yet one of the most provoking, in its department of natural history; useful, because it brings together, *verbatim,* everything that has been written upon the Medusæ in France; provoking, because every attempt in it at an arrangement or digest of the matter so collected serves only to make the obscure more obscure, and the crude more crude. It is executed without any judgment, though with considerable industry. Of what has been done outside of France it is a most imperfect account. Nevertheless, for the present, it is indispensable to the student of the Medusæ, and includes the fullest list published of species and references. A few plates in which some interesting species are figured are appended. I have compiled the following Catalogue of Medusæ, either naked-eyed, or possibly so, enumerated by Lesson, with the localities given in his work, and the name of the original observer.

NAKED-EYED MEDUSÆ ENUMERATED BY LESSON.

* *Figured in works referred to by Lesson.* † *Figured in this Monograph.*

Name in Lesson's Work.	Locality.	Observer and Remarks.
* ? Eulimenes sphæroidalis, *Peron.*	South Atlantic.	Peron.
* ? Eulimenes cyclophylla, *Peron.*	South Atlantic.	Peron and Lesueur.
? Eulimenes heliometra, *Lesson.*	Peru.	Lesson.
* Phoreynia cudonoidea, *Peron.*	Australia.	Peron and Lesueur.
* Phoreynia petasella, *Peron.*	Iles Furneaux.	Peron and Lesueur (figure unpublished).
* Phoreynia istiophora, *Peron.*	S. Australia.	Peron and Lesueur (fig. unpub.)
Phoreynia cruciata, *Lin.*	Norway.	Linnæus (figure much wanted).
* Pileola pileata, *Q.* and *G.*	Gibraltar.	Quoy and Gaimard (Genus ?).
* Marsupialis Planci, *Less.* (*Carybdea marsupialis, Lam.*)	Mediterranean.	Planeus (well figured by Milne Edwards).
* Marsupialis alata, *Reyn.*	Atlantic.	Reynaud (figured in Lesson's 'Centurie Zoologique.')
Marsupialis flagellata, *Lesson.*	New Guinea.	Lesson (figure wanted).
* Bursarius eytherene, *Lesson.*	New Guinea.	Lesson (very doubtful).
* Mitra Rangii, *Lesson.*	(W?) African Seas.	Rang.
* Eurybia exigua, *Eschsch.*	South Sea, between the tropics.	Eschscholtz.
* Cytæis tetrastyla, *Esch.*	Atlantic, under the Equator.	Eschscholtz.
* ? Campanella chamissonis, *Lesson.* (*Medusa campanulata,* E. and C.)	Pacific.	Eysenhardt and Chamisso, insufficiently known.
Campanella Fabricii. (*Medusa campanula,* O. F.)	Greenland and Baffin's Bay.	O. Fabricius (no figure).
* Seyphis mucilaginosa, *Chamisso* and *Eysenh.*	Pacific.	Chamisso (too imperfect).

Name in Lesson's Work.	Locality.	Observer and Remarks.
* Turris papua, *Lesson.*	Coast of the I. of Waigeou.	Lesson.
† Turris borealis, *Less.* (*T. digitale.*)	Arctic and Boreal Seas.	O. Fabricius (*Turris*).
† * Turris neglecta, *Less.*	Celtic Seas.	Davis (*Turris*).
* Circe camtschatica, *Brandt.*	Kamtschatka.	Mertens (*Circe*).
* Circe anais, *Less.*	(W?) Africa.	Rang (*Circe*).
* Circe elongata, *Less.*	(W?) Africa.	Rang (*Circe*).
* Tiara papalis, *Lesson.* (*Medusa pileata*, Forskal.)	Mediterranean.	Forskal (*Oceania*).
* Tiara Sarsii, *Lesson.* (*O. ampullacea*, Sars.)	Norway.	Sars (*Oceania*).
* Tholus funerarius, *Q.* and *G.*	Gibraltar.	Quoy and Gaimard (*Tholus*).
* Pandea conica, *Q.* and *G.*	Gibraltar.	Quoy and Gaimard.
* Pandea rotunda, *Q.* and *G.*	Gibraltar.	Quoy and Gaimard.
* Pandea saltatoria, *Sars.*	Norway.	Sars (*Circe?*).
* Bougainvillea macloviana, *Lesson.*	North Pacific and Behring's Straits.	Mertens (*Bougainvillea*).
† * Bougainvillea britannica, *Forbes.*	North Atlantic.	Forbes (*Bougainvillea*).
† * Bougainvillea octopunctata, *Sars.*	Norway.	Sars (*Lizzia*).
* Proboscidactyla flavocirrata, *Brandt.*	Kamtschatka.	Mertens.
* Melicertum penicillatum, *Esch.*	California.	Eschscholtz.
* Aglaura hemistoma, *Peron.*	Mediterranean.	Peron, Risso (figure unpublished).
* Laodicea crucifera, *Lesson.* (*Medusa cruciata*, Forsk.)	Mediterranean.	Forskal.
* Microstoma ambiguus, *Lesson.*	Island of Waigeon.	Lesson.
* Berenix euchroma, *Peron.*	Equatorial Atlantic.	Peron and Lesueur.
* Berenix thalassina, *Peron.*	Arnheim's Land.	Peron and Lesueur.
* Berenix Cuvieri, *Peron.*	Australia?	Peron and Lesueur.
* ? Staurophora Mertensii, *Brandt.*	Pacific.	Merteus.
* Pegasia dodecagona, *Peron.*	S. Atlantic.	Peron and Lesueur.
* Pegasia cylindrella.	Arnheim's Land.	Peron and Lesueur (figure unpublished).
* Foveolia mollicina, *Forsk.*	Mediterranean.	Forskal.
Foveolia pilcaris, *Gmelin.*	Atlantic Ocean.	
Foveolia bunogaster, *Peron.*	Mediterranean.	Peron.
Foveolia diadema, *Peron.*	South Atlantic.	Peron.
Foveolia lineolata, *Peron.*	Mediterranean.	Peron.
Foveolia pulvinata, *Lesson.*	Indian Seas (?).	Lesson (?).
* Cunina campanulata, *Esch.*	Azores.	Eschscholtz.
* Cunina globosa, *Esch.*	South Seas.	Eschscholtz.
* Ægina citrea, *Esch.*	North Pacific.	Eschscholtz.
* Ægina rosea, *Esch.*	North Pacific.	Eschscholtz.
* Ægina grisea, *Q.* and *G.*	Admiralty Isles.	Quoy and Gaimard.
* Ægina semi-rosea, *Q.* and *G.*	New Guinea.	Quoy and Gaimard.
* Ægina capillata, *Q.* and *G.*	Gibraltar.	Quoy and Gaimard.
Ægina nivea, *Lesson.*	Indian Seas (?).	Raynaud.
Ægina corona, *Lesson.*	Indian Seas (?).	Raynaud.
Ægina carolinarum, *Lesson.*	Pacific.	Lesson.
* Æginopsis Laurentii, *Brandt.*	Behring's Straits.	Mertens.
* Æquorea Forskalea, *Peron.*	Mediterranean and Atlantic.	Forskal.
* Æquorea ciliata, *Esch.*	N. W. America.	Eschscholtz.
* Æquorea violacea, *Milne Edw.*	Mediterranean.	Milne Edwards.

Name in Lesson's Work.	Locality.	Observer and Remarks.
* Æquorea globosa, *Esch.*	South Seas, between tropics.	Eschscholtz.
* Æquorea eurodina, *Peron.*	Bass's Straits.	Peron and Lesueur (fig. unpub.)
* Æquorea cyanea, *Peron.*	Arnheim's Land.	Peron and Lesueur (fig. unpub.)
* Æquorea thalassina, *Peron.*	Arnheim's Land.	Peron and Lesueur (fig. unpub.)
* Æquorea stauroglypha, *Peron.*	French Coasts of British Channel.	Peron and Lesueur (fig. unpub.)
* Æquorea allantophora, *Peron.*	French Coasts of British Channel.	Peron and Lesueur (fig. unpub.)
* Æquorea Risso, *Peron.*	Mediterranean.	Peron and Lesueur, Risso (fig. by Risso).
* Æquorea amphicurta, *Peron.*	De Witt's Land.	Peron and Lesueur (fig. unpub.)
Æquorea bunogaster, *Peron.*	Van Arnheim's Land.	Peron.
* Æquorea sphæroidalis, *Peron.*	Endracht's Land.	Peron and Lesueur (fig. unpub.)
* Æquorea phosphoriphora, *Peron.*	Arnheim's Land.	Peron and Lesueur (fig. unpub.)
* Æquorea rhodolema, *Brandt.*	Conception, in Chili.	Mertens.
† * Æquorea octocostata, *Sars.*	Norway (British Seas).	Sars.
? Æquorea atlantica, *Peron.* (*Medusa æquorea*, Loefling.)	North Atlantic.	Loefling.
? Æquorea danica, *Peron.* (*Medusa æquorea*, Müller, Gm.)	Scandinavia.	O. F. Müller.
? Æquorea groenlandica. (*Medusa æquorea*, O. Fabricius.)	Greenland.	O. Fabricius.
* Polyxenia cyanostylis, *Eschs.*	N. Atlantic.	Eschscholtz.
* Polyxenia purpurea, *Peron.*	Endracht's Land.	Peron and Lesueur.
* Polyxenia pleuronota, *Peron.*	Arnheim's Land.	Peron and Lesueur (fig. unpub.)
* Polyxenia undulosa, *Peron.*	Arnheim's Land.	Peron and Lesueur (fig. unpub.)
* Polyxenia flavobrachia, *Brandt.*	South Sea.	Mertens.
* Stomobrachiota lenticularis, *Brandt.*	Falkland Isles.	Mertens.
* Mesonema cœlumpensile, *Modeer.*	Mediterranean and Atlantic.	Forskal.
* Mesonema abbreviata, *Esch.*	Straits of Sunda.	Eschscholtz.
* Mesonema pileus, *Lesson.*	African Seas?	Lesson.
* Mesonema macrodactyla, *Brandt.*	South Sea.	Mertens.
* Mesonema cœrulescens, *Brandt.*	35° N. lat., 144° lon., W.	Mertens.
* Mesonema dubium, *Brandt.*	Chili.	Mertens.
* Oceania phosphorica, *Peton.*	French coasts of the Channel.	Peron.
Oceania lineolata, *Peron.*	Mediterranean.	Peron, Risso.
Oceania flavidula, *Peron.*	Mediterranean.	Peron, Risso.
Oceania Lesueur, *Peron.*	Mediterranean.	Peron, Risso.
* Oceania dinema, *Peron.*	French Coasts of the Channel.	Peron and Lesueur (fig. unpublished).
? Oceania bimorpha, *Müller.*	Baffin's Bay and Norwegian Seas.	O. Fabricius.
* ? Oceania tetranema, *Peron.*	Holland (Slabber).	Slabber.
* ? Oceania sanguinolenta, *Peron.*	Holland (Slabber).	Slabber (*Turris coccinea*).
* ? Oceania danica, *Peron.*	Norway.	*Thaumantias hemisphærica*, of Müller.
? Oceania paradoxa, *Peron.*	Mediterranean.	Peron.
* ? Oceania microscopica, *Peron.*	Holland (Slabber).	Slabber.
? Oceania heteronema, *Peron.*	Havre.	Peron.
* ? Melicerta perla, *Slabber.*	Holland.	Slabber, perhaps a young *Pelagia*.
Melicerta pleurotoma, *Peron.*	De Witt's Land.	Peron.
Melicerta fasciculata, *Peron.*	Mediterranean.	Peron.
* Melicerta morchella, *Lesson.*	?	Lesson.
† * Saphenia dinema, *Peron.*	French and British Coasts.	Peron and Lesueur.
* Saphenia bitentaculata, *Q.* and *G.*	Gibraltar.	Quoy and Gaimard (*Geryonia* or *Tima*).
* Saphenia balearica, *Q.* and *G.*	Mediterranean.	Quoy and Gaimard.

Name in Lesson's Work.	Locality.	Observer and Remarks.
* Dianea endractensis, *Q.* and *G.*	S. W. Coast of Australia.	Quoy and Gaimard.
Dianea viridula, *Peron.*	French Coasts of Channel.	Peron.
Dianea gibbosa, *Peron.*	Mediterranean.	Peron, Risso.
* Orythia viridis, *Peron.*	Endracht's Land.	Peron and Lesueur.
* Orythia minima, *Cuv.*	Belgium.	Baster.
* Geryonia tetraphylla, *Eys.* and *Cham.*	Indian Ocean.	Eysenhardt and Chamisso.
* Geryonia bicolor, *Esch.*	Brazil, of Cape Frio.	Eschscholtz.
* Geryonia rosacea, *Esch.*	S. Sea, between the Tropics.	Eschscholtz.
* Geryonia exigua, *Q.* and *G.*	Gibraltar.	Quoy and Gaimard (*Geryonia*).
* Liriopa proboscidalis, *Forskal.*	Mediterranean.	Forskal (*Dianæa*).
* Liriopa cerasiformis, *Less.*	Gibraltar.	Quoy and Gaimard (*a Tima?*).
* Xanthia agaricina, *Lesson.*	?	Lesson.
† * Sarsia tubulosa, *Sars.*	Norway (Britain, N. America).	Sars.
* Tima flavilabris, *Esch.*	Azores.	Eschscholtz.
* Thaumantias cymbaloidea, *Slabber.*	Holland.	Slabber (only *T. hemisphærica*).
† * Thaumantias hemisphærica, *Gron.*	Norway (British Seas).	Müller, Gronovius, &c.
* Thaumantias lucida, *Mac.*	Britain.	Macartney, (var. of last).
* Thaumantias plana, *Sars.*	Norway.	Sars.
* Thaumantias multicirrata, *Sars.*	Norway.	Sars.
† * Thaumantias pileata, *Forbes.*	Britain.	E. Forbes.
† * Thaumantias Thompsoni, *Forbes.*	Britain.	E. Forbes.
† * Thaumantias punctata, *Forbes.*	Britain.	E. Forbes.
† * Thaumantias sarnica, *Forbes.*	Britain.	E. Forbes.
? * Linuche unguiculata, *Swartz.*	Jamaica.	Swartz (perhaps the fig. of a higher Medusa).
Usous roseus, *Lesson.*	?	Lesson.
* Lymnorea triedra, *Peron.*	Bass's Straits.	Peron and Lesueur.
* Favonia octonema, *Peron.*	Australia.	Peron and Lesueur.
* Favonia hexanema, *Peron.*	Equatorial Atlantic.	Peron and Lesueur.

1844. Dr. J. G. F. Will, of Erlangen. 'Horæ Tergestinæ,' 4to, Leipsig.

Some of the best researches on the Acalephæ, as yet given to the public, minute, accurate, and philosophical. The naked-eyed species described and figured are *Polyxenia leucostyla; Cytæis polystyla; Cytæis* (?); *Geryonia planata; Geryonia pellucida,* (*a Geryonopsis,*) and *Thaumantias leucostyla;* all observed in the Adriatic.

1846. H. Sars. 'Fauna littoralis Norwegiæ.' 1st pt. in folio, with 10 plates.

The first memoir in this valuable and beautifully illustrated work is devoted to the Medusa-producing polypes (Syncoryna, Podocoryna, Perigonomus,) and to the history of the gemmation of *Cytæis octopunctata,* the *Lizzia octopunctata* of this Monograph.

1846. E. Forbes. "On the Pulmograde Medusæ of the British Seas."

Communicated to the British Association at Southampton, and including the outline of the present treatise. It was printed in the Proceedings of the Association, and 'Annals of Natural History;' also translated in the 'Annales des Sciences Naturelles.'

INDEX OF GENERA AND SPECIES

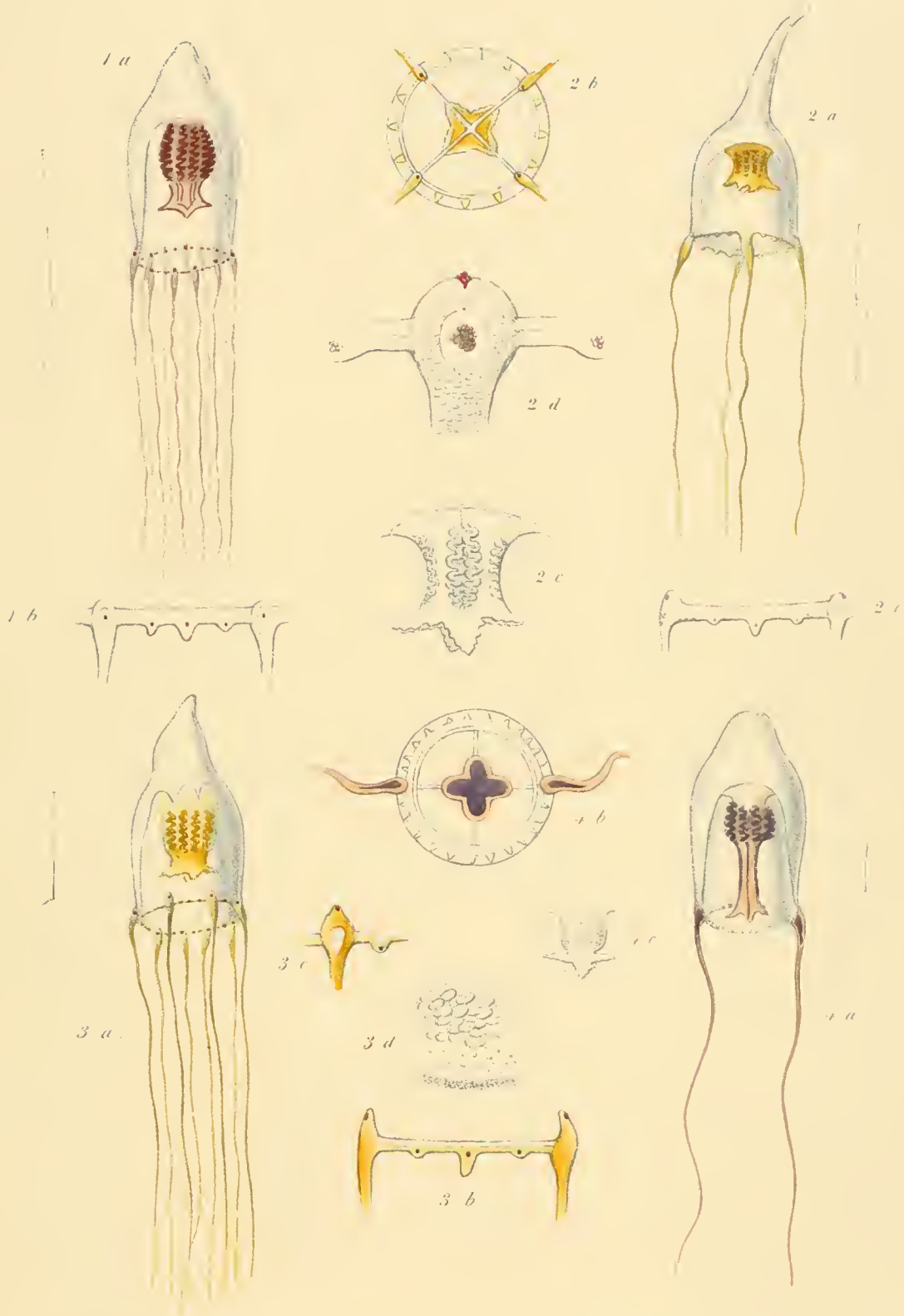
DESCRIBED IN THIS MONOGRAPH,

WITH THEIR SYNONYMS.

*** The names of spurious species and synonyms are in Roman letters.

THE END.

C. AND J. ADLARD, PRINTERS, BARTHOLOMEW CLOSE.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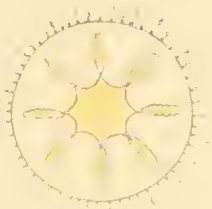

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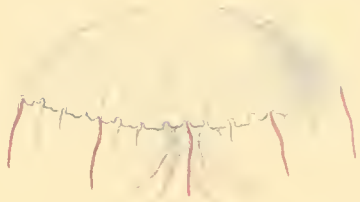

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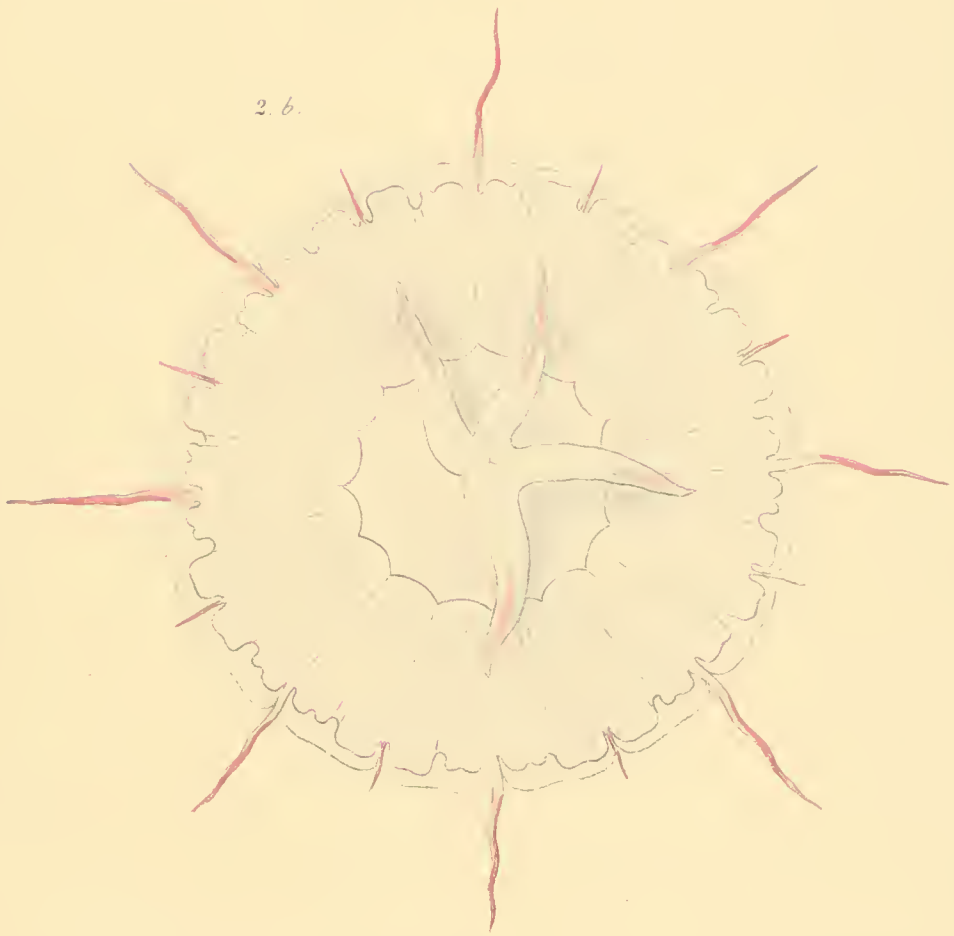

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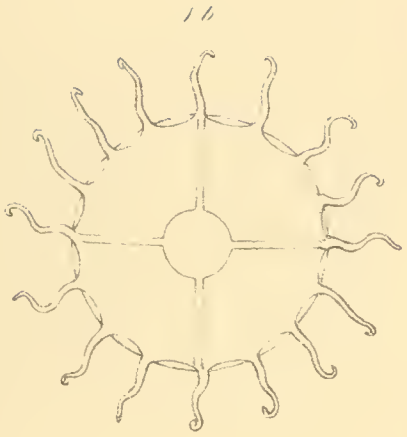

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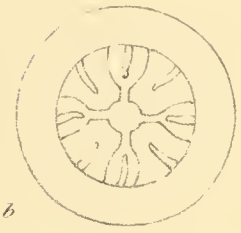

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MEDEER A FORMOSA 2 SARSIA GEMMIFERA 3 SARSIA TRUNCATA

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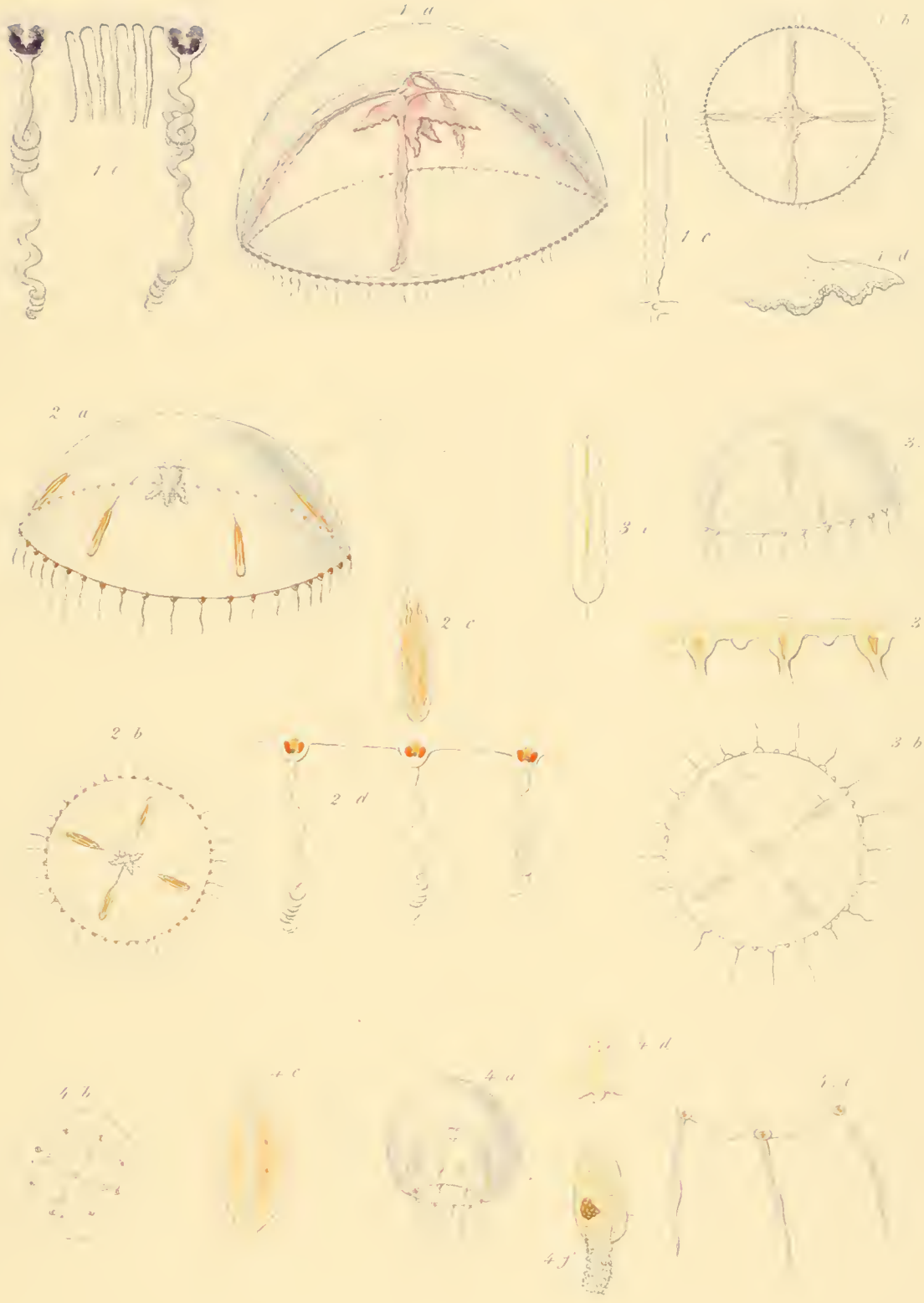
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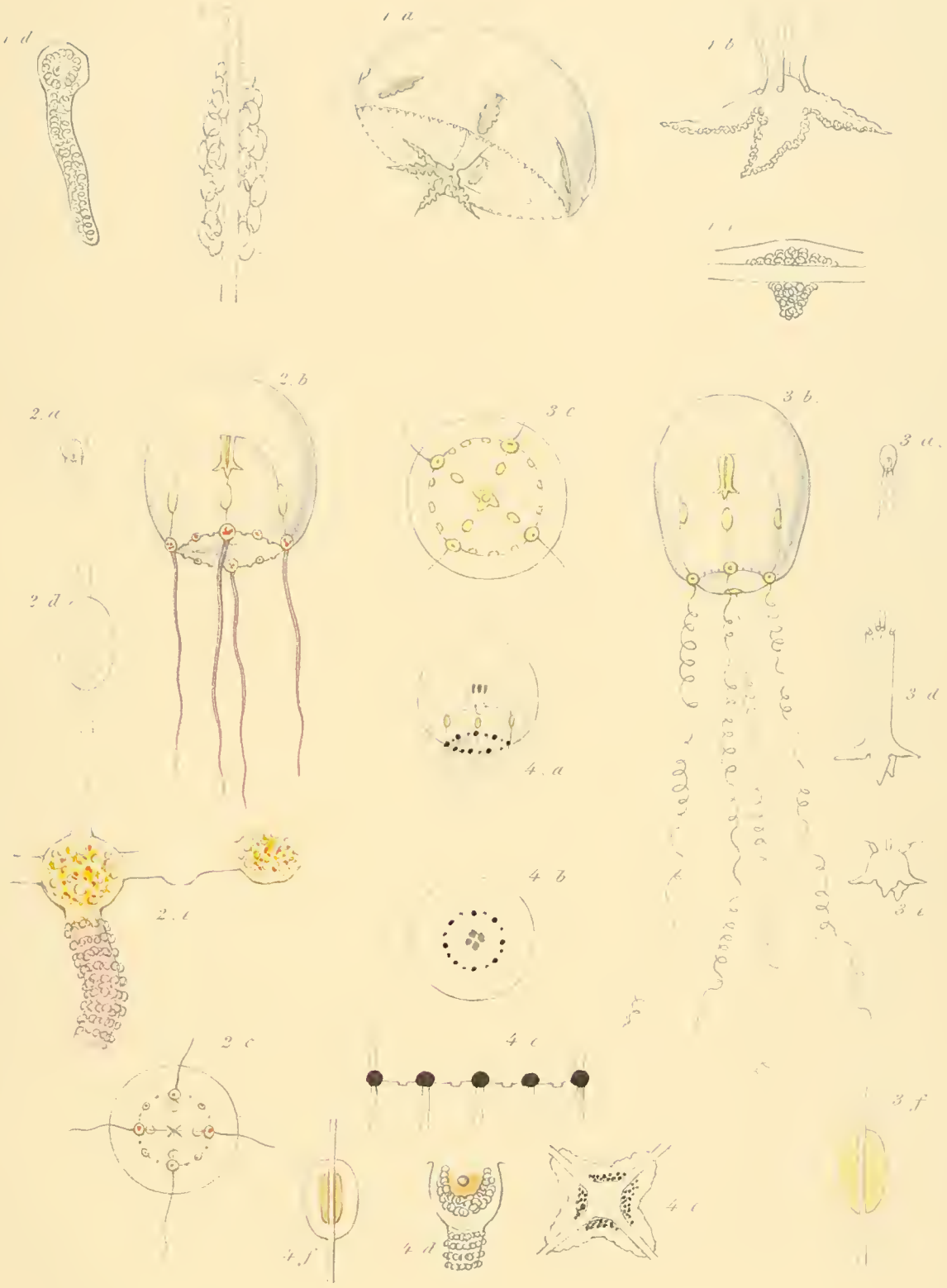
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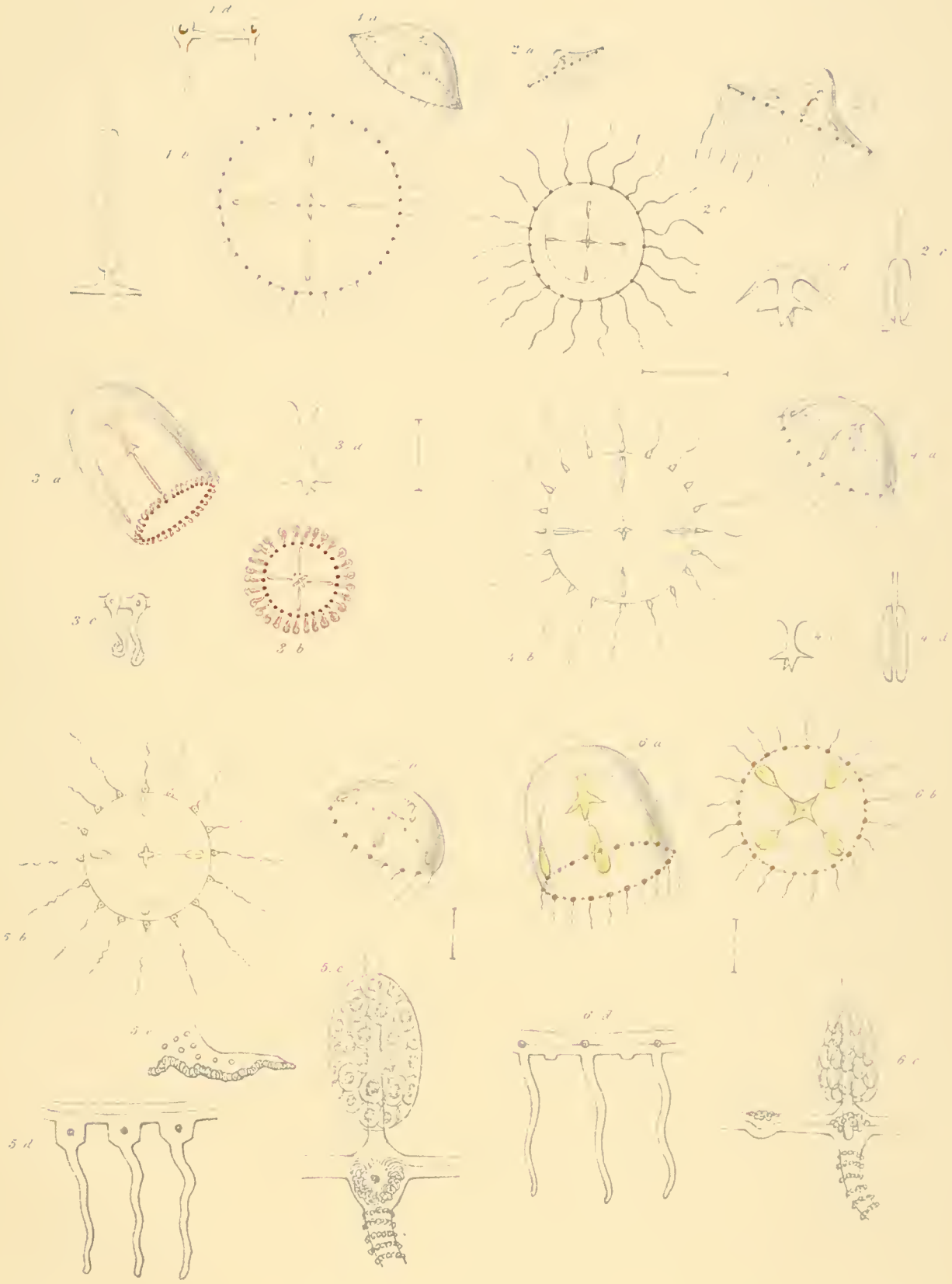

1 THALASSANEMA 2 T. SELECTA 3 T. GIBBOSA 4 T. SARMICA

5 T. THOMPSONI 6 T. UNCINATA


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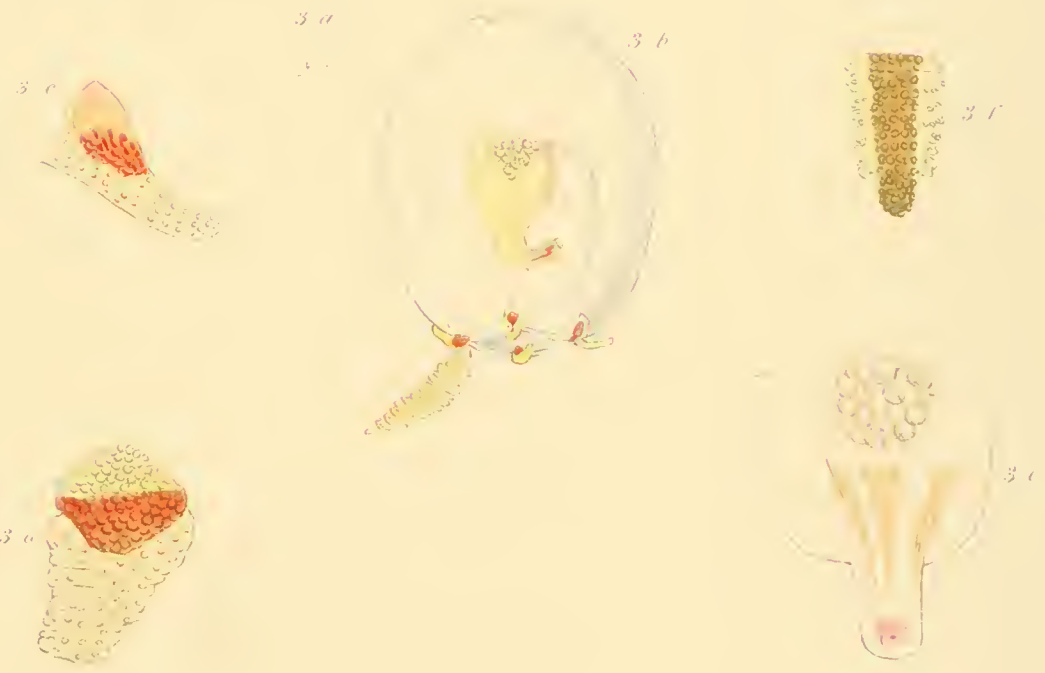
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