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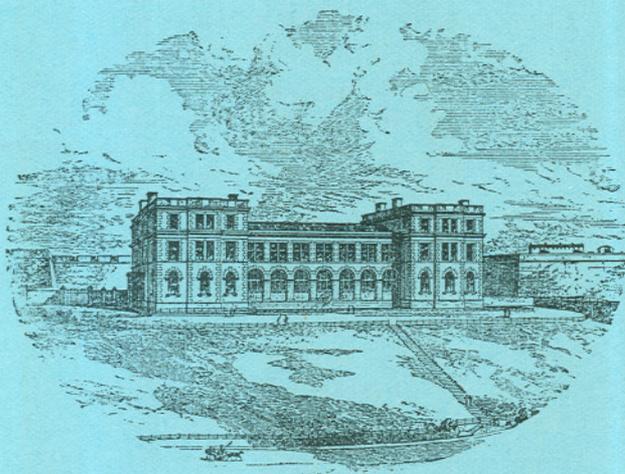
# Journal

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### Professor W. F. R. Weldon, F.R.S.

By the death of Professor W. F. R. Weldon, F.R.S., Linacre Professor of Comparative Anatomy in the University of Oxford, which occurred on Good Friday, 13 April, 1906, with painful suddenness in the midst of his activities, the Marine Biological Association has lost one of its oldest workers and one of its most earnest and enthusiastic supporters. It was in the autumn of 1887, before the building of the Laboratory was completed, that Professor Weldon first commenced work in connection with the Association, and from that time until his appointment to the Chair of Zoology, at University College, London, in 1891, he resided chiefly at Plymouth, and was engaged in investigations at the Laboratory. Since 1891, although the periods spent at Plymouth have not been so prolonged, visits during his vacations have taken place at frequent intervals, and many of his most important papers have been based upon researches carried out at the Laboratory and material collected there.

Professor Weldon's earlier investigations were directed to the study of the classification, morphology, and development of the Decapod Crustacea, and, although much of what he did remains unpublished, the thoroughness with which his researches upon the whole group were carried out was shown in the special courses of lectures upon it, which he subsequently delivered at University College. At the same time several important papers resulted from the work. In two memoirs, one published in the *Journal of the Association* on "The Cœlom and Nephridia of *Palæmon serratus*" (N.S., i. p. 162), and the other in the *Quarterly Journal of Microscopical Science*, on "The Renal Organs of Certain Decapod Crustacea" (vol. xxxii. p. 279), the structure of the green glands of various Decapods was described, and the remarkable development of the bladder of these glands in *Palæmon*, with its considerable extension backwards into the body cavity, was for the first time pointed out. In a later paper, on "The Formation of the Germ Layers in *Crangon vulgaris*" (*Quart. Journ. Micr. Sc.*, vol. xxxiii. p. 343), a careful and detailed account of the early development of a typical decapod ovum was given, and this paper well illustrates Professor Weldon's skill, both as a master of histological technique and as a powerful and accurate draughtsman.

Of Professor Weldon's later work, based upon the application of statistical methods to the study of variation, by which he will be chiefly remembered as a biological thinker of originality and force, it is not necessary to dwell at any length here, but it is of interest to record that one of his earliest, if not his first published statement on this

subject, is the note on "*Palæmonetes varians* in Plymouth," published in the Journal of the Association (N.S., I., 1890, p. 459), in which the variations of the teeth on the rostrum of this species are recorded from an examination of 915 individuals. Later papers based upon work done at Plymouth or upon material obtained there are:—

- "The Variations occurring in Certain Decapod Crustacea. 1. *Crangon vulgaris*" (*Proceed. Roy. Soc.*, vol. xlvii. p. 445).
- "Certain Correlated Variations in *Crangon vulgaris*" (*Proceed. Roy. Soc.*, vol. li., 1892, p. 1).
- "Certain Correlated Variations in *Carcinus mænas*" (*Proceed. Roy. Soc.*, vol. liv., 1893, p. 318).
- "An Attempt to Measure the Death-rate due to Selective Destruction of *Carcinus mænas*, with respect to a Particular Dimension" (*Proceed. Roy. Soc.*, vol. lvii., 1895, p. 360).
- "Remarks on Variation in Animals and Plants" (*Proceed. Roy. Soc.*, vol. lvii., 1895, p. 379).
- "Presidential Address to the Zoological Section (on Natural Selection and Variation)" (*Report. Brit. Assoc.*, 1898).

Professor Weldon became a member of the Marine Biological Association in 1884, the year of the inauguration of the Association, and his name first appears in the list of Founders in 1887. In 1888 he was elected a Member of Council, and from that time he continued to serve the Association in this capacity, having been in recent years the representative of the British Association for the Advancement of Science. His time and energy have been freely devoted to the work of the Council, and his personal experience of the various departments of the Association's activity have given special value to his views and recommendations upon many important questions of policy, which the Council has been called upon to determine.

When the Association undertook to carry out for His Majesty's Government the programme of International Fishery Investigations in the English area, Professor Weldon gave particular attention and devoted much time to the vast amount of statistical work, which is entailed by those investigations, and the fact that both the general methods and the results so far published were subjected to his careful and critical examination has added greatly to their value and to the confidence with which the Council was enabled to regard them.

By his enthusiasm, his energy, and the keenness of his intellectual insight, Professor Weldon helped largely in the attainment of the success which has attended the efforts of the Marine Biological Association, and by his ever-ready co-operation with his colleagues on the Council, and with the members of the scientific staff, he so endeared himself to all those with whom he was associated in the work that his death has left a gap which it will hardly be possible to fill.—E. J. A.

## Notes on some British Nudibranchs.

By

C. Eliot,

Vice-Chancellor of the University of Sheffield.

With Plates XI and XII.

THE following notes are the result partly of an examination of various living specimens at Plymouth in the spring of 1905, and partly of the study of preserved material most kindly placed at my disposal by Mr. E. J. Allen and Mr. W. I. Beaumont, of the Laboratory, Plymouth, Mr. W. E. Hoyle, of the Manchester University Museum, and the Council of the Hancock Museum at Newcastle. I must also express my thanks and obligations to Mr. T. J. Evans, lecturer in Biology at the University of Sheffield, who has prepared for me sections of the smaller specimens and embodied the results in drawings which will add very materially to any value which this paper may have.

The following are the species noticed:—

1. *Tritonia alba*, A. & H.
2. *Staurodoris verrucosa* (Cuvier).
3. *Archidoris testudinaria* (A. & H.).
4. *Geitodoris planata* (A. & H.).
5. *Lamellidoris bilamellata* (L.).
6. *L. oblonga* (A. & H.).
7. *L. depressa* (A. & H.).
8. *L. pusilla* (A. & H.).
9. *Pleurophyllidia loveni*, Bergh.
10. *Lomanotus genei*, Vérany.
11. *L. marmoratus*, A. & H.
12. *L. flavidus*, A. & H.
13. *Hancockia dactylota*, Gosse.
14. *Doto pinnatifida*, A. & H., var. *papillifera*.
15. *Berghia cœrulescens* (Laurillard).
16. *Coryphella rufibranchialis* (Johnst.).
17. *C. gracilis* (A. & H.).
18. *C. landsburghii* (A. & H.).
19. *C. beaumonti*, spec. nov.
20. *Eolis angulata*, A. & H.
21. *Amphorina aurantiaca* (A. & H.),  
(= *Cuthona aurantiaca*.)

22. *Amphorina olivacea* (A. & H.).  
(= *Cratena olivacea*.)
23. *Cratena amœna* (A. & H.).
24. *Calma glaucoides* (A. & H.).
25. *Antiopella cristata* (Delle Chiaje).
26. *Janolus hyalinus* (A. & H.).
27. *Janolus flagellatus*, sp. nov.
28. *Alderia modesta*, Lovén.
29. *Stiliger bellulus* (d'Orbigny).

Of the above, *Coryphella beaumonti* and *Janolus flagellatus* are new species. The first may be regarded as certain, though it offers so many peculiarities that its place in the genus *Coryphella* is open to question. *Janolus flagellatus* differs from other described species in its genitalia, but cannot be regarded as certain until better preserved specimens are examined. *Berghia cœrulescens* must be removed from the list of the British fauna, for the only recorded specimen is a *Facelina coronata*; but *Staurodoris verrucosa* may be added, for it seems to be certainly, though sporadically, recorded from Devonshire, the Clyde, and West Ireland.

An examination of the type specimen of *Tritonia alba*, A. & H., has enabled me to show that this species, which has been called in question, is valid and well characterized. The valuable material with which I have been supplied has, I hope, enabled me to amplify our knowledge of *Lomanotus*, *Hancockia*, *Alderia*, and *Calma*. The systematic position of the last genus appears to me to have been misunderstood; *Calma glaucoides* belongs to the same genus as the later *Forestia mirabilis* of Trinchese, but *Calma cavolini* must be removed from this group, as it does not possess the characteristic radula.

I have also attempted to elucidate the synonymy and affinities of Alder and Hancock's *Doris testudinaria*, which appears to be a fairly common form, though often confounded with *Archidoris tuberculata*, and have also examined the classification of the Cratenidæ. I think that the genus *Amphorina* must be referred to this group, and that the animals described as *Cratena olivacea* and *Cuthona aurantiaca* are really referable to *Amphorina*. *Eolis angulata* is probably a young *Æolidiella glauca*.

#### TRITONIA.

A species of this genus which has been called in doubt is now shown to be valid by an examination of the type specimen, and the following additions may be recorded to *Tritonia* and *Candiella*, of which Bergh recognized sixteen species in the *System der Nudibranchiaten Gastropoden*, 1892. I do not think that the distinction between *Tritonia* and

Candiella can be maintained (*vide* Eliot, "On the Nudibranchiata of the Scottish National Antarctic Expedition," *Trans. Roy. Soc. Edinb.*, vol. xli. part iii. p. 523, 1905).

17. *T. alba*, A. & H.
18. *T. exsulans*, B.
19. *T. incerta*, B.
20. *T. gigantea*, B.
21. *T. (Candiella) australis*, B.
22. *T. (Cand.) ingolfiana*, B.
23. *T. (Cand.) villafranca*, Vayssière.
24. *T. appendiculata*, Eliot.  
(? = *T. challengeriana*, var.)
25. *T. olivacea*, B.
26. *T. irrorata*, B.

#### TRITONIA ALBA, A. & H.

(*Monogr. of the British Nudib. Mollusca*, part vii. p. 48, and  
Appendix, p. vi.)

Specimens of this form were found by Alder and Hancock at Cullercoats, near Newcastle, and described by them as having considerable external resemblance to young individuals of *T. hombergii*, but as differing in dentition from all known Tritonias, inasmuch as the lateral teeth were denticulate or branched. Bergh (*Mal. Unt. in Semper's Reisen*, Heft xv. pp. 734 and 736) rejects the species as doubtful, and thinks that the denticles were merely an illusion of the microscope. An examination of the original specimens preserved in the Hancock Museum at Newcastle-on-Tyne has shown me, however, that this is not the case, and that the teeth are really denticulate.

The two specimens are respectively 7 and 6 mm. long, and 2·8 and 2·2 mm. broad. One is dark brown, the other yellowish. The hard buccal parts are fortunately well preserved, otherwise few characters either external or internal can be established, which is hardly surprising, as the specimen must be at least fifty years old. There is no reason, however, to doubt the accuracy of Alder and Hancock's descriptions. The dorsal margin is large, and seems to have borne in the one specimen six, in the other eight branchiæ of various sizes. No trace of stomach plates was found.

The jaws are yellow, rather long and narrow, and bear near the edge about four rows of small prominences resembling a mosaic. The radula is very transparent, and consists of twenty-five rows, which appear to contain thirty-six teeth on each side of the rhachis when complete. The rhachidian tooth (Pl. XI, Fig. 1. a.) is tricuspid, and hollowed out

below. The first lateral (Pl. XI., Fig. 1. b.) is of the usual clumsy shape, but is rather variable in outline. The second lateral (Pl. XI., Fig. 1. c.) is smooth, moderately stout, and simply hamate. The succeeding teeth become longer and slenderer towards the outside. The third lateral bears a prominence or rudimentary denticle, and the remaining laterals in the middle of the half-row (Pl. XI., Fig. 1. d. e. f.), bear from one to three long branch-like denticles, and sometimes one or two accessory shorter ones. Towards the end of the row the denticles are found only at the tip of the teeth, and the outermost (Pl. XI., Fig. 1. g.) are elongate and bifid. This peculiarity is not marked in Alder and Hancock's plate, which otherwise gives a very accurate representation of the radula.

#### STAURODORIS, BERGH.

It is worthy of consideration if this genus should not bear the Linnæan name of *Doris*. Bergh (*Mal. Unt. in Semper's Reisen*, xiv. p. 616) decided to discontinue the use of this name ("besser wäre es, wie hier geschieht, den Namen Doris als generische Bezeichnung ganz zu streichen"). But there seem at least two objections to this course. Firstly, if an old genus is divided into sub-genera, one of these new sub-genera should, according to the rule generally recognized, bear the name of the old genus. Secondly, it would appear that in *Staurodoris verrucosa*, Bergh, the use of the specific name really admits that the animal is the Linnæan *Doris*. The type of *Doris* is *Doris verrucosa* of the tenth edition of the *Systema Naturæ*. It is true that the animal cannot be recognized from Linnæus's description, but Cuvier identified it rightly or wrongly with a Mediterranean form, and Cuvier's animal has been renamed *Staurodoris verrucosa* by Bergh. But this form can bear the specific name *verrucosa* only on the supposition that it is the *Doris verrucosa* of Linnæus. Therefore either it is *Doris verrucosa*, or else *Staurodoris* with a new specific name; but it cannot logically be *Staurodoris verrucosa*.

Further, it seems a pity to abolish a well-known name used by so many eminent naturalists, and in my opinion the use of *Doris* is not only correct, but convenient. I cannot help thinking that the distinctions between Bergh's genera of the Archidorididæ are somewhat minute, and that a juster classification would be secured by the use of the genus *Doris* (type *Doris verrucosa*), to include as sub-genera at least *Staurodoris*, *Archidoris*, *Anisodoris*, and possibly others.

*Staurodoris*, Bergh, cannot in my opinion be satisfactorily separated from *Archidoris*, Bergh, as the two genera are connected by their less typical members. The typical *Staurodoris* has simply pinnate branchiæ and the back studded with clavate tubercles, which form valves round the rhinophores and branchiæ. But in the less typical form the

branchiæ become bi- or tripinnate and the valvular tubercles less distinct.\* The following forms would perhaps be referable to the sub-genus *Staurodoris* :—

1. *St. verrucosa* (Cuvier).  
*St. pseudoverrucosa*, Jher.  
*St. januarii*, Bergh.
2. *St. bertheloti* (d'Orbigny).
3. *St. d'orbigny* (Gray).
4. *St. pustulata* (Abraham).  
 [See Hedley and Basedow, *Trans. Roy. Soc. S. Australia*, vol. xxix., 1905, p. 150, pl. ix.]
5. *St. maculata* (Garstang).
6. *St. depressa*, Eliot.
7. *St. calva*, Eliot.
8. *St. bicolor*, Bergh.
9. *St. rusticata* (A. & H.).
10. ? *St. pecten*, Eliot.
11. ? *St. flabellifera* (Cheeseman).

The last two species have a peculiar configuration of the branchiæ, which renders their inclusion in this genus doubtful. *St. bertheloti* and *St. d'orbigny* are only known from very imperfect descriptions.

#### STAURODORIS VERRUCOSA (CUV.).

Two specimens from the Museum of the Manchester University, labelled as coming from the Firth of Clyde. The larger is 35 mm. long and 21 broad; the other slightly smaller. The details given below refer to the larger specimen, unless otherwise stated.

Both specimens are depressed, rather stiff and hard, uniform whitish yellow in colour. The back is studded with large and small tubercles. There are fifteen of the former, about 3 mm. high and 2 mm. broad. Smaller ones are scattered among them, and the tubercles decrease in size towards the edge of the mantle, which is fairly wide. The foot is broad; no groove or notch is visible on the anterior margin. The tentacles are ridge-like.

The rhinophore pockets are protected by four tubercles (two large and two small) in the smaller specimen and by three in the other, one of the smaller tubercles not being developed. The branchiæ are simply pinnate, eighteen in the larger specimen, fourteen in the smaller. The pocket has a thin slightly raised lip, bearing eight tall, slender tubercles about 3.5 mm. high, alternating fairly regularly with quite small ones.

The intestines are yellowish, except the stomach, which is black from

\* Vayssièrè's figure of the Mediterranean *Archidoris tuberculata* (*Opisth. de Marseille*, iii. pl. 1, fig. 1) seems to me to have the external characters of *Staurodoris*.

the colour of its contents. The spermatheca is very large. The formula of the yellowish radula is  $55 \times$  about 60.0.60. The teeth are simply hamate, and rather crowded. The outermost are degraded, but not denticulate. In the anterior, but not in the posterior rows, the innermost teeth project somewhat into the rhachis, which bears longitudinal folds.

*St. verrucosa* has already been recorded from the British marine area by Mr. G. P. Farran, who found one specimen at Fahy Bar, Ballynakill, West Ireland (*Ann. Rep. Fish. Ireland, 1902-3*, part. ii. app. vii. [1905] pp. 207-8). Bergh in his systematic arrangement of the Nudibranchiata unites with it *St. januarii*, *St. ocelligera*, and *St. pseudo-verrucosa*, and including these varieties the species is now recorded from the Mediterranean and Adriatic, the coast of Brazil, the Atlantic coast of Europe, and South Carolina.

#### STAURODORIS VERRUCOSA (CUV.), VAR. MOLLIS.

One specimen, labelled Salcombe, R. A. Todd, 3. VIII. 1900. The measurements are: length, 21 mm.; breadth, 12; height, 7. The colour is white, with a faint yellowish tinge; the texture soft. The foot is 17 mm. long and 6 broad, with a longish free tail; it has slight traces of a groove in front, but no notch. The mantle edge is ample, and measures about 4 mm. The tentacles consist of a ridge-like prominence on either side of the mouth; they are attached for the greater part of their length, and show slight traces of a fold. The back is somewhat sparsely tuberculate. Down the centre run six fairly regular longitudinal lines of large tubercles, about 1.5 mm. wide and 1 mm. high. Between them and on the mantle edge are smaller tubercles. A few tubercles near the branchiæ are taller and almost clavate. There is no trace of ridges connecting the various tubercles. The rhinophores are deeply perfoliate, and emerge between two tubercles. The rim of the branchial pocket is slightly raised, and bears ten tubercles of various sizes, but all quite distinct. The largest are 1 mm. high. The branchiæ are simply pinnate, the pinnae being alternately long and short. They project about 4.5 mm. from the pocket, and lie flat on the back like a star. Seen thus they appear to be thirteen, but on opening the pocket it is seen that nine are long and separate, and four small, springing from the sides of the longer ones. All the plumes are united at the base in a common circular band, which bears papillæ outside. The anal papilla is central.

The intestines are white. In the central nervous system the cerebropleural ganglia are above the pedal, which as preserved lie below them at the side. The eyes are black and distinct.

The buccal mass is elongate. In one part of the labial cuticle is a mass of variously shaped spicules, which are apparently the remains of a fragment of food embedded in the skin, and do not represent an armature of the lips. The radula is colourless, with a maximum formula of  $40 \times 45.0.45$ . The teeth are rather straight and only slightly hamate. Towards the end of the rows the spike becomes reduced and the base increases, with the result that the tooth resembles a broad, clumsy hook. The two innermost teeth project into the rhachis, and are lower than the rest, but not denticulate.

The œsophagus is thin, and the salivary glands band-like. The stomach lies in an upper anterior cleft of the liver, but is separate from it. Its walls are thickish, with a strong irregular lamination. The genitalia seem to be as in the typical form. The light-grey hermaphrodite gland is spread over the greenish liver. The spermatheca is large and spherical; the spermatocyst much smaller and elliptical. No armature was found.

I have compared this animal with specimens of *St. verrucosa* from the Mediterranean. It is lighter in colour, very much softer in consistency, and the tubercles are lower and, as a rule, not clavate. But these are all matters of degree, and I do not think a new species can be created on the evidence of a single specimen.

The present specimen is superficially quite unlike *St. maculata* (Garstang), which is very convex, hard, and bears a pattern of knobs connected by ridges.

#### ARCHIDORIS TESTUDINARIA (A. & H.).

[*Doris testudinaria*, Alder and Hancock, *Ann. and Mag. H. N.*, 1862, vol. x., 3rd series, p. 261.

? *Doris testudinaria*, Risso. *Hist. Nat. de l'Eur. Mer.*, iv., 1826, p. 33.

*Archidoris stellifera*, H. von Jhering. See VAYSSIÈRE, *Journal de Conchyl.*, vol. lii. No. 2, 1904, p. 123. *Id. Opist. de Marseille Supp.*, p. 82, 1903.

*Doris testudinaria*. Jeffrey's *British Conchology*, vol. v. p. 85 (written by Alder, as stated on p. 27).]

Both the nomenclature and the specific limits of this form present many difficulties, and it is with great diffidence that I submit it should be called *Archidoris testudinaria*, that it is identical with the *Archidoris stellifera* of Vayssière and von Jhering, and that it is probably distinct from the *Doris planata* of Alder and Hancock. Two points, however, seem certain: first, that the specimens from Plymouth here described are the *Doris testudinaria* of Alder and Hancock; second, that they are distinct from *Archidoris tuberculata*, with which they are often confounded in practice.

In 1862 Alder and Hancock described (l.c.) a new British Dorid, which they identified with the *D. testudinaria* of Risso. From some unpublished notes preserved in the Hancock Museum at Newcastle-on-Tyne, it is probable that they based this identification, not on Risso's description, but on specimens sent from the Mediterranean and labelled *D. testudinaria*, which they considered identical with their specimen from Herm Island.\* Risso's description is vague, inadequate, and, as pointed out first by Philippi (*Enum. Moll. Sicil.*, vol. ii. p. 78), probably inaccurate. Bergh and others have thought that it refers to *Platydoris argo*. But since Alder and Hancock have given the name to a fully described animal, which is possibly identical with Risso's animal, it would seem that their interpretation of the name must be regarded as authoritative. After Alder and Hancock had assigned the name *D. testudinaria* to an identifiable form, von Jhering gave the name *Archidoris stellifera* to Mediterranean specimens, which seem to me to belong to the same species. His description appears to have been only in MS., and publication dates from the memoirs of Vayssière, who uses the same name. As will be seen from the notes here given, stellate forms are found on the British coast, and appear to be specifically the same as the less ornate variety described by Alder and Hancock. It is remarkable, however, that Vayssière states that the mouth of his specimens is armed with a chitinous ring. I could not discover this structure in the specimen which he kindly sent to me.

Alder and Hancock, in the *Ann. and Mag. of Nat. Hist.*, l.c., expressed the opinion that *D. testudinaria* and *D. planata* are distinct though similar species. Subsequently Alder in *Jeffrey's Conchology* (l.c.) came round to the opposite view, and stated that an examination of further specimens of different sizes from the Clyde proved that *D. planata* is the young of *D. testudinaria*. It is extremely difficult to form any decided opinion on this question. The external characters are likely to vary considerably at different periods of the animal's growth, and it would appear that in *D. testudinaria (stellifera)* a labial armature may or may not be developed. Vayssière reports its presence, and Alder and Hancock (*Ann. and Mag. N. H.*, l.c.) say of *D. testudinaria* and *D. planata*, "the character of the tongue is similar in each." On the other hand, in a number of specimens from Plymouth which I have examined, I have found a decided labial armature in the small flat individuals and none at all in the large plump ones. It is present in the specimen of *D. planata* from Alder and Hancock's collection at Newcastle. On the whole I am inclined to think that there are two separate forms which are very much alike in their younger stages.

\* It is even possible that A. & H. may have obtained the specimens from Risso, or from some one who knew the animal which he called *D. testudinaria*. They were writing about Nudibranchs in 1841, but probably began collecting earlier.

(1) *D. planata*. This is a remarkably flat form, which appears not to exceed an inch in length in British waters. The dorsal surface is finely granulated, there is a distinct labial armature, and the radula is decidedly of the type of *Geitodoris*, Bergh, that is to say, there are two kinds of teeth, the inner teeth being of the ordinary hamate shape, and the outer very thin and crowded together in sheaves. It is possible that some specimens (about 50 mm. long) which I have received from the Cape Verde Islands may be adults of this species. They resemble the Plymouth specimens, except that they are much larger and were red in life. The richer colour may perhaps be due to the climate.

(2) *D. testudinaria*. This is a plump form of considerable size (60 mm.). The back is covered with flat tubercles, which are sometimes arranged in a stellate pattern. In the specimens from Plymouth, which I have myself examined, there is no labial armature, but Vayssière states that it is present in the Mediterranean form, which is otherwise undistinguishable. The radula is not unlike that of the last species, but the differentiation of the teeth is less marked. The outer are thinner than the inner ones, but the change is less abrupt, and the thinner teeth are not gathered together in such distinct sheaves or packets.

The names *Platydoris testudinaria* and *Platydoris planata* would seem to be in any case incorrect, for none of the animals have the characters of *Platydoris* (which include a peculiar hard consistency and an armature of hooked scales on the reproductive organs). It is possible, but not demonstrable, that the *Doris testudinaria* of Risso was a *Platydoris*; but, if so, it is neither the *D. testudinaria* nor the *D. planata* of Alder and Hancock.

Alder and Hancock's type specimen labelled "*Doris testudinaria*, Herm," has been kindly lent me by the Council of the Hancock Museum, Newcastle.

It is 30 mm. long, 23 broad, and 15 high. The mantle margin is broken in many places, but it apparently covered the sides and the foot entirely in its original condition. The general colour of the animal is greyish yellow. Some of the dorsal tubercles are lighter than the surrounding surface. There are some reddish spots on the under side of the mantle.

The texture is soft, and the specimen is a little decayed. The back is covered with low flat warts of various sizes. No stellate arrangement is visible. The branchial and rhinophorial pockets are surrounded by tubercles which do not amount to valves. The branchiæ are retracted within the pocket, and their number could not be ascertained. The anterior part of the animal is much retracted, but the long linear tentacles are clearly visible.

The buccal parts have been extracted.

No further examination was made in order not to injure the unique specimen.

I have also examined five specimens seen alive at Plymouth in April, 1905. They vary somewhat in external appearance, and may be described separately.

A. One specimen, rather variable in shape, but flattish. When fully stretched out and moving its length is 60 mm. and its breadth 32. It is active in its motions. The main colour of the back is mottled purplish brown of various shades, the deepest of which is almost black. The general colour is lighter towards the margin, though here the darker shades are more conspicuous by contrast. There are a few irregular sandy-grey markings here and there, especially in front of the rhinophores, and twelve sandy-yellow star-like figures arranged symmetrically in four lines between the rhinophores and the branchial pocket. The back is covered with flat tubercles, very slightly prominent, and more or less of the same size (not more than 1 mm. in breadth), except those forming the centre of the stars, which are about twice as large as the others. The tubercles forming the stars appear to be set in a stellate figure, but the pattern is due to pigment rather than to the arrangement of the tubercles. The edge of the rhinophore pockets is set with small tubercles. The rhinophores are elongate, with about fifteen perfoliations. They are olive coloured, and the stalk is long compared with the laminated part. The branchial pocket is slightly raised and tuberculate. The branchiæ are six, tripinnate, sandy yellow, with purplish flecks. The anal papilla is purplish, but the edge is crenulate and distinctly margined with sandy yellow. The foot is grooved in front and the upper lamina notched. The tentacles are cylindrical and elongate, which makes the whole head look unlike that of *A. tuberculata*. The under side is white, but in this and in all the specimens there are a few purplish spots on the under side of the mantle, which is rather ample and overhangs the foot all round.

B. In a second specimen of about the same size the characters are exactly the same, but there are only four stellate figures on each side, and they are less regular both in their formation and their arrangement. The pockets of the rhinophores and the branchiæ are very distinctly crenulate and tuberculate.

C. Three similar but rather smaller specimens are paler in colour, and the stellate figures are only imperfectly developed. The branchiæ are as many as seven or eight.

The internal characters of all the specimens are much the same. The blood gland is large, double, purple or greyish. The central nervous system is not quite as in *A. tuberculata*. Seen from the upper

side, the ganglia appear united in a horseshoe-shaped mass in which no divisions are clearly distinguished. Seen from below, the division between the cerebro-pleural and pedal ganglia is plain, but the cerebro-pleural ganglia are not distinctly divided into two portions. The common commissure is thick and very short.

The integuments, especially the tuberculate dorsal surface, are very spiculous, and contain a dense mass of colourless rods, often slightly bent, but not swollen in the middle, jointed, or branched.

No labial armature could be found, but on the labial cuticle in some specimens were granular markings resembling grey dust, but not forming rods or compact plates. The radula consists of about thirty rows, and the number of teeth on each side of the rhachis does not appear to much exceed forty as a maximum; but the whole radula is fragile and difficult to extend. The teeth are transparent and colourless, longer and thinner than in *A. tuberculata*, and with narrower bases. Near the rhachis (Fig. 2. a. b.) the teeth are low and with comparatively broad bases; but they increase in length and slenderness towards the outside until the last two or three, which are shorter, but often somewhat deformed (Fig. 2. f.). Teeth with abnormal lumps and projections occur in all parts of the radula (Fig. 2. d.).

The œsophagus is narrow at first, but widens and enters the liver. The stomach lies within the liver. The gall bladder is small and pear-shaped. The intestine issues from the liver about the middle of its dorsal surface, runs forward and then turns backward. The liver is of a dull orange colour; the hermaphrodite gland, spread over it, is of a dull opaque white.

The spermatheca is large, greenish or bluish grey, and spherical. The spermatocyst is small, white or orange-white, less distinctly spherical, and sometimes pear-shaped. There is no prostate. The vas deferens is very slender, long, and convoluted. The penis small, conical, and unarmed. The duct seems to issue at the side of the tip.

Though this species is commonly confused with *A. tuberculata*, it seems to differ in the following points:—

(1) The typical coloration is different, though it is very often imperfectly developed. But there are nearly always purple spots on the lower side of the mantle, which seem not to occur in *A. tuberculata*.

(2) The general form is flatter.

(3) The shape of the tentacles and anterior part of the foot is markedly different.

(4) The tubercles are less prominent and of more equal size.

(5) The branchiæ are stouter and less voluminous.

(6) The shape of the teeth is different.

(7) The stomach is enclosed within the liver.

For purposes of comparison I have examined a specimen of *A. stellifera*, most kindly sent me from Marseilles by Professor Vayssière. It is 31 mm. long, 16 broad, and 10 high, flattish and rather smooth, with low even tubercles. The colour of the dorsal surface is dark olive-brown of various shades; the larger tubercles are yellowish, but the stellate appearance is hardly visible. The under side is pinkish, with reddish brown dots on the lower surface of the mantle. The oral tentacles are longish, conical, and somewhat flattened. The anterior margin of the foot is grooved and perhaps notched, but this is difficult to decide. The edge of the rhizophore pockets is set with small inconspicuous tubercles. The branchiæ are eight; the edge of the pocket is tuberculate, much like the rest of the back, but has no special tubercles of its own. The formula of the radula is about  $18 \times 30.0.30$  and the shape of the teeth as described above for the Plymouth specimens.

Neither in this specimen, nor in those from Plymouth, could I find any trace of the armature described by Professor Vayssière (l.c.) as "anneau chitineux mandibulaire, complet, assez large, offrant dans la partie interne de petits et très courts bâtonnets prismatiques." Nothing was visible but a thick unarmed cuticle.

Vayssière refers this form to Archidoris, and I follow him; but if the external teeth are longer and thinner than the internal ones, and if, as Vayssière has found, a labial armature is sometimes present, it is clear that the division between Archidoris and Geitodoris is not so sharp as might be supposed. It would be interesting to have statistics as to the *uniform* presence or absence of the labial armature in various species. There certainly seems to be ground for suspecting that in some species of Archidoris and Staurodoris it is generally absent, but occasionally present, though not much developed. With reference to this and many other organs, we have little information as to the effect of age and growth on the external and internal characters of Nudibranchs.

#### GEITODORIS PLANATA (A. & H.).

(ALDER and HANCOCK, Monograph, Plate VIII., and Part VII. p. 42. ELIOT, *Proc. Mal. Society of London*, Sept., 1904, vol. vi. No. 3, pp. 180-1.)

In the paper cited above I have described specimens caught at Plymouth, and considered in the Laboratory to be *D. planata*, A. & H., and have also given my reasons for referring them to Geitodoris. Since writing this I have examined two other preserved specimens at Plymouth. The back is granulate, with some larger tubercles, and also with some pits, which often give the upper side a honeycombed appearance. The mantle edge is broad, and on the under side veined with anastomosing lines. The branchiæ appear to be nine, and in small

specimens are very small indeed and hardly visible. There is a distinct labial armature formed of rods, and the radula consists of two kinds of teeth. In the largest specimen the formula seemed to be  $25 \times 6 + 30.0.30 + 6$ , the six outermost teeth being long, very thin, and compressed together so as to look almost like a single tooth. I have also examined a specimen from Alder and Hancock's collection at Newcastle labelled "Doris planata. W. R. Hughes. Sidmouth." It is only 5 mm. long and 4 broad, and entirely dried up, having unfortunately not been kept in alcohol. As far as anything can be made out under such unfavourable conditions, the external characters are much as in Alder and Hancock's plate. The colour is yellowish, the back granulated and pitted, the mantle edge very ample, the branchial pocket large and round. There is a distinct yellow labial armature composed of rods. As usual in these old specimens, the radula is decomposed and in confusion; but there are clearly visible (*a*) ordinary hamate teeth; (*b*) bundles of long, thin, almost shadowy, teeth. The whole animal is very flat.

Through the kindness of Mr. Crossland I have received from the Cape Verde Islands several specimens which are possibly well-grown adults of this form, and in any case are closely allied to it. The general characters, particularly the tentacles, branchiæ, labial armature, and radula (with a formula amounting to at least  $10 + 35.0.35 + 10$ ) are similar. The differences are: (1) the size (50 mm.); (2) the colour, which was in life brilliant vermilion (though some individuals were pale yellow), with numerous black specks apparently visible only under a lens, whereas Alder and Hancock say that *D. planata* was reddish brown, with dark brown spots; and (3) the texture of the dorsal surface, which seems to be covered by a reticulate pattern, with pits between the ridges and flat tubercles at their junctions. But age and a warm climate may account for these differences. However, I have thought it safer to describe the Cape Verde specimens under a separate name as *Geitodoris reticulata*.

#### LAMELLIDORIS, A. & H.

A considerable number of species are found on the coasts of Great Britain, and seem well characterized externally and by differences in the radula. The *Doris beaumonti* of Farran (*Nudibranchiate Molluscs of Ballynakill, app. viii. to part ii. of Report on Fisheries of Ireland for 1901*, p. 4) is, no doubt, *Lamellidoris luteocincta* (M. Sars), which must thus be added to the British fauna.

*L. lactea*, *L. quadrimaculata*, *L. aureopuncta*, *L. miniata*, and *L. olivacea*, described by Verrill from the Bermudas, are all very doubtful forms,

and in many cases it seems clear from the author's descriptions that they do not possess the characters of *Lamellidoris*.

In identifying the specimens noticed below as *L. oblonga*, *L. depressa*, and *L. pusilla*, I have been chiefly guided by the labels which they bear in the collection at the Plymouth Marine Laboratory. I see no reason to doubt these identifications, though it might be difficult to establish them from an examination of preserved specimens only.

#### LAMELLIDORIS BILAMELLATA (L.).

This common species has been fully described by Alder and Hancock and Bergh. The back is covered with distinct, tall, and sometimes clavate tubercles, not unlike those of *Staurodoris verrucosa*. The tubercles at the side of the rhinophores are not conspicuous.

The inner teeth are large, hamate, smooth, and tapering at the tip. The outer are plate-like, with a rudimentary and not very distinct hook. Between the rows there is a series of ear-shaped folds on the rhachis.

#### LAMELLIDORIS OBLONGA (A. & H.).

(A. & H., *Mon. of Brit. Nud.*, Fam. i., pl. 16, figs. 4-5.)

Three preserved specimens from Plymouth. It would appear that this species is recognizable by its shape. Its measurements are roughly, length, 8 mm.; breadth, 3.7 mm.; whereas *L. bilamellata* measures about 12 mm. in length and 9 mm. in breadth. The animal, as preserved, is yellowish, and covered with low, flat tubercles on the dorsal surface. The branchiæ are very inconspicuous, and are not distinguishable from the surrounding tubercles on a superficial examination. The openings of the rhinophores are closed by two tubercles. The rhinophores are exerted and very long. As preserved, the oral veil is remarkably pointed, and the anterior margin of the foot follows its outline.

The buccal crop is large, and divided into two halves by a median band. The radula is very fragile, and consists of twenty-two, thirty-three, and forty-five rows respectively in the three specimens. The inner tooth (Fig. 3. a.) has a broad base, and is divided into three parts by constrictions. The denticulations on the uppermost part are very fine, but clear. The outer tooth (Fig. 3. b.) bears a distinct hook.

#### LAMELLIDORIS DEPRESSA (A. & H.).

One preserved specimen from Plymouth. The mantle margin is wide, and the dorsal surface bears papillose tubercles and contains very long spicules. The colour is yellowish, with a few black and brown spots.

The radula is small and hard to find. The inner tooth (Fig. 4. a.) is squarish, with three small denticles (not one, as according to Alder and Hancock). The outer tooth (Fig. 4. b.) is a squarish plate with a rudimentary denticle.

#### LAMELLIDORIS PUSILLA.

(ALDER and HANCOCK, *Mon. Brit. Nud.*, Fam. i., pl. 13.)

This little species seems to be characterized in life by its white branchiæ and rhinophores.

The radula is somewhat as in *L. oblonga*. The inner tooth (Fig. 5.) has a double convexity at the side, and a few ridges, which hardly amount to denticles, near the tip.

#### PLEUROPHYLLIDIA.

##### PLEUROPHYLLIDIA LOVENI, BERGH.

(BERGH, *Bidrag til en Monogr. af Pleurophyllidierne*, 1866, p. 29; *Id. Mal. Blätter*, 1879, pp. 77-86. JEFFREY'S *Brit. Conchol.*, vol. v. pp. 17-18.)

Two specimens from Plymouth. I was informed that the animals were reddish when alive.

The larger is 35 mm. long and 26 mm. broad, tapering rather suddenly at the tail. The colour is dull yellowish brown, with about fifty rather lighter stripes on the back, of which nine are larger than the others. The branchiæ are thin, and about twenty. The side lamellæ about thirty, very thick, and generally interrupted in the middle.

The smaller specimen is much bent, but would be about 30 mm. long if straightened out and 13 broad. The colour is pale yellowish brown, with a sort of purple glazing in many places, and there are about thirty stripes on the back.

The jaws bear five rows of denticles in one specimen and six or seven in the other.

The formula for the radula is in the first  $25 \times 35.1.35$ , and in the second  $34 \times 32.1.32$ . In both the median tooth bears seven denticles on each side of the central cusp. The first lateral is larger than the rest, and bears six or seven rather coarse denticles. In the larger specimen the first twelve laterals are denticulate (generally with five to six denticles) and the thirteenth very faintly so. The rest are smooth. In the smaller specimen only eleven teeth are denticulate.

It would appear that the Pleurophyllidia found on the British coast is this species, and not *P. lineata*, as it is often described. Bergh also appears to have shown that the correct name of the Mediterranean species is *P. undulata*, not *P. lineata*, and the latter specific name should be cancelled.

*P. loveni* seems to differ from *P. undulata* in its colour, in having fewer and thicker side lamellæ, and in its dentition. In *P. undulata* the central tooth is much broader, and all the teeth, with the exception of the last two or three in each row, are denticulate.

### LOMANOTUS, VÉRANY, 1846.

(ALDER and HANCOCK, *Monograph*, Fam. 3, genus 10 (under name of Eumenis). GARSTANG, *Journ. Mar. Biol. Assoc.*, vol. i., 1889, pp. 185-9. BEAUMONT, *Proc. Royal Irish Acad.*, 1900, pp. 842-4.)

The members of this genus are not common, and large specimens are distinctly rare, though small ones are not infrequent in some localities, e.g. Plymouth. The body appears to be very delicate and easily torn, and most authors report that their specimens were badly preserved. The following species have been described.

1. *Lomanotus genei*, Vérany. *Catal. degli. anim. invert. di Genova e Nizza*, 1846.
2. *L. hancocki*, Norman. *Ann. Mag. N. H.*, vol. xx., 1877, p. 518.
3. *L. portlandicus*, Thomps. *Ann. Mag. N. H.*, 1860, vol. v. p. 50.
4. *L. eisigii*, Trinch. *Rendic. Acc. Sci. Fis. Mat.*, xxii. 3, 1883, pp. 92-4.
5. *L. flavidus*, A. & H., *Monograph*, Fam. 3, pl. 41.
6. *L. marmoratus*, A. & H., *Monograph*, Fam. 3, pl. 1.
7. *L. varians*, Garstang, l.c.

Of these names the last is proposed by Garstang for all the British species (*L. marmoratus*, *L. flavidus*, *L. portlandicus*, and *L. hancocki*), on the supposition that they are really one. But if that supposition is correct, the right course would seem to be not to introduce a new name, but to call all the forms by the earliest of the existing specific names. *L. varians* may therefore be omitted from the list. The remaining six forms may be divided into the large and the small. Of the large forms *L. genei* has undoubted priority as a name, and it is unfortunate that the authors of the remaining three large species, *L. hancocki*, *L. portlandicus*, and *L. eisigii*, did not, in describing them, state definitely in what points they considered them to differ from the typical species. It seems certain that the number of processes on the frontal veil and on the rhinophore sheaths differs in otherwise similar individuals and cannot be made a specific character. *L. portlandicus* does not seem to be distinguished from *L. genei* (l.c.) by any clear character. Norman states that the most marked character of his *L. hancocki* is "the small size of the terminal, simple, conical process, which is projected beyond the calyx-like sheath" of the rhinophores. But it is highly probable that the rhinophores were of the usual type, and that the lower laminated portion was merely hidden within the sheath. Trinchese (l.c.) has

given a somewhat detailed description of *L. eisigii*, from which it appears that its most remarkable characters are: (1) that the hepatic diverticula do not extend into the marginal papillæ; and (2) that the two margins unite at the end of the body and form "una larga pinna che è l'organo principale del nuoto." But a similar organ is found in the specimen described below, and is figured in some unpublished drawings of *L. portlandicus* made by Hancock, and preserved in the Newcastle Museum. Alder and Hancock, as well as Bergh, found the hepatic diverticula in the papillæ, but I could not demonstrate their existence with certainty in the specimen which I examined. It is possible that different specimens may vary in this respect, as do *Dendronotus* and *Bornella excepta*. Trinchese also states that in the young *L. eisigii*, "Ogni papilla conteneva un lobo epatico bene sviluppato."

The small species are *L. marmoratus* and *L. flavidus*, both British. With regard to these the main question is, have they assumed their adult and final form, or are they immature? Trinchese states that the young of *L. eisigii* differs markedly from the adult; and if we recognize the possibility of modifications occurring during growth, it may be said that the two small species present no characters either externally or in the buccal parts which are incompatible with the idea that they are the young of *L. genei*. On the other hand, if they are mature (on which point the evidence is inconclusive), the differences in size and colour are, no doubt, sufficient specific characters. A further question is whether *L. marmoratus* and *L. flavidus* are distinct forms. If they are adults, they must certainly be regarded as separate species. But if they are immature, then considering that *L. flavidus* is smaller than *L. marmoratus*, and that Trinchese states that the young *L. eisigii* is æolidiform, it is probable that *L. flavidus* is the youngest stage of the same species. Alder and Hancock note the æolidiform characters of the type specimen.

As mentioned below, Alder and Hancock's published plates of *L. marmoratus* are wrong in representing the dorsal margin as continuous with the oral veil, and the error does not occur in an earlier drawing preserved at Newcastle.

I recognize provisionally three species:—

1. *L. genei*, V é r a n y .  
    = *L. portlandicus*, Thomps.  
       *L. hancocki*, Norman.  
       *L. eisigii*, Trinchese.
2. *L. marmoratus*, A. & H.
3. *L. flavidus*, A. & H.

It is, however, highly probable that both of these latter will prove to be young forms of the first.

## LOMANOTUS GENEI, VÉRANY.

(BERGH, *Beitr. zur Kennt. Aeolidiaden*, vi. pp. 5-8, and vii. 62-3. VAYSSIÈRE, *Moll. Opisth. de Marseille*, part iii. 87-91. GAMBLE, *Ann. Mag. N. H.*, ser. 6, vol. ix., 1892, p. 379.)

One large specimen from Plymouth Sound, kindly given me by Mr. W. I. Beaumont.

The colour of the preserved specimen is yellowish white suffused with brown, which is deepest on the pericardium, rhinophores, oral veil, mantle margin with papillæ, and on the tail. There are no white dots. Some, but not all, of the papillæ have colourless transparent tips.

The length is 26 mm., the breadth at most 8, and the height 9, including the raised margin. This margin starts from the rhinophore sheaths and is 2-3 mm. wide. It bears thirty-two papillæ on the right, and thirty on the left side, and is bent into six undulations, three upwards and three downwards. The largest papillæ are those in the centre of these undulations and are about 4 mm. high; the rest are about half the size. The papillæ (Fig. 6) are distinctly spoon-shaped, the convex surface being generally outside, but sometimes inside. At the base of the larger papillæ are two folds on the inside. The margin is entire round the tail and forms a horizontal fin. The anus is 15 mm. from the anterior end, and the genital orifices 6 mm., just behind the rhinophores. The oral veil bears four distinct digitations, two on each side, about 2 mm. long. The rhinophore sheaths are about 3 mm. high; the right bears five digitations; the left, though apparently uninjured, has only one. The foot is produced into short pointed angles and grooved. The upper lamina is much stronger and thicker than the lower.

The jaws are yellow, rather soft and flexible, and much as described by Bergh. The edges for some distance inwards are covered by a mosaic of plates or scales with denticulate edges (Fig. 8.). The masticatory process is very short.

The radula corresponds in general with the descriptions of Bergh and Vayssièrè. It consists of thirty-two rows. The teeth are large, crowded, and yellow at the sides of the rows; smaller, spaced, and colourless in the centre. In this specimen, and in all the smaller ones observed, the radula has a great tendency to break and become confused, and it seems impossible to spread it out evenly. It is hard to say whether there is a central tooth or not, as the arrangement appears to be not quite symmetrical. Down the rhachis run four to five irregular and not quite straight rows of very irregularly shaped teeth (Fig. 7. a.), bearing a central cusp and three to seven pointed denticles of various sizes on either side. To the right and left of these teeth the rows be-

come more regular, and there come about ten colourless dagger-like teeth (Fig. 7. b.), with from four to ten fairly regular denticles on either side, the number of denticles increasing as the teeth are further from the rhachis. After this the teeth, as one goes outwards, become larger, yellower, hollowed, and somewhat spoon-shaped (Fig. 7. c.), bearing on either side at least twenty-five denticles, which are shorter and blunter than those of the middle teeth. The outermost teeth of all are somewhat smaller.

The internal organs are not easy to unravel, all the tissues being very thin, soft, and easily torn. The œsophagus leads into a round stomach, which gives off branches (apparently two) at the sides, and is prolonged posteriorly in a diverticulum reaching nearly to the end of the body. On this lie the liver and the hermaphrodite gland, which are both yellowish and difficult to separate from one another. The whole mass is surrounded by a network of transparent tubes, which seem to represent the kidney. The dorsal papillæ are hollow and communicate with the interior of the body, but I could not satisfactorily demonstrate the existence of branches of the liver in them (cf. what Trinchese says about *L. eisigii*). If such exist, they are represented by flocculent masses of no very definite shape, composed of reddish cells. The mucus and albumen glands are large; the ampulla of the hermaphrodite gland long and thick; the vas deferens thinner and coiled; the penis conical and unarmed; the spermatheca small and roundish.

If any real distinction can be drawn between *L. genei* and *L. eisigii*, this animal should probably be referred to the latter in virtue of the shape of the papillæ and the apparent absence of hepatic diverticula in them. But I do not think that the two species are really distinct.

#### LOMANOTUS MARMORATUS, A. & H.

Four living specimens (A) examined at Plymouth in April, 1905, were about 9 mm. long and 2 mm. broad. The ground colour of the living animals is yellowish white, but largely covered with irregular markings of different shades of brown and olive, and also with small sandy dots. The colour is darkest at the sides and lighter in the centre of the back. The tips of the cerata are whitish; the hepatic diverticula within them yellowish brown.

The foot is cleft, and indented in front with strongly hooked corners. The veil is not large, with four processes, two on each side, which are somewhat bulbous at the tip. The rhinophore sheaths are rather tall for the size of the animal, being about 2 mm. high, and bear four or five processes, the number not being always the same on the right and left sheaths. In one specimen one sheath is entirely smooth. The

dorsal margin starts from the rhinophore sheath; it makes four not very distinct undulations and bears about twenty-two papillæ, most of which, especially the taller ones, are carried vertically, though some of the smaller ones point sideways. The taller papillæ bear a distinct bulb under the pointed tip, but in the smaller ones the bulb is less developed. Four of the papillæ are distinctly larger than the rest and, roughly speaking, mark the divisions between the undulations. The third of these larger papillæ is the tallest of all and is about 2 mm. high (Fig. 9. c.).

Another specimen (B), which was about 7 mm. long when at rest and 8 mm. when crawling, was brownish white, with yellowish-brown mottlings down the centre of the back and deep purplish-brown mottlings on the cerata. The other external characters are much as in the specimens already described, but the papillæ are not so long and there are only obscure indications of the subterminal bulb. The dorsal margin is more clearly a web connecting the papillæ. The rhinophore sheaths bear five processes each.

Three other specimens of about the same size were so macerated that nothing could be done with them except to examine the buccal parts.

The jaws and radula are much the same in all eight specimens. The jaws are not denticulate, but near the edge is a mosaic formed of tile-like prominences denticulate on the anterior edge. The radula is very irregular in appearance and could not be laid out straight in any specimen. There is a wide naked rhachis bearing folds, and on each side of the rhachis fifteen to twenty rows of teeth, each containing eight to ten teeth on either side. More could not be made out with certainty. The teeth are longer than in Alder and Hancock's and Bergh's plates, and more uniform. They are dagger-shaped, but slightly bent at the end, bearing at least twelve denticles on either side and perhaps considerably more, but the denticles are hard to see, even with a high power. The innermost are slightly shorter and stouter; the outermost longer and thinner.

The animals are very delicate. They die in captivity without apparent cause, and the body becomes decayed and macerated very rapidly.

This form, especially the specimen called B, approaches the *L. marmoratus* of Alder and Hancock sufficiently nearly to bear the name. Their plate (*Eumenis marmorata*, Fam. 3, pl. 1. a.) contains one of the few inaccuracies to be found in their works, inasmuch as it represents the dorsal margin as continuous with the oral veil, not as starting from the rhinophores. But in a preliminary study for the drawing preserved in a bound volume of Alder's drawings, belonging to the Hancock Museum at Newcastle-on-Tyne, the disposition of the parts is somewhat

indistinct, and it is quite probable that it was meant to represent the dorsal margin as starting from the rhinophores. When this study was copied for the plate as published, the artists themselves probably misinterpreted their earlier and rather indistinct drawing. But I do not think that we should insist that the continuity of the dorsal margin and oral veil is really a character of *L. marmoratus*, A. & H.

#### LOMANOTUS FLAVIDUS, A. & H.

A single small specimen examined alive at Plymouth resembled Alder and Hancock's figure of this species. It is only 4 mm. long and 1 mm. broad. The general colour is pale buff, due to a multitude of little specks. There are also white spots (particularly on the tops of the cerata) and a few purplish-brown spots. At the sides of the head in front of the rhinophores are two purplish-brown patches. The rhinophore sheaths bear five processes, of which the one behind and pointing outside is longer than the others. There are only about twelve papillæ on each side. They are much as in Alder and Hancock's plate—short, thick, and showing no signs of a bulb. Those in the middle are the largest. They mostly have an irregular brown ring or marking.

The animal is not like *L. marmoratus* superficially, but no difference could be found in the buccal parts. The foot, veil, and other external characters not mentioned above are also similar.

#### HANCOCKIA, GOSSE.

= GOVIA, TRINCHESE.

Bergh (*System der Nudib. Gast.*, p. 1048) adopts *Govia* (Trinchese, 1886) as the name of this genus in preference to *Hancockia* (Gosse, 1877), apparently on the ground that Gosse's description is inadequate. But though Gosse does not deal with the anatomy of the animal, his description is amply sufficient for its identification. There can be no reasonable doubt that his *Hancockia dactylota* is the animal described below, and that it is generically and perhaps specifically the same as the later *Govia* of Trinchese. The name is therefore entitled to stand.

The genus appears to be rare, and is recorded from the south of England, Brest, and the Mediterranean. Four described species are probably referable to it: *Hancockia dactylota*, Gosse; *Govia rubra*, Trinchese; *Govia viridis*, Trinchese;\* and *Doto uncinata*, Hesse. In the *Jour. de Conchyl.*, 1872, p. 34, Hesse described under this name a Nudibranch captured at Brest, but Garstang seems to have proved that it is a *Hancockia*. Whether there is really more than one species is a

\* References to the literature are given on following page.

matter of some doubt. Perhaps Trinchese's two species are distinct, and perhaps his *Govia viridis* is identical with both *Doto uncinata* and *Hancockia dactylota*, so that the genus may be tabulated as follows:—

- |   |  |
|---|--|
| { | 1. <i>Hancockia dactylota</i> , Gosse, S. England. |
|   | 2. <i>H. uncinata</i> (Hesse), Brest.              |
|   | 3. <i>H. viridis</i> (Trinchese), Mediterranean.   |
|   | 4. <i>H. rubra</i> (Trinchese), Mediterranean.     |

Hesse regarded his specimen as a *Doto*, and Bergh somewhat doubtfully refers the genus to the Dotonidæ. It would seem to be intermediate between that family and Lomanotus. The narrow radula indicates affinity to *Doto* and the true Æolids. The cerata show analogies to those of *Doto*, though they have not their characteristic shape. But the perfoliations on the rhinophores, the processes on the oral veil, and the manner in which the cerata arise from the dorsal margin recall the characters of Lomanotus rather than of *Doto*.

#### HANCOCKIA DACTYLOTA, GOSSE.

(GOSSE, "On *Hancockia dactylota*," *Ann. Mag. Nat. Hist.*, ser. 4, xx., 1877, pp. 316–19. GAMBLE, "On two rare British Nudibranchs, *Lomanotus* genæi and *Hancockia dactylota*," *ib.*, 6, ix., 1892, pp. 378–85. TRINCHESE, "Ricerche anatom. sul genere *Govia*," *Mem. della R. accad. delle sci. dell' istituto di Bologna*, ser. 5, vii. pp. 183–91, 1886. BERGH, *System der Nudib. Gast.*, p. 1048, 1892, *sub voce* *Govia*.)

Two specimens labelled "Plymouth district, Sept. '97 and '98." They are of much the same size, one being rather more elongate than the other. Measurements in millimetres:—

	Length.		Breadth.		Height.
(1)	7	...	1·2	...	2
(2)	6	...	1·5	...	2

The colour is greyish green, and the shape rather stiff and rectangular. The animals are not very well preserved either externally or internally; but a small specimen subsequently given me by Mr. Allen proved to be in better condition and was sectioned.

The foot is truncate in front; no groove is visible on the anterior margin; the tail is not pointed behind, and is slightly bifid.

The oral veil is smooth in the middle and curves inwards, but the two sides are much expanded and each bears four digits, of which the second from the inside is the longest. The rhinophore sheaths, which are set on the dorsal margin, are about 1 mm. high and 5 mm. broad, straight, cylindrical, not expanded at the top, but divided into eight to ten low lobes. The upper part of the rhinophores is a smooth column; at the base are a few obliquely vertical perfoliations. From the rhinophore sheaths runs backwards a not very distinct marginal ridge, on

which are set five processes on the left side and four on the right. The processes in the first pair are opposite one another. Then they gradually become alternate. They bear lobes with a rather irregular outline, so that the whole process looks like a short, thick branchial plume. The first pair have eight lobes, four on each side, and are folded along the median line, the concave surface being turned outwards. The second, third, and fourth pairs are similarly folded, but bear only seven lobes, three on each side and one terminal. The fifth process (found on the left side only) has five lobes and is irregular in shape. The genital orifices are close to one another, on the flank of the body, between the rhinophores and the first process. The vent is between the first and second processes, close to the dorsal margin.

The nervous system is yellowish. The ganglia are hard to separate, but as seen from above appear to be as described by Trinchese. The cerebro-pleural ganglia are large and triangular, showing no sign of division. The pedal ganglia, which are smaller, lie at their side on a lower level. The buccal ganglia are large. The eyes are large and of an intense bluish black.

The jaws bear a row of distinct but irregularly shaped denticles on the masticatory process. Higher up on the jaw itself there seem to be numerous projections near the edge. The radula resembles that of *Galvina*, and consists of thirty-one rows of three teeth each. The median teeth (Pl. XI., Fig. 10. a.) are very strong and distinct, with four well-developed denticles on each side of a large raised median cusp. The laterals (Fig. 10. b.) are very thin and hard to see, but are much as in *Galvina*, broad, but with a sharply pointed summit.

The animals being small and indifferently preserved, it was difficult to make out the digestive system by ordinary dissection, and the following details are derived almost entirely from the specimen which was sectioned. A fairly long œsophagus (Pl. XII., Fig. 11. a.) leads from the buccal mass to the stomach and gives rise about midway to a curved diverticulum (Fig. 11. b.). The stomach (Fig. 11. c.) is roundish and not very large. From the top of it rises the intestine (Fig. 11. d.), which sends out a tube to the anal papilla (Fig. 11. e.) on the right. The anterior lower part of the stomach is prolonged into two diverticula (Fig. 11. f.), which supply the first pair of cerata and then run straight forward, terminating in the anterior part of the foot. The termination is trifid. Posteriorly the stomach gives rise to a long and fairly wide tube (Fig. 11. i.), which extends to the hinder part of the body and sends off branches (Fig. 11. g.) to the cerata. These branches are at first simple, but before they enter the cerata they divide into as many ramifications (Fig. 11. h.) as there are lobes to supply. These secondary ramifications arise at different levels. At their termination they open externally by

orifices (Pl. XII., Fig. 13. e.) which appear to be enidocysts. They consist of a fairly broad tube, which is narrowed by a constriction when it reaches the integuments and forms outside the constriction a cup-shaped aperture. There are traces of similar openings on the anterior margin of the foot; but it is unusual to find enidocysts in this position, and the structure of the organ is not clear. Abundant mucous glands are scattered over the whole surface of the body, and the mucus can be seen under the microscope in the act of exuding.

The hermaphrodite gland (Pl. XII., Fig. 12. l, n.) is large and fills all the posterior part of the body cavity with large yellowish packets. The anterior genital mass is also well developed, but hardened and not well preserved. No trace of armature was found, and the spermatheca appeared to be surrounded by the albumen gland.

#### DOTO, OKEN.

A considerable number of species have been referred to this genus, but it is greatly in need of a revision based on a study of a large series of living animals. The internal characters offer few points of difference, and the external characters, such as coloration and the shape of the rhinophore sheaths, are somewhat variable, and liable to be either distorted or obliterated in preserved specimens. Bergh, in his *System der Nudib. Gast.*, registers sixteen species, described chiefly by Alder and Hancock, Hesse, and Trinchese. Of these it would appear that *D. arbuscula*, Agassiz, and *D. minuta*, Forbes, are mere names. *D. australis*, Angas, is perhaps a *Melibe* and not a *Doto* at all, and the later *D. ocellifera* of Simroth (*Die Gasteropoden der Plankton Expedition, 1895*, pp. 168-70) is of very doubtful affinities. The forms which probably belong to the genus may be enumerated as follows:—

- |                                      |   |
|--------------------------------------|---|
| 1. <i>Doto coronata</i> (Gm.).       | 10. <i>D. cinerea</i> , Trin.                       |
| 2. <i>D. formosa</i> , Verrill.      | 11. <i>D. pinnatifida</i> (Mtg.).                   |
| 3. <i>D. cuspidata</i> , A. & H.     | = <i>D. splendida</i> , Trin.                       |
| 4. <i>D. fragilis</i> (Forbes).      | 12. <i>D. paulinæ</i> , Trin.                       |
| 5. <i>D. crassicornis</i> , M. Sars. | 13. <i>D. indica</i> , Bergh.                       |
| 6. <i>D. costæ</i> , Trin.           | 14. <i>D. africana</i> , Eliot.                     |
| 7. <i>D. cornaliæ</i> , Trin.        | 15. <i>D. floridicola</i> , Simroth.                |
| 8. <i>D. rosea</i> , Trin.           | perhaps = <i>Dotilla</i> (?) <i>pygmæa</i> , Bergh. |
| 9. <i>D. aurea</i> , Trin.           | 16. <i>D. annuligera</i> , Bergh.                   |

#### DOTO PINNATIFIDA (MONT.), VAR. PAPILLIFERA.

Three specimens from Plymouth, nearly a centimetre long. The coloration, cerata, etc., seem typical of the species as described by Alder and Hancock, but there are numerous papillæ on the back, each with

a black spot at the tip; and there are two or in some places three rows of such papillæ on the sides. The rhinophore sheaths are ample in front, but slit behind, and bear two or three papillæ (Fig. 14.). All these papillæ are too much developed to be called tubercles, and are half or even three-quarters of a millimetre in height. The anal papilla is very large.

The buccal mass is very small and the radula minute, though it contains more than 100 closely fitting teeth. The teeth bear at least three denticles on each side of the central cusp and perhaps other accessory denticles and ridges; but it is difficult to get a distinct view of any tooth, even under the highest power.

This form is probably a variety of *D. pinnatifida* with the tubercles more developed. All the proportions of the animal are larger than those described by A. & H., and it is possibly merely the normal adult form.

#### BERGHIA CÆRULESCENS (LAURILLARD).

The specimen preserved at Plymouth under this name is really a *Facelina coronata*, and has neither the rhinophores nor the dentition of *Berghia*. *Berghia* should probably be removed from the list of the British fauna, as there appears to be no other record of its occurrence.

The cerata are set in eight groups. At the interior end of several of them (that is at the sides of the clear space in the middle of the back) are a number of quite small tubercular papillæ, hardly half a millimetre high, and similar ones are found here and there in the middle of the rows. These tubercles probably represent cerata which have been bitten off and are in process of reproduction. See Bergh, *Beiträge zur Kenntniss der Æolidiaden*, v. p. 826. Alder and Hancock mention that the animals of this species (*F. coronata*) have the habit of eating one another's cerata.

#### ÆOLIDIELLA, BERGH.

##### EOLIS ANGULATA, A. & H.

I think that the *Eolis angulata* of Alder and Hancock (*Monogr.*, Fam. 3, pl. 23) is really referable to this genus, and merely a broad and probably immature specimen of *Æolidiella glauca*. Professor Herdman kindly gave me a specimen from Port Erin in the Isle of Man which was identified by him when alive as possessing the external characters of *Eolis angulata*. The preserved specimens also seemed to have these characters, as far as they could be recognized, except that the cerata were more numerous. When dissected it was found to possess the jaws and characteristic radula of *Æolidiella glauca*.

If this specimen is really Alder and Hancock's *Eolis angulata*, I do not think that species can be separated from *Æolidiella glauca*. As shown in Alder and Hancock's plates the coloration and general appearance are much the same, and it is noticeable that in both the rhinophores are represented as showing indications of slight annulation. Since *Eolis angulata* was four lines long and *Æolidiella glauca* nearly two inches, differences in shape and the number of cerata cannot be regarded as safe specific characteristics.

The anatomy of *Æolidiella glauca* is described by Bergh in his *Beitr. zur Kenntn. der Æolidiaden*, viii., 1885, pp. 24-8. The known distribution of the species extends from Scandinavia to the Mediterranean.

### CORYPHELLA.

This genus consists of Æolids, with a triseriate radula, somewhat elongate bodies, and unperfoliated rhinophores. It is noticeable, however, that in several species the rhinophores show traces of rings or wrinkles, or bear minute lumps. The details submitted below seem to show that *C. gracilis* and *C. smaragdina* are varieties of one species. *C. beaumonti*, now first described, offers many peculiarities, and almost merits generic rank.

Bergh in his *System der Nudibranchiaten Gasteropoden* recognizes twenty-three species, of which several must be regarded as doubtful (e.g. *C. alderi*, *C. parvula*, *C. semidecora*, *C. forelisi*, *C. ocellata*), since the radula is unknown. To this list may be added:—

*C. cooperi*, Cockerell (*Jour. of Mal.*, 1901, viii. 3, p. 85).

*C. californica*, Bergh (*Mal. Unt. in Semper's Reisen*, vi. 1, 1904, p. 6).

*C. sarsi*, Friele (*Bergen's Museums Aarbog*, 1902, No. 3, p. 12).

Cockerell (*J. of Malac.*, 1901, p. 121) considers Cooper's *Æolis iodinea* to be a *Coryphella*, but Bergh refers it to *Flabellina*. Verrill's *Coryphella* (?) *pallida* is somewhat doubtful.

### CORYPHELLA RUFIBRANCHIALIS (JOHNST.).

(ALDER and HANCOCK, *Monog. of British Nudib.*, Fam. 3, pl. 14.)

One living specimen, Plymouth, April, 1905. The animal is very elongate, 15 mm. long and only 3 mm. broad. The foot is produced in front into fairly long tentacular angles, which are very distinctly grooved. The oral tentacles are 5 mm. or more long, and are carried in a curved position. The rhinophores are 7 mm. long, straight, and covered with rows of little lumps set in fairly regular rings. There are about twenty-five rings, and about eight lumps in each.

distinct but short horns. The oral tentacles are moderately long, with a few scattered opaque white dots. The rhinophores are long, wrinkled, but not perfoliate, transparent and colourless, except that the tips are covered with opaque white dots. The eyes are small, but black and distinct. The cerata are set in five groups, composed on the right side of three, four, two, four, three, and on the left of three, three, four, two, three cerata respectively. These five groups are all seen to be distinct when the animal is moving and stretched out. Otherwise the first and second and the fourth and fifth appear to coalesce, though the third always remains distinct. The general impression produced is that the cerata are few and scattered irregularly. The innermost are the largest and are rather swollen. The body is colourless and transparent. On the tail is a line of irregular bright white spots. The yellowish-grey hermaphrodite gland can be seen through the integuments. The hepatic diverticula within the cerata consist of two elements, one bright green, the other brownish yellow. As a rule the green predominates and gives the general colour, but in some of the cerata the brown pigment prevails.

The jaws are thin and colourless, with at least six rows of denticles. The radula consists of thirteen rows. The central tooth has as a rule four denticles on each side of the median cusp, but sometimes five, and only once six. The laterals have the apex turned inwards and bear five or six denticles.

A third specimen was dead when examined. Though much macerated and mutilated, it appeared to have resembled the one just described externally. The cerata were green with white tips. The radula consisted of twelve rows. The central teeth have uniformly seven denticles on each side of the median cusp. The laterals bear three to six denticles. The tips of several laterals seem to point outwards.

According to Alder and Hancock, who created both species, *C. gracilis* has orange-red cerata and four denticles on the central teeth, whereas *C. smaragdina* has green cerata and seven denticles. The second of the forms described above appears to be intermediate both in colour and dentition between *C. gracilis* and *smaragdina*, and suggests that the animals in which the green pigment predominates should be called *C. gracilis*, var. *smaragdina*.

Vayssière (*Recherches sur les Moll. Opisth. du Golfe de Marseille*, ii. p. 76), regards *C. landsburghii*, *C. rufibranchialis*, *C. pellucida*, *C. smaragdina*, and *C. gracilis* as being all synonyms. This appears to me excessive, as besides other characters the forms vary in their dentition. But it must be admitted that we require much more information to enable us to judge how far the number of denticulations may vary within the limits of one species.

The cerata look less thick than in Alder and Hancock's plate. They are slender and cylindrical, but often irregularly constricted near the tips, as if injured. The last two are set medianly on the caudal ridge. The anus is lateral, but high up. The tail not long.

The body is transparent and colourless, with only a very little opaque white on the oral tentacles and rhinophores. The hepatic ramifications within the cerata are of a bright, light scarlet, and somewhat irregular in outline. Above the scarlet is a broad opaque white ring, and above that a pellucid point. There is a faint yellow tinge in the rhinophores and down the centre of the back.

The jaws bear eight to nine rows of irregular denticles. The radula consists of thirteen rows. The median tooth has a strong central cusp, and seven rather long and thin denticles, curving slightly inwards. The side teeth bear twelve longish slightly curved denticles. Alder and Hancock (*Tongues of the Eolididæ*) say that the apex of the side teeth points outwards, but this did not seem to be the natural position in the present specimen, though the teeth are easily displaced.

In spite of this and some other small points of difference, I think this specimen must be referred to *C. rufibranchialis*. It can hardly be *C. pellucida*, which it also resembles, as that animal is said to have smooth lateral teeth.

#### CORYPHELLA GRACILIS (A. & H.).

One living specimen, Plymouth, April, 1905, 6 mm. long, and rather elongate. The body is of a not very transparent white, with a good deal of opaque white, especially on the oral tentacles, rhinophores, and tail. The cerata have opaque white pigment at the top, which sometimes, but not always, forms a distinct ring. The hepatic diverticula are of a reddish orange. The anterior angles of the foot are produced, but are not very long. The oral tentacles are distinctly longer than the rhinophores, which are smooth. The cerata are rather thick and elliptical, and are set in four groups, containing on each side eight, five, five, and three cerata respectively.

The radula consists of eleven teeth. The central tooth bears four to six (generally five) denticles on each side of the median cusp. The laterals bear six denticles.

This appears to be a fairly typical specimen of *C. gracilis*. Alder and Hancock say it has four denticles on the central tooth, Bergh that it has five.

Another living specimen seen at Plymouth at the same time was 9 mm. long and 2.5 broad. It was very active, and fond of swimming foot uppermost.

The tail is long; the anterior angles of the foot are produced into

## CORYPHELLA LANDSBURGHII, ALDER &amp; HANCOCK.

(ALDER and HANCOCK, *Monog. of British Nudib.*, Fam. 3, pl. 20. TRINCHESE, *Æolidide di Genova*, ii., Tav. lxii., lxiv., lxvi.-lxx. BERGH, *Die Nudibr. gesammelt während d. Fahrten d. Willem Barents*, p. 8.)

One living specimen, Plymouth, April, 1905. Very slender and elongate, 7 mm. long and only about 1 mm. broad. Cerata nearly 2 mm. long; rhinophores 2.3 mm. long. Foot produced into distinct tentacular angles. Oral tentacles fairly long and slightly wrinkled; rhinophores longer and more distinctly wrinkled. They bear low rings of rather irregular outline, but not perfoliations or knobs. The cerata are set in eight short rows arranged as follows on each side:—

2	}	Three rows close together.
2		
3		
2	}	Two rows close together.
3		
2		Three distinct rows.
2		

The body, rhinophores, and tentacles are of a clear amethyst, with which the orange-red ramifications of the liver within the cerata form a striking contrast. The cerata bear a ring of opaque white below the pellucid tips. The foot is whitish.

The jaws bear six to seven rows of denticles near the top, but the number decreases lower down. The radula consists of thirty rows. The central tooth is rather broad and arched. It bears five denticles on each side of the central cusp, which is not much larger than the rest. The laterals are of a fair size, but somewhat difficult to see, as they are quite colourless. They have a long apex and five to six small denticles.

This appears to be a fairly typical example of Alder and Hancock's *C. landsburghii*. They do not mention that the rhinophores are wrinkled, though it is indicated in their plate, and they describe them as distinctly shorter than the oral tentacles, which is not the case here.

The most striking characteristic of this form is its strangely contrasted coloration. It is very doubtful if the specimen from Vardö referred to this species with a query by Bergh (l.c.), really belongs to it.

CORYPHELLA BEAUMONTI, *spec. nov.*

Mr. W. I. Beaumont, to whom the species is dedicated, has kindly furnished me with the following notes on the living animal.

“*Eolid from Barn Pool (Plymouth)*. Length, 16 mm., but looks as if the

posterior part of the body had been lost, as it ends abruptly only 3-4 mm. behind the heart.\* The outline of the anterior end of the foot is like *Eolis nana*, except that the sides are produced into small angular projections kept tucked in and consequently inconspicuous. Head nearly as wide as the foot. The oral tentacles very minute; merely short processes of angles of the oral veil. The rhinophores are long and smooth, held erect with tips bent back. The eyes do not show. Papillæ very numerous and extremely long, slender and tapering to fine points, constantly in motion, curling and uncurling, and when at rest convoluted. A group of small papillæ, apparently three rows, is wholly in front of the rhinophores on each side. Then a row on each side abreast of rhinophores. Another row between this and the next, which is abreast of the anterior end of the heart. Then a row level with the posterior end of the heart. The outer ends of the rows are not double.

"The colour of the body is red, tending to orange on the rhinophores, but elsewhere more rosy. The colour seems to be situate in the superficial tissues. The papillæ are superficially flesh-coloured. The hepatic cœca are in most of the papillæ rosy purple throughout, but in a few pale greenish purple, except at the tip, which is rosy purple in all and more deeply coloured than the rest of the organ. The cœca are slender, especially at the distal ends, and much corrugated. The extreme tips of the papillæ beyond the end of the cœca are yellowish flesh colour, deeper than the superficial colour of the rest of the papillæ."

I have examined two preserved specimens given me by Mr. Beaumont, 20 mm. and 14 mm. long respectively. The colour is dead white, not very transparent. The hepatic diverticula are yellowish white and corrugated. The external characters agree with Mr. Beaumont's description. The front of the foot is broad and expanded, but the tentacular angles are small and bent downwards and inwards. The anterior margin is not grooved. Over the mouth is a broad oral veil (5.3 mm.) expanded into short tentacles (1.7 mm.) at the sides. The rhinophores are long (7.5 mm.), thin, not perfoliate, and placed close together on a slight prominence. There are three rows of cerata distinctly in front of them. The cerata are set on eight narrow, curved ridges, which are single and do not form horseshoes. The first three rows are close together, the next three not far apart, but the last two are more distant. In the perfect specimens the length of the cerata obscures this arrangement. There are four to six cerata in each row. The cerata in front of the rhinophores are short, cylindrical, and 2-4 mm. long. The posterior cerata are very long; in the specimen, which has a body 20 mm. long, they measure as much as 15 mm. and are about 1 mm. broad at the base.

\* The specimens here described are much the same.—C. E.

The jaws bear two or three rows of denticles. The radula is triseriate, and consists of twenty and fourteen rows respectively in the two specimens. The central tooth (Fig. 15. a.) has a strong central cusp, which bends slightly downwards, and hence sometimes appears asymmetrical when pressed flat in a slide. On each side of it are a number of small denticles of varying shape and size. The smallest number observed was sixteen and the largest twenty-four. The laterals (Fig. 15. b.) are also broad, with slightly lower cusps, and twenty to thirty accessory denticles on the inner side. No denticles were visible on the outer side of the laterals.

The penis, which is partially protruded in one specimen, is sickle-shaped and very deeply grooved, consisting of a lamina folded down the middle and probably capable of assuming a foliaceous expansion. This part is unarmed, but the base of the penis and the end of the spermatic duct bear numerous yellow cones (Fig. 16.) terminating in a short bent appendage. They appear to be soft and not spiculous or chitinous. The spermatheca is large and spherical.

As this species has smooth rhinophores and the radula of *Coryphella*, I provisionally refer it to that genus in order to avoid multiplying genera. But in many of its characters—such as the shortness of the oral tentacles, the length of the cerata, the position of some of the cerata in front of the rhinophores, and the conformation of the penis—it differs markedly from the described *Coryphellæ*, and it may ultimately prove better to make it the type of a new genus.

#### CRATENIDÆ, BERGH.

(BERGH, *Mal. Unt. in Semper's Reisen*, Heft i., 1870, pp. 1-4, and Heft xviii. pp. 1021-4. BEAUMONT, "Fauna and Flora of Valentia Harbour," in *Proc. Royal Irish Acad.*, 1900, pp. 834-8. FRIELE, "Mollusken der ersten Nordmeerfahrt," *Bergen's Museums Aarbog*, 1902, No. 3, p. 9.)

As the authors cited above observe, Bergh's classification of this group raises many difficulties in practice, on account of the minuteness of the generic distinctions and the doubt whether the forms really possess the characters which he attributes to them. He divides the sub-family into five genera—*Cuthona*, *Cuthonella*, *Cratena*, *Hervia*, and *Phestilla*. Of these the last named differs from the others in several particulars. *Hervia* also may be set aside as characterized by the corners of the foot being prolonged into tentacular processes. It is not recorded from British waters, though as the habitat of one species is the Northern Atlantic it may some day be added to our fauna. The other three genera, *Cuthona*, *Cuthonella*, and *Cratena*, are closely connected, and to them must be added in my opinion *Amphorina*. Bergh classes

*Amphorina* under the Galvinidæ, which hardly form a natural sub-family, the only character common to the component genera being that the cerata are more or less inflated. In *Amphorina* this feature is not very marked, and its other characters ally it to *Cratena*. The tropical genera *Zatteria*, *Myja*, and *Ennoia* are also probably allied, but need not be considered here.

With regard to nomenclature, Bergh appears to have proved that the names *Cavolina* and *Montagua* must be rejected.

The animals which compose the four genera *Cratena*, *Cuthona*, *Cuthonella*, and *Amphorina* are small and inconspicuous, though often beautifully coloured. The rhinophores are not perfoliate, the corners of the foot are not developed into tentacular processes, and the radula is uniseriate. There is an absence of any very striking characteristics either internal or external. The most distinct genus is *Amphorina*. It has slightly inflated cerata, a style on the penis, and a long tapering radula containing from fifty to eighty teeth, which gradually increase in size. The denticles on the teeth, particularly the median cusp, arise far back, and hence have a peculiar elevated appearance. To this genus at least the following species must, in my opinion, be referred:—

1. *Amphorina alberti*, Quatrefages.
2. *A. cœrulea* (Mtg.).
3. *A. molios*, Herdman.\*
4. *A. aurantiaca* (A. & H.) = *Cuthona aurantiaca*.
5. *A. olivacea* (A. & H.) = *Cratena olivacea*.

Perhaps *Cratena viridis* will prove to be an *Amphorina*, as may also *E. glottensis*. In separating the other genera Bergh makes use of the structure of the auditory capsule, which he says contains a single otolith in *Cuthona*, but several otoconia in *Cuthonella* and *Cratena*. Beaumont, however, denies this, and reports the existence of single otoliths in species classified by Bergh under *Cratena* (e.g. *Cr. amœna*). In any case, the character is so minute and so difficult to determine in preserved specimens that it seems undesirable to use it, unless absolutely necessary. Setting aside possible differences in the auditory capsule, it would appear that the only clear distinction between *Cuthona* and *Cratena* formulated by Bergh is that the head is broad in the former, but not in the latter. This character seems to be clear and conspicuous, though, as it is merely a question of degree and development, one may doubt if it is really of generic value. If it is accepted, it would appear that the following are referable to *Cuthona*:—

1. *Cuthona nana*, A. & H.
2. *C. pumilio*, Bergh (Sargasso Sea).

\* I agree with Mr. Beaumont (l.c.) in thinking that the specific distinctness of this species from *A. cœrulea* is doubtful.

3. *C. bicolor*, Bergh (Japan).
4. *C. peachii*, A. & H. (see Beaumont, l.c.).

*Eolis inornata*, A. & H., and *Cuthona stimpsoni*, Verrill ("Addns. to Marine Fauna of N. America," in *American J. of Sci. and Arts*, vol. xvii. p. 314, 1879), possibly belong to this group, but are imperfectly described, and the buccal parts unknown.

The genus *Cuthonella* was founded by Bergh for a single specimen obtained by the *Challenger* in the Faroë Channel. Like *Cuthona* it has a broad head, but it differs from both *Cuthona* and *Cratena* in having the foot truncated in front, jaws armed with several series (not a single series) of denticles, and the anus opening on the back, not on the side. It will be seen that all these characters, except the last, are very slight. Friele (l.c.) examined specimens from the North Atlantic which had the general characters of the *Cratenidae* and a dorsal anus, but a rounded foot and a rather irregular denticulation of the jaw. Not wishing to create a new genus for these trifling deviations, he referred the form to *Cuthonella*, the characteristic of which thus becomes the position of the anus, which is dorsal, but somewhat to the right of the median line.\*

The genus thus contains—

1. *Cuthonella abyssicola*, Bergh.
2. *C. ferruginea*, Friele.
3. *C. berghi*, Friele.

All from the North Atlantic, but not from British waters.

There remains the large genus *Cratena*, in which can be included most of the forms not assigned to *Cuthona*, *Cuthonella*, and *Amphorina*, though some of the less-known species of this group, such as *Eolis northumbrica*, present remarkable peculiarities. In *Cratena* the head is not broad, the cerata are not inflated, and the anal papilla is on the side, not on the back. The radula is generally (but not always) short and not markedly tapering. The teeth bear a few (rarely more than ten) denticles on each side of a central cusp which is often not prominent. As a rule the penis is unarmed, but in some cases, for which it hardly seems worth while to create a new genus, it bears a style. The following species seem referable to this genus with more or less certainty:—

1. *Cratena hirsuta*, Bergh. Greenland.
2. *Cr. obrilcki* (Mörch). Greenland.
3. *Cr. pustulata* (A. & H.).
4. *Cr. amœna* (A. & H.).
5. *Cr. fructuosa*, Bergh. Sargasso Sea.

\* I understand this to be the case in *Cuthonella abyssicola*, but Bergh's statements in the *Challenger Report*, on p. 24 and p. 25, are not quite consistent.

6. *Cr. concinna* (A. & H.).\*
7. *Cr. pilata* (Gould). North-West Atlantic.
8. *Cr. bylgia*, Bergh. Philippines.
9. *Cr. longibursa*, Bergh. Pelew Islands.
10. *Cr. stipata* (A. & H.).
11. *Cr. cavanceæ*, Bergh. Chile.
12. *Cr. pusilla*, Bergh. Juan Fernandez.
13. *Cr. cucullata*, Bergh. Malay Archip.

*Cr. viridis* (Forbes) and *Cr. glottensis* are probably Amphorinas, and it seems difficult to separate *Cratena gymnota* (Gould) from *Amphorina aurantiaca*. *Cr. arenicola* (Forbes), *Cr. veronicae* (Verrill), *Cr. couchii* (Cocks), and *Cr. purpurascens* (Fleming) are imperfectly described. *Cr. cingulata* is placed by Alder in *Jeffrey's Conchology*, vol. v. p. 53, under *Galvina*, which implies that it has a triseriate radula. *Cr. lugubris*, Bergh, is referred to this genus with a query by the author himself.

In *Jeffrey's Conchology*, vol. v. p. 45, etc., Alder distributes the British forms between *Cuthona* and *Cavolina*. The former, which is defined as having the branchiæ close set and a uniseriate radula with a central spine and lateral denticulations, includes *C. peachii*, *C. nana*, *C. stipata*, *C. angulata*, *C. inornata*, *C. concinna*, *C. olivacea*, *C. aurantiaca*, and *C. pustulata*. *Cavolina*, which is defined as having the branchiæ set in rather distant rows and a uniseriate denticulated radula with the central spine a little prominent, includes *C. couchii*, *C. amæna*, *C. northumbrica*, *C. arenicola*, *C. glottensis*, *C. cærulea*, *C. viridis*, and *C. purpurascens*. Though something may be said for this division, it ignores the existence of *Amphorina* (Quatrefages, 1844), and the point on which stress is laid—whether the branchiæ are close set or in distant rows—is often difficult to determine in preserved specimens, and might be doubtful in living ones.

In the above remarks I have merely considered how the described species can be most naturally distributed among the described genera. Whether those genera are valid and necessary is another question. I doubt myself if Bergh's whole subfamily of Cratenidæ, including *Amphorina* (but perhaps excluding *Phestilla*) offers more than one good generic type; and if nature provides a great number of similar forms it seems unscientific to separate them into many genera on the strength of small points of difference. It is convenient, no doubt, to divide a large genus into sections or subgenera, but to split it into several genera if the differences between them are of less than ordinary generic value obscures the real uniformity of the animals classified.

\* *Cr. concinna*. Since writing the above I have had an opportunity of examining a specimen of this species from the Menai Straits, given me by Prof. Herdman. The characters agree with A. & H.'s description. No style was found on the penis. The teeth of the radula are remarkably long, narrow, and pointed.

## AMPHORINA AURANTIACA (A. &amp; H.).

(ALDER and HANCOCK, *Mon. Brit. Nud.*, Fam. 3, pl. 27.

BEAUMONT, l.c., pp. 836-7.)

One living specimen examined at Plymouth, April, 1905. The animal, which was active and seemed to resent being touched, measured 8 mm. in length and 3.5 in breadth when extended. Mr. Beaumont observes that specimens as highly coloured as Alder and Hancock's plate are rare, and the present one was decidedly less brilliant. The tentacles and rhinophores were colourless, the latter with a faint red tinge. The body was colourless and transparent, with very minute, hardly visible opaque white dots. Behind the black eyes was a reddish spot, possibly caused by some internal organ showing through the skin. The general effect of the cerata was that they were reddish with white tips. The integuments of the cerata were colourless, as could be seen at the tips, where there is no liver; below this colourless tip was a broad band of opaque white, formed by an aggregation of minute dots. The hepatic diverticula were reddish brown.

The foot is expanded anteriorly into a disk, but there are no tentacular angles. The tail does not project beyond the cerata behind. The rhinophores are somewhat longer than the tentacles. In the living animal the cerata show no distinct arrangement in rows; a bare space is visible anteriorly behind the rhinophores; further back the cerata close over and hide the dorsal surface. When stripped off, the cerata are seen to be arranged in ten rows, each containing two to four.

The jaws bear several series of minute denticles. The radula consists of a single series of seventy-six teeth, tapering markedly in breadth. They bear two or three main denticles (Fig. 17.) on each side of the median cusp, and one or two secondary smaller denticles occasionally and irregularly interposed between the main denticles. All the denticles, especially the median cusp, arise unusually far back. Mr. Beaumont states that the penis is armed with a style.

Verril in *Proc. U. S. National Mus.*, iii., 1880, p. 390, observes that *Cuthona aurantiaca*, A. & H., is very closely allied to *Cratena gymnota* (Gould), which has been described by Bergh in *Beiträge zur Kenntniss der Aolidiaden*, viii., 1885, pp. 33-5. The dentition agrees exactly, but the form and arrangement of the cerata are different, and Bergh found no armature on the penis. It may therefore perhaps be well to keep the forms provisionally distinct.

This form must, I think, be referred to *Amphorina*, for it has all the main characters of that genus. The cerata are stout (see Alder and Hancock), the penis is armed with a style (according to Beaumont), the radula is tapering, and the denticles on the teeth arise far back. Loman

in his paper *Anteekening over twee voor de nederlandsche Fauna nieuwe Nudibranchiata*, published in the *Tijdschrift der Nederlandsche Dierkundige Vereeniging*, 1893, p. 35, has already called the animal *Amphorina aurantiaca*.

AMPHORINA OLIVACEA (A. & H.).

(ALDER and HANCOCK, *Mon. Brit. Nud.*, Fam. 3, pl. 26.

BEAUMONT, l.c., p. 834.)

One living specimen was seen at Plymouth in April, 1905, which I should have hesitated to identify with Alder and Hancock's *E. olivacea* on account of the differences in tint and markings; but Mr. Beaumont considered it referable to this species, and stated that the coloration is very varying. As the other characters of the animal proved to agree with *E. olivacea*, I have no doubt he is correct.

The animal is only 4 mm. long, stoutly built, with a short tail. The body colour is whitish; the tentacle, the rhinophores, and the region behind them are yellowish. There are no red markings, but the cerata and body, especially the head, are sprinkled with conspicuous dots of bright, opaque yellow. The tips of the cerata are whitish and the hepatic diverticula are olive-coloured.

The front of the foot is slightly expanded into round lobes, but there are no tentacular angles. The cerata are rather thick; the branches of the liver within them are of loose and irregular shape. The cerata are set in eight rows, fairly close together, containing three to four each.

The jaws bear a row of minute but distinct blunt denticles. The radula tapers somewhat, but not conspicuously; it consists of a single series of fifty-three teeth, with six denticles on each side of the median cusp (Fig. 18.). This cusp is elevated and rises further back than the others. I found the verge armed with a hooked style (Fig. 19.) as already described by Mr. Beaumont.

I think that this species, like *Eolis aurantiaca*, A. & H., must be referred to *Amphorina*, for it has thick papillæ, a spine on the penis, and a long somewhat tapering radula, in which the teeth have the central cusp rising far back.

CRATENA AMCENA (A. & H.).

(ALDER and HANCOCK, *Mon. Brit. Nudib.*, Fam. 3, pl. 3.

BEAUMONT, l.c., p. 834.)

One living specimen, Plymouth, April, 1905. The animal when fully extended is about 7.5 mm. long. The body is of a not very clear white, with opaque white spots, especially on the head and tail. The angles of the foot are rounded in front. The tentacles and rhinophores are as in

Alder and Hancock's plate, spotted with white and with a reddish-brown band about a third of the way down. The cerata are spotted with opaque white and brown and have white tips, below which is often, but not always a distinct reddish-brown ring; they are carried as represented by Alder and Hancock, but there are only five or at most six groups, arranged as follows:—

1 )  
 4 )  
 4  
 4  
 4  
 3

The hepatic diverticula are not nearly as green as represented by Alder and Hancock, but greyish brown with only a faint greenish tinge.

The jaws bear a single row of small but distinct blunt denticles. The radula consists of a single series of seventeen teeth, not tapering conspicuously; there are five denticles on each side of the central cusp, which is not much higher than the rest. Beaumont found the verge to be armed with a colourless spine, but I was unable to discover it.

If *Cratena* and *Amphorina* are maintained as separate genera, it is difficult to say to which this species should be referred. Beaumont found that it had a single otolith and a style on the penis, characters which belong to *Amphorina*; but the cerata are not inflated, the radula is short, and the denticulation of the teeth is not like that found in *Amphorina*. I therefore describe the animal, though with considerable hesitation, as *Cratena amona*.

#### CALMA, A. & H.

Much confusion has arisen about this genus, for later authors have not paid sufficient attention to the statements made about it by Alder and Hancock, and these statements, which are scattered in various parts of the monograph, are not always plain if taken separately, though if taken all together they are clear enough. Alder and Hancock described the type species first in the letterpress to plate 22 (under the name of *Eolis glaucoides*) as a very curious *Eolis* which will probably constitute a new generic type, and pointed out the remarkable characters of the "gastro-hepatic vessel" and "the ovary." Their language about the radula in this passage is wanting in precision, but in the letterpress to plate 47 (*Tongues of the Eolididæ*) they say that the tongue is very slender, resembles a continuous band, and can only be seen in profile. The figure clearly represents the tongue as I have found it, a continuous chitinous ribbon in which the teeth are fused

together and only appear as minute serrulations. On page 21 of the Appendix they create the genus *Calma* for *Eolis glaucoides*, but unfortunately mention only the external characters and do not refer to the anatomy.

Hence Trinchese, followed by Bergh (*Beit. zur Kennt. der Æolid.*, iii., 1876, pp. 643-7, and vii., 1882, pp. 61-4) and Vayssière (*Opisth. de Marseille*, ii., 1888, 84-8), regarded the genus as akin to *Flabellina*, and referred to it the *Eolis cavolini* of Vérany.

Later (*Rendiconti Accad. Sci. Fis. Mat. di Napoli*, xx. 5, 1881, pp. 121-2, and *Mem. Ac. Sci. Istit. di Bologna*, S. iv. T. x. pp. 57-61) Trinchese described under the name of *Forestia mirabilis* a Mediterranean Æolid having all the main characters of Alder and Hancock's *Calma glaucoides*—the thread-like undivided radula, the broad, simple hepatic system, and the hermaphrodite gland arranged along the two sides of the body. Friele and Hansen had also (*Bidrag til Kundskaben om de nordske Nudibranchier*, 1875, pp. 78-9) described another species from the Northern Atlantic, calling it merely *Eolis albicans*, but indicating its affinities to the genus *Calma*, A. & H. Bergh, in his *System der Nudib. Gasteropoden* (p. 1025 and p. 1034) puts *Eolis albicans* under *Forestia*, and makes the genus *Calma* consist of *C. glaucoides*, A. & H., and *C. cavolini* (Vérany).

There can, however, be little doubt that the really important characters of *Calma* are those mentioned above, and that the genus is equivalent to the later (1881) *Forestia*. It will then contain three species.

1. *C. glaucoides*, A. & H. Atlantic.
2. *C. albicans*, Friele and Hans. Atlantic.
3. *C. mirabilis* (Trinchese). Mediterranean.

*C. albicans* appears closely allied to *C. glaucoides*. *C. mirabilis* differs in having a few separate teeth, as well as the continuous chitinous band, and it would seem that the groups of papillæ do not rise from a common stalk.

It seems probable that *Calma cavolini* does not belong to this genus. It is regarded by Bergh and Vayssière as related to *Flabellina*, from which it differs in having no perfoliations on the rhinophores. The radula is not like that of *Calma glaucoides*, but has separate teeth of the usual pattern. There is some doubt whether it is triseriate or uniseriate, the laterals being in any case very small. It would seem that in some points the digestive and reproductive organs resemble those of *C. glaucoides*, but neither Bergh nor Vayssière suggest that it resembles *Forestia mirabilis*. They had perhaps not seen Trinchese's paper at the time they wrote. Whatever may be the true affinities of the form, the differences in the buccal parts prevent its being referred to *Calma*, and I would propose that it should be rebaptized *Calmella*.

I do not think that the inflated shape of the cerata and their arrangement on low pedestals are really important characters in *Calma*, and would define the genus as at present known in the following way.

Animal flattish, cerata arranged in rows and sometimes rising from a pedestal. No cnidocysts. Rhinophores simple. Corners of anterior margin of foot prolonged into tentacular processes. Penis unarmed. Jaws not denticulate. Radula a continuous band not divided into separate teeth and merely bearing serrulations on the upper surface. Digestive system much simpler and less ramified than is usual in the *Æolididæ*; kidney also simple and not ramified. Hermaphrodite gland symmetrically arranged on the two sides of the body.

Though the anatomy of *Calma* is characterized by a certain simplicity, this simplicity is no doubt not primitive, but secondarily acquired and connected with the unusual diet of the animal, which feeds on the eggs of fish. The nature of the food no doubt explains the degeneration of the radula and perhaps also the absence of cnidocysts (see Grosvenor, "On the Nematocysts of *Æolids*," *Proc. Roy. Soc.*, 1903, vol. lxxii. No. 486, p. 469). Several of my specimens seemed to be gorged and distended with gelatinous matter, and probably the creatures' habit of thus stuffing themselves accounts for the breadth and simplicity of the alimentary passages.

#### CALMA GLAUCOIDES, ALDER & HANCOCK

Seven specimens received from the Plymouth Laboratory. Two of them resemble Alder and Hancock's figures more than do the others, which are flatter and have swollen, almost ovate cerata. But no differences of structure were found, and as all the specimens were identified at the Laboratory with *C. glaucoides*, it is probable that they were all alike externally when alive.

The length varies from 10 to 4 and the breadth from 4 to 2 mm. The general colour is whitish or drab, but varies in detail, because the transparent integuments allow the contents both of the body and of the cerata to be seen. The broad digestive tract with its diverticula is generally coloured a pale dull yellow, but contains here and there blackish masses in the cerata as well as in the main alimentary tract. In two specimens these black portions are so large that the general colour appears to be bluish black. At the sides of the body between the cerata the white follicles of the hermaphrodite gland are distinctly visible. The integuments are generally brownish at the sides of the body and at the bases of the cerata.

The margin of the foot is expanded both in front and at the sides, so as to be considerably wider than the head and body; anteriorly the foot is rounded, and is produced on each side into a short tentacular process,

which is almost invisible in many specimens. The cerata are set in from nine to twelve rows, the most common number being ten. Each row contains two or three cerata, more rarely four. The stalk or common base on which they are set is not at all conspicuous, but when an attempt is made to detach them they come off in twos or threes, and not separately. They are not at all caducous. In most specimens they are oblong-ovate in shape; but in two (as in Alder and Hancock's figures) they are cylindrical. The tentacles and rhinophores are both small, without a trace of perfoliations.

The jaws are thin, smooth, and colourless. The radula consists of a colourless, continuous ribbon, bent into a roughly semicircular shape (Fig. 20.), and bearing 60-100 denticulations like the teeth of a saw, and gradually increasing in size.\* No trace of any loose, detached teeth was found. The œsophagus leads into a dilatation (Fig. 21. d.) of moderate size, which may be called the stomach. From it extends a diverticulum on either side which supplies two cerata. Posteriorly the stomach is prolonged into a very wide sacculated gut (Fig. 21. a.), which extends to the extreme end of the body and gives off simple diverticula, each of which supplies a single group of cerata. These diverticula fill the cerata entirely, and no cnidocysts were found. The contents of the digestive tract, including the cerata, resemble hardened jelly, and are probably composed of the eggs of fish, which the animal is said to eat. In this jelly are embedded moderately hard black lumps, detachable from their surroundings and easily friable, which the jelly is not. As mentioned above, in some specimens this black substance forms the major part of the contents of the digestive tract.

The lobes of the hermaphrodite gland are white, and visible through the dorsal integuments. They are composed of small pouches containing ova, scattered rather irregularly round a larger and more elongate pouch containing spermatozoa, and they alternate with the diverticula proceeding from the alimentary canal to the cerata. There is no armature on the penis. The renal organ (Pl. XII., Fig. 22.) consists of a simple sac with a few constrictions. It does not in my specimens extend as far backwards as indicated by Hecht's figures (*Contribution à l'étude des Nudibranches, Mem. Soc. Zool. de France*, viii. 1895, pl. iv. figs. 47, 48), but terminates soon after the commencement of the posterior third of the body.

#### JANIDÆ, BERGH.

This family superficially resembles the true *Æolids*, but offers several differences of organization. Except in *Madrella*, the radula is multi-

\* Below the row of denticulations (a) there can be seen under a high power three or four series of minute pits and projections (b).

seriate, which would seem to be a more primitive arrangement than the extremely narrow radulae of the *Æolids*; but the anal papilla is situated near the end of the back in the median line, which seems to be an instance of secondarily acquired symmetry. The digestive system offers peculiarities of its own; and the cerata, together with the hepatic diverticula, extend in front of the rhinophores along the anterior margin. There is generally a crest between the rhinophores.

Three British genera are known—*Antiopella*, *Janolus*, and *Proctonotus*. The nomenclature of the first genus is confusing. Vérany described it as *Janus* in 1844, and this name is used by Bergh, Trinchese, and Vayssière on the ground that it has priority over *Antiopa*, the name used by Alder and Hancock in 1855. But the objection to the name *Janus* (as pointed out by Alder and Hancock in the text for plate 43) is that it has been in use for a genus of Hymenoptera since 1835. But Mr. Hoyle states (*Journal of Conchology*, 1902, p. 214) that *Antiopa* is in its turn invalid for a similar reason, namely, that it was used for a genus of Diptera as early as 1800. He proposes to call the animal *Antiopella*, and it would seem that this name must stand, unless some one proves that it also is preoccupied.

*Antiopella* has perfoliate rhinophores with a crest between them, and jaws with denticulate edges. Only one species is properly authenticated, *A. cristata*, which is recorded from the Mediterranean and British waters. *Janus sanguineus*, Angas, is somewhat doubtful. The plate suggests that it may be an unusually red variety of *Madrella ferruginosa*, which has also the habit mentioned by Angas of discharging a yellow secretion which colours the water round it.

The genus *Janolus* was created by Bergh for a specimen obtained by the *Challenger*, and differing from *Antiopella* in having a very broad margin to the foot and remarkably large undenticulate jaws. Bergh has since shown that Alder and Hancock's *Antiopa hyalina* belongs to this group. A third species, *Janolus caeruleopictus*, Eliot, is recorded from California; and a fourth, somewhat doubtful, species is described below.

The genus *Proctonotus* was created by Alder and Hancock for two specimens found near Dublin, and is also recorded from West Ireland and Arran. The rhinophores are not perfoliate (though they bear wrinkles and tubercles), and there is no crest between them. The radula is broad and the jaws are not denticulate.

#### ANTIOPELLA CRISTATA (DELLE CHIAJE).

Four living specimens at Plymouth, April, 1905, the largest 30 mm. long and 8 broad. Alder and Hancock's figure of this species is not very good, and that of Trinchese (*Æolididæ del Porto di Genova*, pl. 44) is in

some respects superior. The general colour is transparent white with a faint yellowish tinge. The rhinophores and the crest between them are very large and distinctly yellowish. On the back and sides of the body and on the tips of the cerata are very vivid metallic spots which appear blue in some lights and pink in others. There is a streak of the same colour on the tail. The hepatic system is of a deep, rich brown, and its ramifications can be seen clearly through the transparent skin.

The cerata are very deciduous, and in these specimens many, or even the majority, are quite small and tubercular. These are evidently new growths replacing lost appendages.

JANOLUS HYALINUS (A. & H.).

(ALDER and HANCOCK, *Monog. Brit. Nudib.*, Fam. 3, pl. 44. BERGH, *Mal. Untersuch. in Semper's Reisen*, vi. 1, p. 8.)

Two preserved specimens from Plymouth, one 8 mm. long, the other only 4.3 mm. They agree as to external characters with Alder and Hancock's description. The colour is yellowish, with traces of lighter and darker mottlings. The cerata are crowded and irregularly set. There are generally four to five in a transverse row. The innermost are the largest and about 5 mm. high; they decrease in size outwards, and the outermost are mere tubercles. They bear knobs, as described by Alder and Hancock. The anterior margin of the foot is somewhat undulated, with a bend inwards in the middle. It is not grooved in the ordinary way, but the sides of the head are developed into lappets which extend downwards towards the sides of the foot and form a ridge parallel to them. There is a small fold round the head bearing two distinct tentacles. The rhinophores bear irregular perfoliations which do not go all round the club. The interrhinophorial crest is elongate.

The jaws are large and smooth, with no denticles. The radula consists of fifteen rows varying from 11.1.11 to 13.1.13. The teeth are hamate and increase in size from the rhachis outwards, the last but one being the largest, and the outermost of all smaller (Fig. 23.). They bear three to five (rarely seven) long ridge-like denticles, which are not very small, but difficult to see on account of the extreme transparency of the teeth. These denticles seem to have escaped the notice of both Alder and Hancock (*Tongues of the Eolididae*) and Bergh, who describe the teeth as smooth. The denticulation is probably variable.

Alder and Hancock's figures of this species (*Monograph*, pl. 44, figs. 8 to 12) are not good, but much better unpublished drawings by Hancock are preserved in the Newcastle Museum.

JANOLUS FLAGELLATUS, *sp. nov.*

One specimen from Plymouth labelled "*Antropa hyalina* nr. *Eddystone*

25. vi. 97." As preserved, it is of a uniform dull-white colour, slightly transparent on the back, but elsewhere opaque. The length is 15.5 mm.; the breadth 8; the height to the top of the pericardium 7.5, but the end of the body has burst open, and the hermaphrodite gland is protruding. The foot is broad (as much as 9.5 mm. in one place), with ample and undulated mantle margins. It is notched in front, and connected with the head by two very distinct intermediate fleshy plates. Above them are two small but distinct tentacles, forming the extremities of a narrow oral veil. The rhinophores are straight, cylindrical, moderately stout, and bear irregular but distinctly vertical perfoliations, which often join one another or end abruptly before they reach the summit. Between them is a very distinct crest, consisting of about ten transverse perfoliations, which are themselves crinkled and again perfoliate.

The only cerata preserved are minute, not more than 1 mm. high, more numerous on the right than on the left, and set in one to two rows. There are also several small cerata in front of the rhinophores. There is no trace of larger cerata, but they have probably been lost and replaced by young ones in the first stages of growth. The anus is medio-dorsal, set very far back, and cup-like. There appear to be a few tubercles on the broad tail.

The genital orifices are about 5 mm. from the head and surrounded by strong folds. The verge is exerted and extremely long. It consists of a straight cylindrical column, not tapering, 4 mm. long, and bearing at the end a flagelliform appendage 5 mm. long, so that the whole organ measures 9 mm.

The digestive organs are much compressed by the greatly developed reproductive glands and are not very well preserved, but appear to agree with Alder and Hancock's account of *Antiopa cristata*. The oesophagus is short and opens into a large laminated stomach, from which the intestine runs backwards and which receives the two principal hepatic trunks. Owing to the cerata being minute and rudimentary the course of the hepatic diverticula in them cannot be traced; but beneath the dorsal skin, and especially at the sides, there is a thick network of tubes out of which the hepatic trunks seem to arise.

The central nervous system is like that described by Bergh for *Janolus australis*, and the eyes have long connectives.

The buccal mass is large (5 mm. × 4 mm.) and yellowish white. The jaws bright, deep orange, very thick and strong, as in *Janolus hyalinus*. The radula consists of fifteen rows, with a maximum formula of 20.1.20. The lateral teeth (Fig. 24. b.) are yellow, hamate, low, with a large, broad base. The median teeth (Fig. 24. a.) are small, with a low inconspicuous hook. No denticulations could be seen.

The hermaphrodite gland is very large, and fills the whole posterior part of the body with numerous packets of yellowish-white follicles. The anterior genital mass is enormous (10 mm.  $\times$  7 mm.) for the size of the animal, and both the mucous and albumen glands are greatly swollen. The spermatheca is elliptical. The verge is as described above; the canal follows the whole length of the flagellum to the very end.

It would seem that the flagelliform character of the verge distinguishes this species from *J. hyalinus*. No such formation is indicated in Bergh's description of *J. hyalinus*, nor have I found it myself in that animal. Also there seem to be some differences in the radula; and though the shape of the cerata is unfortunately unknown, the general appearance and dead-white colouring do not resemble *J. hyalinus*. But the species is open to doubt unless confirmed by other specimens.

#### ALDERIA, ALLMAN.

Three species of this genus have been described.

1. *A. modesta* (Lovén).
2. *A. comosa*, A. Da Costa. Naples (*Ann. del Museo Zoologico, Napoli*, anno iv. 1864, p. 32, and pl. ii. 3).
3. *A. harvardiensis* (Agassiz). East coast of North America (see Gould, *Invertebrata of Massachusetts*, 1870, pp. 254-5, pl. xvi. 226-8).

Alder and Hancock published some account of the anatomy of *A. modesta* in their monograph, but only the external features of the other two species are known. *A. comosa* is green, with numerous long cerata, and the anal papilla lies behind the pericardium. It must be regarded as very doubtful if *A. harvardiensis* is really distinct from *A. modesta*, which differs in being darker, in having fewer and smaller cerata, and, if Gould's figure may be trusted, in the more angular shape of the head. But the description and the figure do not quite agree as to the disposition of the cerata, and the colour of *A. modesta* is very variable.

*Alderia* seems allied to *Limapontia*, from which it differs chiefly in having cerata and a much greater ramification of the hepatic system. The lateral expansions of the foot remind one of the wings of *Elysia*.

#### ALDERIA MODESTA, LOVEN.

(ALDER and HANCOCK, *Monog.*, Genus 17, Fam. 3, pl. 41.)

I am indebted to Mr. W. I. Beaumont for several specimens of this interesting form, labelled "Ardfry, County Galway, May 1904." In some unpublished MSS. of Albany Hancock preserved in the Hancock

Museum at Newcastle-on-Tyne I have found the following notes on the living animal:—

“The foot exhibited beautiful dendritic markings.\* The glands in the papillæ are considerably branched. The animal yields a quantity of mucus, has a strong sugar smell, and is sluggish in its motions. The papillæ are remarkable for their rhythmical pulsations. They dilate and contract simultaneously between thirty and sixty times a minute. The contraction is very forcible, the posterior surface of the papillæ being most contracted. This pulsation has all the appearance of being connected with the circulation. The papillæ are much depressed when in a state of contraction.”

The colour of the preserved specimens varies from white to yellow, with darker mottlings on the back and upper side of the cerata. The variations in shade are considerable. Sometimes the ground colour is yellowish and the mottlings light, leaving a general impression of yellowish brown. Sometimes the mottlings are thick and dark and the ground colour opaque white. The upper surface then appears to be purplish black, with a few white markings.

The animals are stoutly built, the largest specimens measuring 5.5 mm. by about 3.5. In front the dorsal surface is bare, the cerata being set only at the sides, but behind they close over the body. The foot is white, broader than the body, with an expanded margin, but rather straight in front. No anterior groove is visible.

At the sides there is a groove between the body and this margin, so that the body, though narrower than the foot, partly overhangs it. On this lateral projection of the body are set the cerata in three not very regular longitudinal rows. As a rule only two rows are fully developed, and the third, which consists of smaller cerata, has the appearance of being crowded in. The total number of cerata on either side does not appear to exceed fifteen, which is less than the number shown in Alder and Hancock's plates. The cerata are somewhat ovate in shape. Those behind are larger and more inflated than those in front. They contain ramified hepatic diverticula which bear primary and sometimes short secondary branches.

The head bears on each side a rounded prominence, but there are neither rhinophores nor tentacles in the ordinary sense. The anus is on a prominent papilla in the medio-dorsal line and nearly terminal.

There is no trace of jaws. The radula is ascoglossan and short, containing five or six teeth in the ascending, and about as many in the descending portion. In an irregular heap lie about seven teeth of varying size, and with them a mass of minute spines, apparently repre-

\* Due apparently to the ramified diverticula of the alimentary canal being seen through the semi-transparent sole.

senting the first teeth. The mature teeth (Pl. XI, Fig. 25.) are large and spoon-shaped. The outline is rather irregular, and there are generally two more or less distinct projections on the back.

There is no crop attached to the buccal mass, but from it issues a thin tube (Fig. 26. a.) which must apparently be regarded as equivalent to a stomach as well as to an œsophagus, at least in its posterior part, for from it arises the intestine (Pl. XII, Fig. 26. b.). This is a larger tube which bends slightly to the right and then runs directly backwards at first on the right under the side of the pericardium and finally above the renal organ to the anal papilla (Fig. 26. c.). The thin tube issuing from the buccal mass bears two folds inside. At its posterior extremity these folds become more numerous, and the tube bends downwards and dilates into a large stomach-like pouch (Fig. 26. e.). It is clear, however, that the intestine does not issue from this pouch, but from the narrower tube. It is probable that the animal lives on vegetable juices, and that the two folds in the tube act as strainers and valves, establishing communication alternately between the mouth and the pouch and between the pouch and the intestine, only one line of communication being open at a time. The pouch is prolonged anteriorly under the œsophagus and divides into two diverticula (Fig. 26. d.) which enter the anterior lobes of the foot. Posteriorly it extends almost to the end of the body and gives off two sets of ramifying diverticula (Fig. 26. f.). The upper diverticula (about four in number) enter the cerata and are also ramified in the body. The lower diverticula (also about four) extend downwards through the hermaphrodite gland and do not enter the cerata, but their ramifications within the body create the peculiar dendritic markings (Fig. 28. i.) visible through the sole of the foot.

The central nervous system (Pl. XI, Fig. 30.) forms a collar round the œsophagus consisting of seven principal ganglia close to one another and connected by very short commissures, the longest being that connecting the cerebral ganglia. They should probably be regarded as two cerebral, two pedal, and three visceral ganglia. Connected with the cerebral ganglia are two smaller ganglia, probably rhinophorial in function and innervating the most sensitive part of the head, although no external rhinophores are developed.

The hermaphrodite gland is large and ramified throughout the whole lower part of the body, filling up the interstices between the other organs. The ampulla and duct of the gland are short. After the bifurcation of the male and female branches (Pl. XII, Fig. 27. b.) the former runs to an orifice at the right anterior corner of the head. The vas deferens (Fig. 27. d.) is not very long or much convoluted. A rather large prostate (Fig. 27. c.) opens into it by several ducts. The penis is armed with a rather long curved spine which in some specimens at any rate

points inwards when the organ is retracted. Shortly after the bifurcation the female branch receives a long duct (Fig. 27, g.) into which open the follicles of the albumen gland (Fig. 27. h.). This gland, like the hermaphrodite gland, is extensively ramified, especially in the last fourth of the body. Close to the entry of this duct and lying anteriorly is a pouch-like diverticulum (Fig. 27. f.) which is probably a spermatheca. No second spermatheca was found. The female branch here makes a sharp turn and runs backwards nearly to the end of the body; it then doubles on itself and runs forwards, opening anteriorly close to the male orifice. All this section (Fig. 27. i.) of the female branch after the spermatheca is very much larger than the other parts and provided with remarkably thick glandular walls. It should probably be regarded as the uterus passing through the mucus gland. It is one of the largest and most conspicuous organs in the animal, and when sections are cut it generally expands and overlaps the heart and kidney.\* This, however, appears to be the result of the disturbance caused by the cut, and not a natural arrangement. It is noticeable that near the bifurcation of the male and female branches there arises a cœcum which extends anteriorly and reaches the integument, but without forming any orifice. Pelseener states (*Recherches sur divers Opisthobranches*, p. 62) that in *Elysia* the second female orifice is developed later than the others and is not found in young individuals. It is conceivable that this cœcum in *Alderia* may ultimately open externally.

The pericardium appears to be as usual and is medio-dorsal. The renal organ (Fig. 28. k.) lies below it and is entire in the front, but the posterior portion gives off ramifying tubes, some of which extend into the cerata.

Blood lacunæ are distributed throughout the body, including the foot. The largest lie one on either side of the renal organ below the cerata, into which they send up long diverticula; the main portion of these diverticula lies on the posterior side of the cerata, which no doubt accounts for the peculiar pulsation and contraction noticed by Alder and Hancock in this part.

#### STILIGER BELLULUS (D'ORBIGNY).

) = *Calliopœa bellula*, D'ORBIGNY. *Mag. de Zool.*, 1837, pp. 12 to 14.

*Stiliger mariae*, BERGH. *Mal. Unt. in Semper's Reisen*, Heft iii, 1872, pp. 137, 144; *Id. Beit. zur Kennt. der Æolid.*, v. pp. 12 to 17.)

Bergh has published two detailed description of this species, which I notice here merely to mention that it apparently ought to be called *St. bellulus* and not *St. mariae*.

\* This dislocation seems due to the elasticity and expansive power of the tissues which form the walls of the uterus.

The genus was created by Ehrenberg (1831) for an animal found in the Red Sea and having the same external characters as this species, though the radula is unknown. Until the original *Stiliger ornatus* (not *modestus*, as it is sometimes quoted) is re-examined, some doubt must exist as to the identity of *Calliopæa* and *Stiliger*, though that identity is highly probable.

In 1837 d'Orbigny gave the name of *Calliopæa bellula* to a mollusc whose external characters are quite recognizable from his description. In 1865 Meyer and Möbius (*Fauna der Kieler Bucht*) described an apparently identical animal as *Embletonia marie*, wrongly regarding it as an *Æolid*. Bergh refers both forms to *Stiliger* and brackets them together, but gives the preference to Meyer and Möbius's name, although d'Orbigny's name has undoubted priority if his species is admitted to be a *Stiliger*.

Through the kindness of Mr. Farran I have received three specimens from Ballynakil, Co. Galway. They are indifferently preserved, and have lost some or all of the cerata. The best specimen is 7 mm. long and has thirteen cerata remaining. They were apparently set in two rows, and are of an ovoid shape. The posterior cerata of the inner row are relatively very large (2 mm. high). The rhinophores are distinct and white.

The ground colour is greyish white, with brownish or olive markings on the cerata and body. The foot is greyish white without markings. The opaque white internal organs, especially the hermaphrodite gland, can be seen through the integuments.

The radula contains five teeth in the ascending and twelve in the descending slightly spiral portion. They are as represented by Bergh, but so transparent that they are seen only with difficulty.

The species is recorded from Kiel, West Ireland, the Atlantic coast of France, and Trieste.

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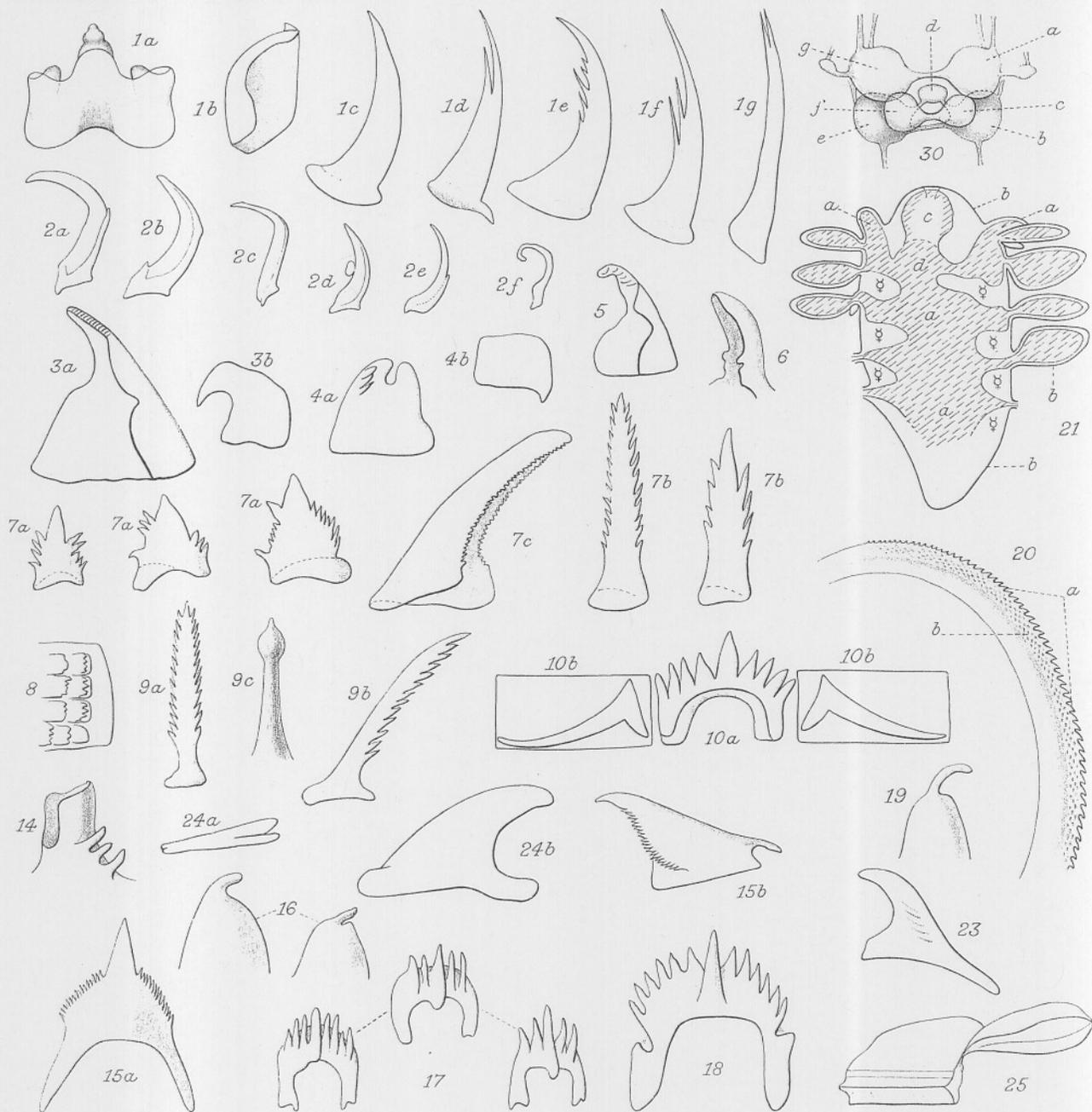
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3. *Lamellidoris oblonga*. a. inner tooth; b. outer ditto.
4. *Lamellidoris depressa*. a. inner tooth; b. outer ditto.

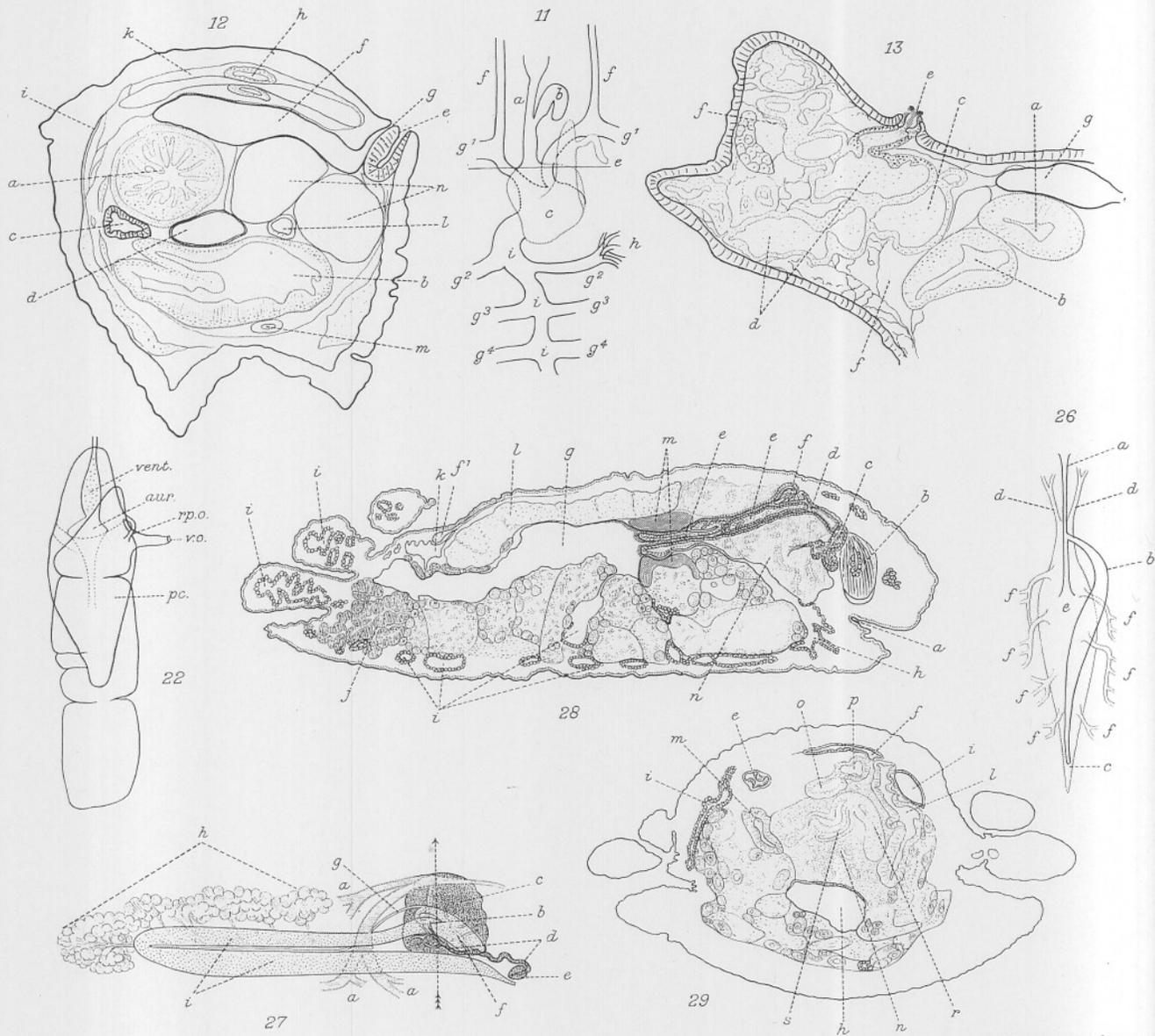
5. *Lamellidoris pusilla*. Inner tooth.
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7. *Lomanotus genei*. Teeth. *a. a. a.* from the middle of the radula; *b. b.* further from the middle; *c.* still further from the middle.
8. *Lomanotus genei*. Edge of jaw with denticulate scales.
9. *Lomanotus marmoratus*. *a. b.* teeth; *c.* a large papilla.
10. *Hancockia dactylota*. A row from the radula. *a.* median tooth; *b. b.* laterals.
11. (Plate XII.) *Hancockia dactylota*. Diagram of the digestive system. The intestine and upper part of the stomach are drawn in yellow, the rest of the digestive system in black. *a.* œsophagus; *b. b.* diverticulum on œsophagus; *c.* stomach; *d.* intestine; *e.* anus; *f. f.* anterior diverticula; *g.<sup>1</sup>-g.<sup>4</sup>* branches supplying the cerata; *h.* secondary ramifications in the cerata existing on all the main branches, but only drawn here; *i.* posterior prolongation of the stomach.
12. (Plate XII.) *Hancockia dactylota*. Transverse section through the anal papilla and renal opening. *a.* intestine; *b.* stomach; *c. d.* anterior diverticula; *e.* anal papilla; *f.* kidney; *g.* renal orifice; *h.* heart; *i.* blood lacunæ; *k.* pericardium; *l.* hermaphrodite gland; *m.* duct of albumen gland; *n.* two lobes of hermaphrodite gland.
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16. *Coryphella beaumonti*. Cones from the penis.
17. *Amphorina aurantiaca*. Teeth.
18. *Amphorina olivacea*. *a.* a tooth.
19. *Amphorina olivacea*. End of penis with stylet.
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21. *Calma glaucoides*. Diagram of digestive system. *a. a. a.* the gut and its prolongations into the cerata; *b.* integuments of body and cerata; *c.* buccal mass, ♂ hermaphrodite gland; *d.* stomachic dilatation.
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23. *Janolus hyalinus*. A tooth.
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27. *Alderia modesta*. Diagram of reproductive system. *a.* ducts of hermaphrodite gland; *b.* bifurcation of the male and female branches; *c.* prostate; *d.* vas deferens; *e.* penis; *f.* a pouch which is probably the spermatheca; *g.* the duct of the albumen gland; *h.* the albumen gland; *i.* main channel of the female organs, which should probably be regarded as the uterus passing through a mucus gland. The hermaphrodite portion of the organs is coloured orange, the male portion black, and the female red. The arrow indicates the point at which the section represented in Fig. 29 is cut.

28. *Alderia modesta*. A longitudinal section cut slightly to the left of the median line and not quite sagittal. It does not show the mouth and buccal mass very distinctly, but gives a better view of the rest of the digestive tract than is obtained by a median section. *a*. left side of mouth; *b*. left side of buccal mass; *c*. left side of central nervous system; *d*. oesophagus; *e*. tube with laminated walls running into the stomachic pouch; *f*. point where the intestine commences, the intestine runs somewhat to the right but reappears for a moment at *f*<sup>1</sup>; *g*. stomachic pouch; *h*. anterior diverticulum of the pouch; *i. i. i.* lateral diverticula in the foot and cerata; *j*. albumen gland; *k*. renal organ; *l*. uterus (the organ marked *i*. in Fig. 27), which on being cut has expanded and spread dorsally at the expense of the renal organ and pericardium; *m*. portions of the hermaphrodite duct containing masses of spermatozoa; *n*. prostate. The remaining parts of the drawing are mostly lobes of the hermaphrodite gland.
29. *Alderia modesta*. Transverse section cut at the point marked by an arrow in Fig. 27. *e. h. l. n.* as in the longitudinal section (Fig. 28); *f*. the intestine passing over to the right side; *i. i.* latero-dorsal diverticula of *h*; *m*. a prolongation of the hermaphrodite duct; *o*. the female branch running forward into a pouch (? spermatheca); *p*. ditto running backwards from the pouch; *v*. vas deferens; *s*. one of the prostatic tubules entering into the vas deferens.
30. *Alderia modesta*. Central nervous system. *a*. right cerebro-pleural ganglion; *b*. right pedal ganglion; *c*. right visceral ganglion; *d*. median visceral ganglion; *e*. left pedal ganglion; *f*. left visceral ganglion; *g*. left cerebro-pleural ganglion.



West, Newman lith.

Fig<sup>s</sup> 1-10, 14-21, 23-25, 30.



West, Newman chromo.

Figs 11-13, 22, 26-29.

T. J. E. del.

**First Report of the Council of the Marine Biological Association of the United Kingdom on work carried out in connection with the International Fishery Investigations.\***

TO SIR EDWARD W. HAMILTON, K.C.B., K.C.V.O.

*Chairman of the North Sea Fisheries Investigation Committee.*

SIR,

I am instructed by the Council of the Marine Biological Association to submit for the information of the North Sea Fisheries Investigation Committee the first Report on work done in connection with the International Investigation of North Sea Fisheries, dealing chiefly with researches carried out during the years 1902 and 1903, together with the detailed reports upon that work which have been drawn up under the Council's direction by those members of the scientific staff to whom the different sections of the investigations have been entrusted.

The Council desire to report as follows :—

**I.—General.**

At the request of His Majesty's Government, the Council of the Marine Biological Association undertook to conduct the scientific part of the scheme of fishery investigation adopted by the International Conference held at Christiania in 1901 in the southern portion of the area assigned to Great Britain, subject to such modifications as might be introduced by the International Council subsequently established, and in accordance with the general regulations of that Council.

The following is a list of members who have served on the Council since the commencement of the investigations in 1902 :—

*President*—Professor E. Ray Lankester, LL.D., F.R.S.

\* Reprinted from *International Fishery Investigations. First Report on Fishery and Hydrographical Investigations in the North Sea and Adjacent Waters (Southern Area). Conducted for His Majesty's Government by the Marine Biological Association of the United Kingdom, 1902-1903.* Presented to both Houses of Parliament by Command of His Majesty. London : Printed for His Majesty's Stationery Office, 1905. *Blue Book* Cd. 2670. Price 8s. 9d.

*Members of Council*—Messrs. G. L. Alward, G. P. Bidder, G. C. Bourne, Prof. T. W. Bridge, F.R.S. (joined 1904), Francis Darwin, F.R.S., Prof. J. B. Farmer, F.R.S. (retired 1903), G. Herbert Fowler, S. F. Harmer, F.R.S., Prof. W. A. Herdman, F.R.S., E. W. L. Holt (joined 1905), the late Prof. G. B. Howes, F.R.S., J. J. Lister, F.R.S., Hugh Robert Mill, Prof. E. A. Minchin, Prof. Charles Stewart, F.R.S. (retired 1904), Prof. D'Arcy W. Thompson, C.B., R. N. Wolfenden, M.D.

*Governors*—Messrs. the late J. P. Thomasson, The Prime Warden of the Worshipful Company of Fishmongers and E. L. Beckwith (representing the Fishmongers' Company), Prof. Sir J. Burdon Sanderson, Bart., F.R.S. (representing the University of Oxford), A. E. Shipley, F.R.S. (representing the University of Cambridge), Professor W. F. R. Weldon, F.R.S. (representing the British Association for the Advancement of Science).

*Hon. Treasurer*—Mr. J. A. Travers (late Prime Warden of the Worshipful Company of Fishmongers).

*Secretary*—Mr. E. J. Allen.

The section of the international work which was undertaken by the Marine Biological Association fell into two main divisions, (1) a survey of the fishing grounds in the southern part of the North Sea, together with an investigation of the life-histories of the principal food fishes found upon them, and (2) an investigation of the physical conditions and of the plankton or minute floating organisms of the waters of the English Channel.

The following is a list of the scientific staff employed by the Council to carry out these investigations:—

*Director and Secretary to the Council*.—E. J. Allen, D.Sc.

*Naturalist in charge of Fishery Investigations* (who is also in charge of North Sea Survey)—W. Garstang, M.A.

*Assistant Naturalists for Fishes*—H. M. Kyle, M.A., D.Sc. (until April, 1903), F. Balfour Browne, B.A. (until January, 1903), W. Wallace, D.Sc.

*Assistant Naturalists for Invertebrates*—C. Forster-Cooper, B.A. (until August, 1903), R. A. Todd, B.Sc., J. O. Borley, M.A.

*Assistant Naturalist for Plankton*—L. H. Gough, Ph.D.

*Hydrographer*—D. J. Matthews.

*Assistants*—J. Potter, A. L. Ansell, G. T. Atkinson.

The Council desire to report that in their opinion the naturalists entrusted with the different branches of the investigations have carried out their duties with efficiency and success.

In order to undertake the necessary experimental work at sea, the Council hired the steam trawler "Huxley," a vessel 115 feet long and of

191 tons gross, for a period of three years from August 21st, 1902. Some difficulty was experienced in obtaining a vessel suitable for the work with the funds available, but the Council had the good fortune to be assisted in the matter by one of its members, Mr. G. P. Bidder, who purchased the "Huxley" from her former owners and let her to the Association upon very favourable terms. The alterations required to fit her for the work of scientific exploration were made to the vessel, suitable cabins for the use of the naturalists were built in the fish hold, and a small laboratory was provided on deck. The "Huxley" made her first voyage to the fishing grounds on November 1st, 1902. Since that time she has been constantly employed in the North Sea and English Channel, and has proved suitable and efficient for the work required of her.

To carry out the North Sea work adequately, the Council found it necessary to establish a laboratory on the east coast of England. After careful consideration, and in view of the area in which the investigations were for the most part to be conducted, the port of Lowestoft was selected as the one offering the best facilities. Premises were hired near the trawl-market and fitted out temporarily to suit the requirements of the work. The laboratory work connected with the investigations in the English Channel has been done in the Association's laboratory at Plymouth, their steamer "Oithona" being used to make the observations at sea during the summer months, whilst for the winter observations the "Huxley" has come round from the North Sea.

The detailed memoirs prepared by the naturalists to whom the carrying out of the different portions of the investigations has been assigned are printed in the present volume. These memoirs deal chiefly with the work done during the first year of the commission of the Association (1903), though certain special experiments carried out in the second year (1904) also receive attention.

In considering the record of results contained in these memoirs, it is first of all essential to remember that they deal with operations undertaken in connection with one portion only of an extensive scheme of co-operative work. They must therefore be looked upon primarily as a statement of observed facts, contributed to the common stock of information which is being gradually brought together. For this reason it has been necessary to print the records of observations in considerable detail and in a form which shall be as convenient as possible for the use of other workers, but until the work done in other countries has been published in a similar way and the whole of the observations have been duly co-ordinated and considered, it will not be possible to estimate the results derived from the international undertaking.

At the same time, considering the English work alone, as it is set forth in the series of special reports by the naturalists, the Council of

the Association feel confident that our knowledge of a number of the most essential matters, upon a proper understanding of which any attempts to improve the yield of the deep sea fisheries must in future be based, has already been considerably extended, and they are not without hope that at no distant date practical measures founded on a rational appreciation of the problems involved may be undertaken with certain profit to the fishing industry. Meanwhile the Council draw attention to the following points raised in the special memoirs, which in their opinion seem worthy of particular consideration.

## II.—Fishery Investigations in the North Sea.

Experiments made by marking fishes, more especially Plaice, with numbered labels and returning them to the sea, where they have subsequently been recaptured by fishermen, have furnished much information on three important subjects—the migrations of the fishes, the growth of the fishes, and the intensity of the commercial fishing in the North Sea. The experiments have shown that the larger Plaice are capable of very extensive migrations in a comparatively short time. The extent and variety of the possible journeys may be illustrated by two instances. A Plaice, 33 centimetres (13 inches) long, liberated on December 12th, 1903, on the Leman Ground, in the latitude of Lincolnshire, was recovered by a Hastings trawler off Winchilsea, in the English Channel, on March 23rd, 1904, having travelled a minimum distance of 175 miles in a little over three months, whilst another fish, marked and liberated on August 12th, 1903, off the Lincolnshire coast, near Mablethorpe, was recaptured in April, 1904, eight months afterwards, in St. Andrew's Bay, having travelled 210 sea miles from the point of liberation. Such extensive migrations, however, appear to be confined chiefly to Plaice of larger size, the smaller fishes (below 8 inches) being seldom found to travel long distances at a rapid rate. During the summer months there seemed to be a general tendency for the Plaice on the shallow-water "nurseries" off the coast of Holland to move into deeper waters towards the north and west, whilst the fish marked in the southern bight of the North Sea showed a disposition to move in a northerly direction. In the winter (1902-3 and 1903-4), on the other hand, many of the larger fish (above 9 inches) moved southwards from the Leman Ground and the north-west coast of Holland towards the southern bight of the North Sea.

The intensity of commercial trawling in the North Sea is indicated by the fact that out of 855 marked Plaice above 20 centimetres (8 inches) in length liberated outside territorial limits the number recaptured within twelve months yields a total of 21 per cent, whilst

experiments on the Dogger Bank in the spring of 1904 resulted in the recapture of more than 40 per cent of the Plaice exceeding 25 centimetres (10 inches) in less than twelve months. From this result it seems clear that the total annual catch of the fishermen no longer forms an insignificant proportion of the total stock of Plaice.

Trawling experiments in the area under investigation with an otter- and a beam-trawl of the ordinary commercial patterns have given extensive information as to the distribution of fishes of different sizes, and the results obtained, when combined with those of the marking experiments, have done much towards furnishing a preliminary view of the natural history of the fishes in the southern half of the North Sea, and of the Plaice in particular, its distribution at different sizes, and the seasonal movements which it undertakes.

A series of experiments on the transplantation of small Plaice from the inshore nurseries to the open waters of the Dogger Bank in the middle of the North Sea, carried out in 1904, has thrown much new light upon the condition of the fishing grounds. The increase of weight of small plaice marked and transplanted in early spring from the crowded inshore grounds to the Dogger Bank was found in the following winter to be six times the normal increase of marked fishes of the same size left on the inshore grounds. Such a result suggests that the central grounds of the North Sea possess a larger food supply suitable for the nourishment of the Plaice than is at present made use of, and that they may therefore be capable of maintaining a much larger population of Plaice than now exists upon them, whilst on the nursery grounds owing to undue competition for the food available the Plaice are unable to attain their maximum rate of growth. Whether transplantation on a commercial scale from the small-fish grounds to the Dogger Bank or other suitable localities would be a practical method of increasing the total weight of Plaice available for capture in the North Sea is a problem concerning which further information and experiment will be required. Quite apart from this question, such a result as that already indicated is of the greatest significance for the proper understanding of the condition of the Plaice fishery and of the methods proposed for improving it by the prevention of the capture of immature fish.

Particular attention has been paid to the study of the age of fishes of particular sizes and to their rate of growth. It has now been shown that by an examination of the otoliths or ear-stones a precise estimate of the age of individual fishes can be arrived at, the otoliths showing alternate white and dark rings, the white rings formed in spring and early summer, the dark in late summer and autumn. This method has been applied in detail to a considerable number of Plaice from fishing

grounds in the North Sea and English Channel, and by its means it has been possible to form an estimate of the average rate of growth in different localities, a result which has direct bearings on many practical problems.

A large quantity of information has also been collected as to the food of fishes of different species and at different stages of their growth upon the various fishing grounds of the North Sea, the information being derived in part from the examination of the food-contents of many of the fishes captured in the trawl, and in part by an investigation of the fishing grounds with special apparatus.

### III.—Hydrographical and Plankton Investigations in the English Channel.

Before the commencement of the International Investigations it had been shown that the character of the water filling the North Sea varied greatly from season to season and from place to place. A knowledge of such changes was obviously of the first importance in seeking to understand the migrations of the fishes and the fluctuations of the fisheries. The international programme therefore provided for a co-operative study of these phenomena over the whole area under investigation. To the English investigators was assigned the study of the waters of the English Channel, which were important not only in connection with the fisheries in the Channel itself, but also as constituting one of the sources of origin of the waters of the North Sea.

It was arranged that simultaneous periodic cruises should be undertaken by the different co-operating countries, during which observations should be made at fixed stations scattered over the whole area, and that these observations should be as far as possible supplemented by others taken between the stations and in the intervals between the cruises. There are three chief kinds of evidence which, when known over an extended area, are capable of giving an indication of the course of the prevailing currents, and the probable origin of the water at any particular place. These are (1) the salinity of the water, (2) its temperature, and (3) the character of the plankton or minute floating organisms which it contains. At each of the stations visited on the periodic cruises, therefore, samples of the sea-water were collected at different depths and brought to the laboratory, where their salinity was determined; the temperature of the water at different depths was observed, and samples of the plankton were collected for subsequent examination. Intermediate samples were taken between the fixed stations, and frequent meteorological observations were also made.

Four quarterly cruises, as arranged in the international programme, were carried out in the English Channel in February, May, August, and

November, 1903, simultaneously with similar cruises undertaken elsewhere by other countries. Samples of the surface water were obtained from time to time in the periods between the quarterly cruises, chiefly through the co-operation of officers of the mercantile marine.

Complete records of the observations made on the periodic cruises have been sent to the Bureau of the International Council, and have been published in the quarterly bulletins issued by that authority.\*

The hydrographical observations during 1903 appear to show that the direction of the flow of the waters of the English Channel was from west to east, and that they were derived from a northerly current of about 35.6 per thousand salinity from the Bay of Biscay and from a southerly current of about 35.2 per thousand salinity or less from the Irish Sea and Bristol Channel. The meeting place of these waters may be roughly fixed as south of the Scilly Islands in mid-channel, and it was generally found that the salinity of the water increased as this point was passed from west to east.

Owing to the varying salinity and temperature of these two currents, it has been found that at the entrance to the Channel the water is often divided into distinct layers, whilst the changes of their relative velocity, combined with the general drift up Channel, give rise to alternate areas of high and low salinity which follow one another eastward. On the line between the Isle of Wight and Cape Barfleur the salinity has been low on all four cruises, a state of things due, in all probability, to the amount of fresh water discharged from the Hampshire basin and the Seine. The presence of denser water south of Beachy Head, however, points to the occasional passage of a high salinity current across this line.

It would appear that during the summer and early autumn of 1903 the Channel waters were derived largely from the Irish Sea, while during the rest of the year the high-salinity water of the Bay of Biscay preponderated.

The plankton observations show that a large proportion of the more oceanic organisms found off the mouth of the Channel do not penetrate for any considerable distance up Channel, even along a central axis, the percentage of oceanic species having on each cruise fallen below 40 at the stations on the line from the Isle of Wight to Cape Barfleur. When compared with those taken by other countries in the southern part of the North Sea, the observations indicate that conditions very similar to those found in the southern part of the North Sea, between a line from the Wash to Heligoland and the Straits of Dover exist in the eastern

\* *Bulletin des Résultats acquis pendant les Courses Périodiques, Conseil Permanent International pour l'Exploration de la Mer.* Année 1902-1903, Nos. 3 et 4. Année 1903-1904, Nos. 1 et 2.

end of the English Channel (from the Isle of Wight to the Straits of Dover).

The results both of the hydrographical and of the plankton work suggest that during the period under investigation there was on the whole a constant passage of water from the Channel into the southern part of the North Sea, but the rate at which this passage took place must have been very slow.

In conclusion, the Council of the Marine Biological Association would take this opportunity of expressing their indebtedness to all who have assisted them during the course of these investigations, to those who have acted as their agents for the receipt of marked fish returned by the fishermen at the different ports, and more especially to the fishermen themselves, as well as to those officers of the mercantile marine who have supplied samples of sea water and taken observations of its temperature in different localities.

I am, Sir,

Your obedient Servant,

MARINE BIOLOGICAL LABORATORY,

PLYMOUTH,

2 August, 1905.

E. J. ALLEN,

*Director and Secretary to the Council.*

### List of Memoirs which accompany the above Report.

- General Report on the Fishery Investigations.* By WALTER GARSTANG, M.A. pp. 1-12.
- Report on Experiments with Marked Fish during 1902-3.* By WALTER GARSTANG. With 31 Detailed Tables, 2 Appendices, and 6 Charts. pp. 13-44.
- Experiments in the Transplantation of Small Plaice to the Dogger Bank.* By WALTER GARSTANG. With 1 Chart, 2 Illustrations in Text, and 3 Detailed Tables. pp. 45-66.
- Report on the Trawling Investigations, 1902-3, with especial reference to the distribution of the Plaice.* By WALTER GARSTANG. With 6 Figures in the Text, 2 Appendices, 4 Detailed Tables, and 2 Charts. pp. 67-198.
- Preliminary Investigations on the Age and Growth-Rate of Plaice.* By WILLIAM WALLACE, D.Sc. With Diagrams (Figs. 1-4) in Text, Tables A and B and I.-VII. in Text, and Plate I. pp. 199-226.
- Report on the Food of Fishes collected during 1903.* By R. A. TODD, B.Sc. pp. 227-288.
- Report on the Physical Conditions in the English Channel, 1903.* By DONALD J. MATTHEWS. With 6 Plates. pp. 289-324.
- Report on the Plankton of the English Channel, 1903.* By LEWIS H. GOUGH, Ph.D. With 16 Charts and 7 Figures in the Text. pp. 325-377.

# Marine Biological Association of the United Kingdom.

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## Report of the Council, 1904-5.

### The Council and Officers.

Four ordinary meetings of the Council have been held during the year, at which the average attendance has been ten. Committees of the Council have visited the Laboratories at Plymouth and Lowestoft and carried out a detailed examination of the work which is being done. The thanks of the Council are again due to the Royal Society, in whose rooms their meetings have been held.

The Council record with regret the death of the Right Hon. the Earl of Morley, a Vice-President of the Association, as well as that of Professor G. B. Howes, F.R.S., a member of Council.

Professor T. W. Bridge, F.R.S., was elected a member of Council to fill a vacancy caused by the resignation of Professor Charles Stewart, F.R.S.

### The Laboratories.

No alterations of importance have been made to the buildings or fittings at the Plymouth Laboratory, which continues to be maintained in an efficient state. Particular attention has been paid to the rearing of marine organisms under laboratory conditions, and a considerable measure of success has been attained.

The building rented at Lowestoft is now becoming somewhat congested, and if the amount of work to be done continues to grow, additional accommodation will be necessary.

### The Boats.

The *Oithona* has this year undergone an extensive refit, a new boiler and new decks having been put in, in addition to general repairs. She is now in first-class condition, and has been used extensively in the English Channel and along the East Coast of England. She has on two occasions made the voyage from Plymouth to Ushant and Parson's Bank.

The collecting at Plymouth during the winter was done with the sailing boat *Anton Dohrn*.

The work in the North Sea in connection with the International Investigations has been again carried out by the *Huxley*.

### The Staff.

Mr. S. Pace, who for the last three years has efficiently occupied the post of Assistant Naturalist for Invertebrates at Plymouth, was recently appointed Director of the Marine Biological Laboratory at Millport on the Clyde, and is consequently leaving the service of the Association. There have been no other changes in the staff.

### Occupation of Tables.

The following Naturalists have occupied tables at the Laboratory during the year:—

- G. P. BIDDER, M.A., Cambridge (Experiments for determining bottom currents).
- E. T. BROWNE, M.A., London (Medusae).
- A. D. COTTON, Kew (Algae).
- Sir CHARLES ELIOT, K.C.M.G. (Nudibranchiata).
- G. H. GROSVENOR, M.A., Oxford (Nudibranchiata).
- T. V. HODGSON, Plymouth (Pycnogonida).
- J. J. LISTER, F.R.S., Cambridge (Foraminifera).
- Prof. E. W. MACBRIDE, F.R.S., Montreal (Echinoderma).
- Mrs. S. PACE, Plymouth (Polyzoa).
- J. LLOYD WILLIAMS, Bangor (Algae).

Six students attended a course of study in Marine Biology conducted at the Laboratory during the Easter vacation by Mr. G. H. Grosvenor.

### The Library.

The thanks of the Association are due for the following books and current numbers of periodicals presented to the Library during the past year:—

- Académie Imp. des Sciences de St. Pétersbourg. Bulletin.
- Allgemeine Fischerei-Zeitung.
- American Microscopical Society. Transactions.
- American Museum of Natural History. Bulletin.
- Memoirs.
- American Philosophical Society. Proceedings.
- Annaes de Sciencias Naturaes.
- Australian Museum. Records.
- Bergens Museum. Aarboeg.
- Hydrographical and Biological Investigations in Norwegian Fiords.
- An Account of the Crustacea of Norway, etc.; by G. O. Sars.
- Bernice Pauahi Bishop Museum, Honolulu. Occasional Papers.

- Board of Agriculture and Fisheries. Annual Report of Proceedings under the Salmon and Freshwater Fisheries Acts.
- Annual Report of Proceedings under Acts relating to Sea Fisheries.
- Report of Meeting of Fisheries Representatives.
- Boston Society of Natural History. Proceedings.
- Brighton Public Library, Museum and Art Galleries. Annual Report.
- Bristol Naturalists Society. Proceedings.
- British Association for the Advancement of Science. Report.
- Brooklyn Institute of Arts and Sciences. Cold Spring Harbor Monographs.
- Memoirs of Natural Sciences.
- Science Bulletin.
- Bryn Mawr College. Monographs, Reprint Series.
- Bulletin Scientifique de la France et de la Belgique.
- The Carnegie Institution. The Coral *Siderastrea radians* and its Postlarval Development; by J. E. Duerden.
- The Waterlilies. A Monograph of the Genus *Nymphaea*; by H. S. Conard.
- La Cellule.
- College of Science, Tokyo. Journal.
- Colombo Museum. *Spolia Zeylanica*.
- Comité für Unterstützung der Küsten-Bevölkerung des Russischen Nordens. Zoologische Studien im Barents-Meere . . . Vorläufige Bericht.
- The Commissioners of Fisheries, N. S. Wales. Report.
- Conchological Society of Great Britain and Ireland. Journal of Conchology.
- Conseil perm. internat. pour l'Exploration de la Mer. Bulletin des Résultats acquis pendant les Courses Périodiques.
- Publications de Circonstance.
- Rapports et Procès-Verbaux des Réunions.
- Cuerpo de Ingenieros de Minas del Peru. Boletín.
- Kgl. Danske Videnskabernes Selskab. Oversigt.
- Skrifter.
- Dept. of Agriculture, etc., Ireland. Reports.
- Dept. of Marine and Fisheries, Canada. Annual Report.
- Deutsche Zoologische Gesellschaft. Verhandlungen.
- Deutscher Fischerei Verein. Zeitschrift für Fischerei.
- Deutscher Seefischerei Verein. Mitteilungen.
- La Feuille des Jeunes Naturalistes.
- Field Columbian Museum. Publications.
- Imp. Fisheries Bureau, Tokyo. Journal.
- Fisheries Society of Japan. Journal.
- The Fisherman's Nautical Almanack; by O. T. Olsen.
- Fishery Board for Scotland. Annual Report.
- The Fishing Gazette.
- The Foreign Office. Report on the Fishing Trade of the Weser Seaports.
- The Government Biologist, Cape of Good Hope. Marine Investigations in South Africa.
- Report.
- Government Museum, Madras. Report.
- International Catalogue of Scientific Literature. Report.
- R. Irish Academy. Proceedings.
- Transactions.
- Isle of Man Fish Hatchery. Third Annual Report.
- Kommission zur wissenschaftlichen Untersuchung der Deutschen Meere, etc. Wissenschaftliche Meeresuntersuchungen.

- Kommissionen for Havundersøgelser, Copenhagen. Meddelelser, series Fiskeri, Hydrografi, Plankton.  
 — Skrifter.
- Laboratoire Biologique de St. Petersbourg. Bulletin.
- Lancashire Sea Fisheries Laboratory. Report.
- Lancashire and Western Sea Fisheries. Superintendent's Report.
- Leland Stanford Jr. University. Contributions to Biology from the Hopkins Seaside Laboratory.
- Liverpool Biological Society. Proceedings and Transactions.
- Liverpool Marine Biology Committee. Annual Report.
- Manchester Microscopical Society. Annual Report and Transactions.
- Marine Biological Association of the West of Scotland. Annual Report.
- Marine Biological Laboratory, Woods Holl. Biological Bulletin.  
 — Research Seminar.
- Mededeelingen over Visscherij.
- R. Microscopical Society. Journal.
- Ministry of Marine, France. Bulletin de la Marine Marchande.
- Le Mois Scientifique.
- Musée du Congo. Annales.
- Musée d'Histoire Naturelle, Paris. Bulletin.
- Musée Oceanographique de Monaco. Bulletin.
- Museo Nacional, Buenos Aires. Anales.
- Museo Nacional de Montevideo. Anales.
- Museo Zoologico della R. Università di Napoli. Annuario.
- Museum of Comparative Zoology, Harvard College. Bulletin.  
 — Memoirs.  
 — Report.
- The Museums Journal.
- Natural History Association of Miramichi. Proceedings.
- Naturforschende Gesellschaft in Basel. Verhandlungen.
- Naturhistorischen Museum, Hamburg. Mitteilungen.
- Nederlandsche Dierkundige Vereeniging. Tijdschrift.
- New York Academy of Sciences. Annals.
- New York Zoological Society. Bulletin.  
 — Report.
- New Zealand Institute. Transactions.
- Norges Fiskeristyreelse. Aarsberetning vedkommende Norges Fiskerier.
- Northumberland Sea Fisheries Committee. Report on the Scientific Investigations.
- La Nuova Notarisia.
- Oberlin College. The Wilson Bulletin.
- Physiographiske Forening Christiania. Nyt Magazin for Naturvidenskaberne.
- Plymouth Institution. Annual Report and Transactions.
- Plymouth Museum and Art Gallery. Annual Report.
- Quarterly Journal of Microscopical Science. (Presented by Prof. E. Ray Lankester, F.R.S.)
- Le Réveil Salicole Ostréicole et des Pêches Maritimes, etc.
- Rijksinstituut voor het Onderzoek der Zee. Jaarboek.  
 — Uitkomsten van Meteorologische Waarnemingen.
- Rousdon Observatory. Meteorological Observations.
- Royal Society of London. Philosophical Transactions.  
 — Proceedings.  
 — Reports of the Evolution Committee.  
 — Reports of the Malaria Committee.

- Royal Society of London. Report of the Sleeping Sickness Committee.  
 — Report to the Government of Ceylon on the Pearl Oyster Fisheries of the Gulf of Manaar.  
 — Year-Book.
- Royal Society of Victoria. Proceedings.  
 Scottish Microscopical Society. Proceedings.  
 Selskabet for de Norske Fiskeriers Fremme. Norsk Fiskeritidende.  
 Smithsonian Institution. Annual Report.  
 — Special Bulletin.  
 — Bulletin of the United States National Museum.  
 — Proceedings of the United States Museum.  
 Sociedad Geográfica de Lima. Boletín.  
 Società di Naturalisti in Napoli. Bollettino.  
 Societas pro Fauna et Flora Fennica. Acta.  
 — Meddelanden.  
 Société Belge de Géologie, etc. Bulletin.  
 Société Centrale d'Aquiculture et de Pêche. Bulletin.  
 — Liste des Membres.  
 Société d'Océanographie du Golfe de Gascogne. Rapports présentés à l'Assemblée générale de Janvier 1904, et Compte Rendu du Punch Annuel.  
 Société Imp. Russe de Pisciculture et de Pêche. Messenger de l'Industrie de la Pêche.  
 — Revue Internationale de Pêche et de Pisciculture  
 — Věstník Rířibopom'shlennosti.  
 Société Zoologique de France. Bulletin.  
 — Mémoires.
- South African Museum. Annals.  
 Station de Pisciculture, etc., Toulouse. Bulletin.  
 Station de Recherches Maritimes, Ostend. Jets over Zeevaart.  
 — Travaux de la Station de Recherches relative à la Pêche Maritime à Ostende.
- Kgl. Svenska Vetenskaps-Akademien.  
 — Arkiv för Botanik.  
 — Arkiv för Zoologie.
- Tokyo Imp. Museum. Proceedings of the Dept. of Natural History.  
 Tokyo Imp. University. Calendar.  
 A Treatise of Zoology; edited by E. R. Lankester.  
 Tuft's College. Studies.  
 United States Commission of Fish and Fisheries. Bulletin.  
 — Report of the Commissioner.  
 Universidad de La Plata. Publicaciones.  
 University of California. Publications.  
 University of Iowa. Bulletin from the Laboratories of Natural History.  
 University of Pennsylvania. Bulletin.  
 — Catalogue.  
 — Provost's Report.  
 — Contributions from the Botanical Laboratory.  
 — Contributions from the Zoological Laboratory.
- University of Toronto. Studies.  
 Kgl. Vetenskaps Societeten, Upsala. Nova Acta.  
 Zoological Society of Japan. Annotationes Zoologicae Japonensis.  
 Zoological Society of London. List of the Fellows.  
 — Proceedings.  
 — Transactions.

- Zoological Society of London. Zoological Record.  
 Zoologische Museum, Berlin. Mitteilungen.  
 Zoologiske Museum, Copenhagen. The Danish Ingolf Expedition.
- Dr. E. J. Allen. Beiträge zur Kenntnis der Spermatogenese bei den  
 Cölenteraten; by W. M. Aders.  
 — Matériaux relatifs à la faune des Polypes Hydraires des mers arctiques,  
 Part I.; by A. Schydrowsky.  
 — Über die Theilung von Protohydra Leuckarti; by W. M. Aders.  
 The Secretary, Danish Legation. Fiskeri-Beretning for Finansaaret, 1903-1904.  
 The Director, The Royal Gardens, Kew. American Hydroids, Part II. The  
 Sertularidæ; by C. C. Nutting.  
 Dr. S. F. Harmer and Mr. A. E. Shipley. The Cambridge Natural History,  
 Fishes, Ascidians, &c.  
 Mr. R. G. Harrison. Catalogue of the Collection of Human Embryos in the  
 Anatomical Laboratory of the Johns Hopkins University. By F. P. Mall.  
 Honolulu Museum. Fauna Hawaiiensis.  
 The Secretary of State for the Colonies. Report of the Government Biologist,  
 Cape of Good Hope.  
 Owens College. The Alcyonaria of the Cape of Good Hope, Part II.; by  
 S. J. Hickson.  
 — The Alcyonaria of the Maldives, Part III.; by S. J. Hickson.  
 — On the Bearing of Mendelian Principles of Heredity on current theories  
 of the Origin of Species; by A. D. Darbishire.  
 — Report on the Polyclad Turbellaria collected by Professor Herdman at  
 Ceylon in 1902; by F. F. Laidlaw.  
 — The Stylasterina of the Siboga Expedition; by S. J. Hickson and H. M.  
 England.  
 — On the Supposed Antagonism of Mendelian to Biometric Theories of  
 Heredity; by A. D. Darbishire.  
 — Variations; by S. J. Hickson.  
 Société d'Océanographie du Golfe de Gascogne. Les Cartes Litho-Biologiques  
 du Fond de la Mer; by Manley-Bendall and C. Bénard.  
 — Les Courants de l'Atlantique nord et du Golfe de Gascogne; by C. Bénard.  
 — Quelques Essais sur les Liquides Conservateurs des Animaux et des  
 Organismes Marins; by C. Bénard and Manley-Bendall.

To the authors of the Memoirs mentioned below the thanks of the  
 Association are due for separate copies of their works presented to the  
 Library:—

- Ashworth, J. H. and Annandale, N. Observations on some Aged Specimens  
 of Sagartia troglodytes, and on the Duration of Life in Cœlenterates.  
 Baudouin, M. *Le Lernæenicus Spratte*, parasite de la Sardine en Vendée.  
 Browne, E. T. Hydromedusæ [of the Maldives and Laccadives] with a Re-  
 vision of the Williadae and Petasidae.  
 — Scyphomedusæ [of the Maldives and Laccadives].  
 — and Vallentin, R. On the Marine Fauna of the Isles of Scilly.  
 Chadwick, H. C. Report on the Crinoidea collected by Professor Herdman,  
 at Ceylon, in 1902.  
 Darbishire, A. D. On the Bearing of Mendelian Principles of Heredity on  
 current theories of the Origin of Species.  
 — On the Supposed Antagonism of Mendelian to Biometric Theories of  
 Heredity.  
 Duncker, G. Ueber Asymmetrie bei 'Gelasimus pugilator' Latr.  
 — Junge Goldbutt (*Pleuronectes platessa*, L.) in der Neustädter Bucht  
 — Symmetrie und Asymmetrie bei bilateralen Thieren.

- Eigenmann, Carl H. The Eyes of the Blind Vertebrates of North America. V.  
 Eliot, C. On the *Doris planata* of Alder and Hancock.  
 — On some Nudibranchs from East Africa and Zanzibar. Parts III., IV.,  
 and V.  
 Fowler, G. H. Biscayan Plankton Collected during a Cruise of H.M.S.  
 "Research," 1900. Parts I., II., III.  
 — Notes on the Anatomy of *Gazelletta*.  
 — Notes on *Rhabdopleura Normani*, Allman.  
 Gardiner, J. S. Notes and Observations on the Distribution of the Larvæ of  
 Marine Animals.  
 — The Turbinolid Corals of South Africa, with Notes on their Anatomy and  
 Variation.  
 Giard, A. Sur l'éthologie du Hareng des côtes du Boulonnais.  
 — Sur une faunule caractéristique des sables à diatomées d'Ambleteuse.  
 Parts I., II., and III.  
 — Rapport sur la Prétendue Nocivité des Huitres . . .  
 — Sur la parthénogénèse artificielle par dessèchement physique.  
 — Tonogamie; la chose et le mot.  
 — A propos des travaux de Miss Harriet Richardson sur les Bopyriens.  
 Gough, L. H. Plankton, English Channel: November, 1903.  
 — Plankton Animals and Plants.  
 Harrison, R. G. Neue Versuche und Beobachtungen über die Entwicklung der  
 peripheren Nerven der Wirbeltiere.  
 Hartmeyer, R. Ascidien von Mauritius.  
 Hickson, S. J. The Alcyonaria of the Maldives. Part III.  
 Hodgson, T. V. Preliminary Report of the Biological Collections of the "Dis-  
 covery."  
 — On a new Pycnogonid from the South Polar Regions.  
 — Scotia Collections.—On *Decalopoda australis*, Eights—an old Pycnogonid  
 rediscovered.  
 Hoyle, W. E. The Cephalopoda of the Maldives and Laccadive Is.  
 Krogh, A. On the Tension of Carbonic Acid in Natural Waters and especially  
 in the Sea.  
 — The abnormal CO<sub>2</sub> Percentage in the Air in Greenland, and the General  
 Relations between Atmospheric and Oceanic Carbonic Acid.  
 Lee, A. Bolles. La Structure du Spermatozoïde de l'*Helix pomatia*.  
 — L'Évolution du Spermatozoïde de l'*Helix pomatia*.  
 Lister, J. J. *Astrosclera Willeyana*, the Type of a new Family of Sponges.  
 — Contributions to the Life-History of the Foraminifera.  
 — Ditto (abstract).  
 — A possible explanation of the quinqueloculine arrangement of the cham-  
 bers in the young of the microspheric forms of *Triloculina* and *Biloculina*.  
 — Note on a (? Stomatopod) *Metanauplius* Larva.  
 — On the Reproduction of Orbitolites.  
 — A Visit to the Newly Emerged Falcon Island, Tonga Group, South  
 Pacific.  
 — Notes on the Geology of the Tonga Islands.  
 — and Fletcher, J. J. On the Condition of the Median Portion of the  
 Vaginal Apparatus in the *Macropodidæ*.  
 MacFarland. A Preliminary Account of the Dorididæ of Monterey Bay,  
 California.  
 Man, J. G. de. Ein neuer freilebender Rundwurm aus Patagonien. *Plectus*  
 (*Plectoides*) *patagonicus* n. sp.  
 Moore, J. P. and Busch, K. J. Sabellidæ and Serpulidæ from Japan with  
 Descriptions of New Species of Spirorbis.

- Norman, A. M. British Isopoda of the families *Ægida*, *Cirolanidæ*, *Idoteidæ*, and *Arcturidæ*.
- and Brady, G. S. British Land Isopoda. Second Supplement.
- and Scott, T. Crustacea Copepoda new to Science from Devon and Cornwall.
- Osborn, H. F. *Ornitholestes Hermanni*, a New Compsognathoid Dinosaur from the Upper Jurassic.
- Punnett, R. C. Merism and Sex in "*Spinax niger*."
- Shipley, A. E. *Cladorchis Watsoni* (Conyngham), a Human Parasite from Africa.
- Notes on Parasites [from the Maldives and Laccadives].
- and Hornell, J. The Parasites of the Pearl Oyster.
- Smith, J. C. A Preliminary Contribution to the Protozoan Fauna of the Gulf Biologic Station.
- *Synchaeta bicornis*: a new Rotifer from the brackish waters of Lake Pontchartrain, Louisiana.
- Stephens, J. A List of Irish Cœlenterata, including the Ctenophora.
- Storey, T. A. Tonus Rhythmus in Normal Human Muscle and in the Gastrocnemius of the Cat.
- Trybom, F. Åtgärder för Fiskerinäringen i Sverige år 1903.
- Biologiske Undersökningar 1901-1904.
- Walker, A. O. Report on the Amphipoda collected by Professor Herdman, at Ceylon, in 1902.
- Worth, R. H. Hallsands and Start Bay.

### General Work at the Plymouth Laboratory.

A report on the local distribution of the marine invertebrate fauna occurring in the neighbourhood of Plymouth, which has been in preparation for several years, has now been published in the *Journal of the Association*.

In the compilation of this report, the Director of the Laboratory has been ably assisted by Mr. R. A. Todd and by Mr. S. Pace, as well as by a large number of workers who have occupied tables in the Laboratory from time to time. The Council desire to thank those naturalists who have thus voluntarily assisted in this work.

The Director has continued to devote special attention to the Polychætes found at Plymouth, and in addition to the list contained in the report above referred to, has published a paper on the anatomy of *Pœcilochaetus* (*Quart. Journ. Micr. Sci.*, vol. 48, 1904) and a description of a new British Sabellarian, *Pallasia murata*, n. sp.

Mr. Pace has worked chiefly at Echinoderms and Molluscs, and has published a paper on the local Cucumariidae in the *Association's Journal*.

The exhibit which, at the request of the British Royal Commission, was prepared by the Association for the St. Louis Exhibition, proved very successful, and was awarded a Grand Prize, whilst a gold medal was given for publications.

## The International Fisheries Investigations.

### SECTION I.—NORTH SEA WORK.

#### A. WORK OF THE S.S. "HUXLEY."

TRAWLING INVESTIGATIONS.—The survey of the North Sea trawling grounds has been steadily continued during the year. From June 1904 to the end of May 1905 the *Huxley* made 35 voyages, during which 304 hauls of the large commercial trawls (otter and beam) were taken, and the quantities and sizes of the fishes caught systematically recorded.

From the commencement of the investigations 66 voyages have been completed, and the results of 653 hauls with the large trawls analysed and recorded.

The work of the *Huxley* was supplemented during July 1904 by a series of investigations by the s.s. *Oithona* in the shallower waters of Bridlington Bay, the Wash, and the Thames estuary.

FISH MEASURED.—The investigation of the relative numbers of fishes of different sizes on various fishing grounds in the North Sea and of their seasonal distribution has been continued. In this connection during the past year about 100,000 fishes have been measured on the fishing grounds where they were caught, viz. 95,000 caught with the large commercial trawls of the *Huxley*, and nearly 5,000 caught with the smaller trawls of the *Oithona* and *Huxley*.

More than 210,000 fishes have been measured in this way since the commencement of the investigations, as shown in detail in the following table:—

	PLAICE.	HADDOCK.	OTHERS.	TOTALS.
I.—Commercial Trawls.				
Voyages I-XXXI, 1902-4	35,061	8,388	64,165 ...	107,614
„ XXXII-LVI, 1904-5	27,577	7,561	60,141 ...	95,279
TOTALS	62,638	15,949	124,306 ...	202,893
II.—Small Trawls.				
Voyages I-XXXI, 1902-4	1,813	—	764 ...	2,577
„ XXXII-LVI, 1904-5	215	1	1,305 ...	1,521
S.S. <i>Oithona</i> , July 1904	843	—	2,400 ...	3,243
TOTALS	2,871	1	4,469 ...	7,341
III.—GRAND TOTALS . . . . .	65,509	15,950	128,775 ...	210,234

MARKING EXPERIMENTS.—During the year 2,660 marked plaice have been set free in different parts of the North Sea, of which 187 have already been recaptured.

Prior to June 1904, 2,455 marked plaice had been liberated, of which

401 have since been recaptured, making a total of 5,115 liberated and 588 recaptured up to date.

In the great majority of cases the fishermen have been able to give trustworthy particulars concerning the date and locality of recapture, and the fishes themselves have been forwarded to the laboratory at Lowestoft for examination and measurement.

These experiments have been eminently successful in throwing light upon the seasonal migrations of this species, and upon differences in the rate of growth on different fishing grounds.

The experiments in the transplantation of small marked plaice from the inshore grounds to the Dogger Bank, in the spring of 1904, which were briefly referred to in the last annual report, have yielded results of considerable scientific importance, and suggest the possibility of practical applications. The average year's growth of small marked plaice, about 20 cm. (8 ins.) in length, on the coastal grounds of the southern and eastern parts of the North Sea, has been found to be not more than 5 cm. (2 ins.); whereas on the Dogger Bank the average growth of similar fishes has been found to be 15 cm. (6 ins.) in the same time. In other words, small 8-inch plaice, weighing about 3 oz., which after a year's growth on the coastal grounds become 10-inch fish, weighing  $5\frac{1}{4}$  oz., are transformed in the same time into 14-inch fish weighing 1 lb. each, by transplantation to the Dogger Bank.

As small plaice do not naturally occur upon the Bank, the problem is raised whether the yield of plaice from the North Sea could not be materially increased by the annual transplantation of large numbers of such fish on a commercial scale from the coastal grounds to the Dogger Bank.

Experiments in transplantation on a more extensive scale have been carried out during the past few months in various parts of the English area in order to provide additional information bearing upon this subject.

The marking experiments during the past year have also been extended to a considerable number of other species, including Turbot, Brill, Soles, Lemon Soles, Flounders, Dabs, and Cod.

**SPECIAL EXPERIMENTS.**—While the investigations at sea have proceeded, in general, on the same lines as during the previous year, increased attention has been paid to special experiments upon particular problems. Among these may be mentioned:—

- (i) Experiments on the vitality of trawl-caught plaice.

- (ii) Experiments on the proportion of small fishes which escape through the meshes of the commercial trawl.
- (iii) Investigations on the rough grounds unsuitable for commercial trawling.
- (iv) Collection of samples of bottom deposits.
- (v) Experiments on bottom currents by means of Mr. Bidder's drift-bottles.
- (vi) Collection of fish-stomachs, for determining the food of fishes.
- (vii) Collection of otoliths from trawled fish for investigations on the age of fishes at different sizes.

#### B. LABORATORY INVESTIGATIONS.

AGE OF FISHES.—Considerable progress has been made with the otolith investigations. The growth-rate of the Plaice during the first few years of its life has been definitely determined for several different parts of the coast. The results show a substantial agreement over the southern part of the North Sea, but a much more rapid growth in the western part of the English Channel than in the former area. The determination of the relation between age and size during the later years is beset with difficulties connected with the existence of local differences of growth on the offshore grounds, complicated by the migrations of the fish. These points are being carefully investigated. The method of study has been extended during the year to other suitable species, especially the Cod.

FOOD OF FISHES.—Records of the general fauna of the different trawling grounds have been kept systematically, and have been supplemented from time to time by the results of special hauls with the dredge and other implements.

The contents of over 6,000 stomachs of fishes have been examined and recorded in detail.

The age and food of all marked fishes recaptured has been regularly recorded.

BOTTOM DEPOSITS.—Samples of the sea-bottom from about 200 localities have been collected from time to time, and are under analysis with the object of determining the influence of this factor on the distribution of fishes and of the organisms upon which they feed.

#### C. FISHERMEN'S RECORDS.

The system of fishermen's trawling records has been continued without interruption. Three or four Lowestoft and Ramsgate smacks,

and five or six Grimsby steam trawlers have been constantly engaged in providing these supplementary records of individual hauls. The number of returns provided by the fishermen during the past year amounts to a total of nearly 7,000, as follows:—

Smacks	...	1,350	hauls.
Steamers	...	5,437	„
Total		<u>6,787</u>	„

#### SECTION II.—HYDROGRAPHIC AND PLANKTON WORK IN THE ENGLISH CHANNEL.

The quarterly hydrographic cruises required by the International programme were made in the English Channel in August and November 1904, and in February and May 1905. The usual routine work was carried out, and in addition current measurements were made with the Ekman-Nansen current-meter on Station 2 (47 miles S.W. of the Eddystone), in 50 fathoms, during the November and following cruises.

In addition to the observations made on the quarterly cruises, samples of surface water and temperature records have been received every fortnight from four steamers crossing the English Channel—from Newhaven to Caen, from Southampton to Havre and St. Malo, and from Plymouth to the Channel Islands and St. Brieuc. These, together with samples obtained from lightships, have made it possible to draw up fortnightly surface charts for the Channel east of the line joining Plymouth to Guernsey.

Since September 1904, samples have been collected over the North Atlantic between Lat. 20° N. and Lat. 56° N. every noon by the kindness of the captains of fifteen of the larger passenger steamers sailing from English and Scotch ports.

In May 1904, water of 35.30 ‰ S. and over extended up the Channel as far as the Isle of Wight. During the summer the salinity gradually fell, and in July the highest value found on the Plymouth-Guernsey line was 35.25 ‰ S., which in August had diminished to 35.00 ‰ S. During the cruise in this month, surface water as high as 35.40 ‰ S. was only found at one place—near Ushant, but this high-salinity water extended west as an undercurrent to Parson's Bank, and thence north nearly to mid-Channel.

The salinity remained low, with only slight variations, until the first week in October, when water of 35.30 ‰ S. was found for a short time between Plymouth and Guernsey. A decline then set in until

November 16th, when 35.30 ‰ S. again appeared on the Plymouth-Guernsey line. During the cruise in November, a narrow tongue of surface water of 35.40 ‰ S. and over was found stretching north from Ushant to near mid-Channel, when it took a sharp turn to the west. This apparent movement from east to west, against the general Channel drift, was due to a sheet of fresher water entering from the west and nearly covering a broad layer of denser water which extended at the bottom from Ushant at least as far as Parson's Bank.

About the middle of December the flow of high-salinity water increased, and during the first week in January 1905, water of 35.40 ‰ S. appeared in the Channel between Plymouth and Guernsey for the first time since February 1904. In February there was a slight fall here, but the presence of water of 35.50 ‰ S., or possibly 35.60 ‰ S., a few miles to the west showed that the Atlantic flow was still increasing, displacing the whole of the fresher water from surface to bottom. This flow reached its maximum towards the end of February with water of 35.59 ‰ S., between Plymouth and Guernsey, though it had not fallen below 35.40 ‰ S. at the end of April. The samples collected since that date have not been worked out. The general results show an increased Atlantic flow during the first few months of 1905.

The specific gravity of various samples collected in the North Atlantic between Lat. 56° N. and Lat. 20° N. has been determined directly, and so far no reason has been found for doubting the accuracy of the ratio of total halogens to specific gravity as given by Knudsen's Tables. These experiments are still in progress.

The results of the two years of hydrographic work which have now been carried out show that the western portion of the English Channel is sometimes filled with warm Atlantic water of high density entering from the south, whilst at other times the water is of low density, being derived chiefly from the Bristol Channel and St. George's Channel, and in the case of the coastal waters being diluted to a certain extent with river water. Occasionally water of both kinds may be found as distinct layers—the water of high salinity usually forming the bottom layer. These changes take place somewhat irregularly and vary in different seasons and from year to year. It seems clear that such changes must have a fundamental influence on all problems connected with the life-history and distribution of the organisms inhabiting the area—including the food fishes.

Samples of Plankton were collected at each station on the four

quarterly cruises in the English Channel, whilst regular samples at weekly and fortnightly intervals have been obtained off Plymouth, between Plymouth and the Channel Islands, and from different lightships off the English and Irish coasts. The principal species found in these samples have been identified, and tables showing the results for the stations worked on the Channel cruises have been published in the Bulletin of the International Council for the study of the sea.

The Plankton observations in 1904-5 have confirmed the conclusion arrived at from the work of the preceding year, that the proportion of oceanic to neritic species decreases in the English Channel very regularly from west to east. At the same time it has been found that the absolute number of oceanic as well as the absolute number of neritic species is highest in the western basin of the Channel, decreasing both towards the open ocean in the west and towards the meridian of the Isle of Wight in the east. It is suggested that this rise in the number of species, in a region where newly-arrived Atlantic water meets water which has been lying over a shallow bottom and has received the outflow of rivers, may be due to an increase of soluble food-substances which are necessary for the development of various organisms.

#### Published Memoirs.

The following papers, either wholly or in part the outcome of work done at the Laboratory, have been published elsewhere than in the Journal of the Association:—

ALLEN, E. J. *The Anatomy of Pœcilochætus*. Quart. Journ. Micr. Sci., vol. xlviii., 1904, pp. 79-152.

DANNEVIG, H. C. *On the First Successful Experiment with Importation of European Sea Fishes to Australian Waters*. Fisheries of New South Wales. Annual Report for 1902. II.

MINCHIN, E. A. *The Characters and Synonymy of the British Species of Sponges of the Genus LEUCOSOLENIA*. Proceed. Zool. Soc., Lond. 1904, vol. ii., pp. 349-96.

ELIOT, Sir C. N. E. *On the DORIS PLANATA of Alder and Hancock*. Proceed. Malacol. Soc., vol. vi., 1904, pp. 180, 181.

ELIOT, Sir C. N. E. *Notes on two Rare British Nudibranchs, HERO FORMOSA var. ARBORESCENS and STAURODORIS MACULATA*. Proceed. Malacol. Soc., vol. vi., 1905, pp. 239-43.

RANDLES, W. B. *Some Observations on the Anatomy and Affinities of the Trochidae*. Quart. Journ. Micr. Sci., vol. xlviii., 1904, pp. 33-78.

WOODCOCK, H. M. *On CYSTOBIA IRREGULARIS (Minch.) and Allied "Neogamous" Gregarines*. Arch. Zool. Exp. et Gén. Notes et Revue, 1904, No. 8.

**Donations and Receipts.**

The receipts for the year for the ordinary work of the Association include the grants from His Majesty's Treasury (£1,000) and the Worshipful Company of Fishmongers (£400), Special Donations (£55), Annual Subscriptions (£108), Rent of Tables in the Laboratory (£19), Sale of Specimens (£322), Admission to the Tank Room (£133).

**Vice-Presidents, Officers, and Council.**

The following is the list of gentlemen proposed by the Council for election for the year 1905-6 :—

*President.*

Prof. E. RAY LANKESTER, LL.D., F.R.S.

*Vice-Presidents.*

The Duke of ABERCORN, K.G., C.B.	Sir EDWARD BIRKBECK, Bart.
The Earl of ST. GERMANS.	Sir MICHAEL FOSTER, K.C.B., M.P., F.R.S.
The Earl of DUCIE, F.R.S.	A. C. L. GÜNTHER, Esq., F.R.S.
Lord AVEBURY, F.R.S.	Sir JOHN MURRAY, F.R.S.
Lord TWEEDMOUTH, P.C.	Prof. ALFRED NEWTON, F.R.S.
Lord WALSHINGHAM, F.R.S.	Rev. Canon NORMAN, D.C.L., F.R.S.
The Right Hon. A. J. BALFOUR, M.P., F.R.S.	Rear-Admiral Sir W. J. L. WHARTON, K.C.B., F.R.S.
The Right Hon. JOSEPH CHAMBER- LAIN, M.P.	

**Members of Council.**

G. L. ALWARD, Esq.	Prof. W. A. HERDMAN, F.R.S.
G. P. BIDDER, Esq.	E. W. L. HOLT, Esq.
G. C. BOURNE, Esq.	J. J. LISTER, Esq., F.R.S.
Prof. T. W. BRIDGE, F.R.S.	H. R. MILL, Esq.
F. DARWIN, Esq., F.R.S.	Prof. E. A. MINCHIN.
G. HERBERT FOWLER, Esq.	Prof. D'ARCY W. THOMPSON, C.B.
S. F. HARMER, Esq., F.R.S.	R. N. WOLFENDEN, Esq., M.D.

*Hon. Treasurer.*

J. A. TRAVERS, Esq.

*Hon. Secretary.*

E. J. ALLEN, Esq., The Laboratory, Citadel Hill, Plymouth.

The following Governors are also members of the Council :—

THE PRIME WARDEN OF THE FISH- MONGERS' COMPANY.	Prof. Sir J. BURDON SANDERSON, Bart., F.R.S. (Oxford University).
E. L. BECKWITH, Esq. (Fishmongers' Company).	A. E. SHIPLEY, Esq., F.R.S. (Cambridge University).
Prof. W. F. R. WELDON, F.R.S. (British Association).	

Dr.

## Statement of Receipts and Expenditure

	£	s.	d.	£	s.	d.
To Balance from last year, being Cash at Bank and in hand, viz. :—						
On Plant, Repairs and Renewal Fund Account .....	116	10	8			
Donations to Fund for Repair of ss. <i>Oithona</i> received last year .....	271	0	0			
	<u>387</u>	<u>10</u>	<u>8</u>			
Less Amount overpaid on General Account .....	283	6	2	104	4	6
„ Current Income :—						
H. M. Treasury .....	1,000	0	0			
Fishmongers' Company (half-year's payment) .....	200	0	0			
Annual Subscriptions .....	108	2	0			
Rent of Tables .....	19	4	0			
Interest on Investment .....	9	10	5	1,336	16	5
„ Extraordinary Receipts :—						
T. H. Riches, Donation to Fund for Repair of ss. <i>Oithona</i> .....	50	0	0			
The late G. Brebner, per E. A. Batters .....	5	0	0			
British Royal Commission, for Repayment of Balance of Expenses in connection with Exhibit at St. Louis Exhibition .....	120	17	11			
Ditto for Sale of Exhibit, including Specimens .....	100	0	0			
Amount realized by Sale of £500 Forth Bridge Railway 4 % Guaranteed Stock .....	582	0	6	857	18	5
„ Balance, being amount due to Bankers .....	146	9	1			
Less Cash in hand .....	<u>20</u>	<u>19</u>	<u>4</u>	125	9	9

[NOTE.—This liability is exclusive of the amount of £100 due to Mr. G. P. Bidder in respect of advance made last year, and of the amount held to be necessary as a Plant, Repairs, and Renewals Fund which, with £25 added during the year, should stand at £141 10s. 8d.]

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 £2,424 9 1

Examined and found correct,

 (Signed) EDWIN WATERHOUSE, F.C.A.  
 G. HERBERT FOWLER.

 R. NORRIS WOLFENDEN.  
 L. W. BYRNE.

27th June, 1905.

## Marine Biological Association of the United Kingdom.

## LIST

OF

## Governors, Founders, and Members.

31ST MAY, 1906.

## I.—Governors.

The British Association for the Advancement of Science, <i>Burlington House, W.</i> .....	£500
The University of Oxford .....	£500
The University of Cambridge.....	£500
The Worshipful Company of Clothworkers, 41, <i>Mincing Lane, E.C.</i> .....	£500
The Worshipful Company of Fishmongers, <i>London Bridge, E.C.</i> .....	£7705
Bayly, Robert (the late) .....	£1000
Bayly, John (the late) .....	£600
Thomasson, J. P. (the late) .....	£970
G. P. Bidder, Esq., <i>Cavendish Corner, Cambridge</i> .....	£800

## II.—Founders.

\* Member of Council. † Vice-President. ‡ President.

1884 The Corporation of the City of London .....	£210
1884 The Worshipful Company of Mercers, <i>Mercers' Hall, Cheapside</i> .....	£341 5s.
1884 The Worshipful Company of Goldsmiths, <i>Goldsmiths' Hall, E.C.</i> .....	£100
1884 The Royal Microscopical Society, 20, <i>Hanover Square, W.</i> .....	£100
1884 The Royal Society, <i>Burlington House, Piccadilly, W.</i> .....	£350
1884 The Zoological Society, 3, <i>Hanover Square, W.</i> .....	£100
1884 Bulteel, Thos., <i>Radford, Plymouth</i> .....	£100
1884 Burdett-Coutts, W. L. A. Bartlett, 1, <i>Stratton Street, Piccadilly, W.</i> ....	£100
1884 Crisp, Frank, LL.B., B.A., Treas. Linn. Soc., 17, <i>Throgmorton Avenue, E.C.</i> .....	£100
1884 Daubeny, Captain Giles A., <i>The Vicarage, Tottington, Bury, Lancs.</i> ...	£100
1884 Eddy, J. Ray, <i>The Grange, Carleton, Skipton</i> .....	£100
1884 Gassiott, John P. (the late) .....	£100
‡1884 Lankester, Prof. E. Ray, F.R.S., <i>British Museum (Natural History), South Kensington, S.W.</i> .....	£100
1884 The Rt. Hon. Lord Masham (the late) .....	£100
1884 Moseley, Prof. H. N., F.R.S. (the late) .....	£100

for the Year ending 31st May, 1905.

Gr.

	£	s.	d.	£	s.	d.
By Current Expenditure :—						
Salaries and Wages—						
Director .....	200	0	0			
Naturalist .....	250	0	0			
Director's Assistant .....	150	0	0			
Wages .....	418	16	3	1,018	16	3
Travelling Expenses .....				44	17	1
Library .....				79	2	0
Journal—Printing and Illustrating .....	159	18	0			
Less Sales of Journal .....	18	16	0	141	2	0
Buildings and Public Tank Room—						
Gas, Water, Coal, etc. ....	110	1	1			
Stocking Tanks, Feeding, etc. ....	31	7	1			
Maintenance and Renewals .....	53	16	8			
Rent of Land, Rates, Taxes, and Insurance .....	17	5	8			
	212	10	6			
Less Admissions to Tank Room .....	133	18	5	78	12	1
Laboratory, Boats, and Sundry Expenses—						
Stationery, Office Printing, Postages, etc. ....	152	11	3			
Glass, Chemicals, and Apparatus .....	£99	9	10			
Less Sales .....	44	2	3	55	7	7
Purchase of Specimens .....	29	14	4			
Maintenance and Renewals of Boats, Nets, Gear, etc .....	£292	18	7			
Less Sales .....	79	6	10	213	11	9
Coal and Water for Steamer .....	89	16	6			
Insurance of Steamer (two years) .....	44	0	9			
	585	2	2			
Less Sales of Specimens, etc. (including £50 from International Investigations Commission for use of ss. <i>Oithona</i> ) .....	372	0	4	213	1	10
Bank Interest .....				1	19	4
„ Extraordinary Expenditure :—				1,577	10	7
Cost of New Boiler and Repairs to ss. <i>Oithona</i> , less £15 received for Sale of Old Boiler.....				846	18	6
[NOTE.—This expenditure has been met as to £321 by special donation, and as to £525 18s. 6d. by part proceeds of Sale of Investment, per contra.]						
				£2,424	9	1

## Marine Biological Association of the United Kingdom.

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1884 The Rt. Hon. Lord Masham (the late) .....	£100
1884 Moseley, Prof. H. N., F.R.S. (the late) .....	£100

+1884	The Rt. Hon Lord Avebury, F.R.S., <i>High Elms, Bromley, Kent</i> .....	£100
1884	Poulton, Prof. Edward B., M.A., F.R.S., <i>Wykeham House, Oxford</i> ...	£100
1884	Romanes, G. J., LL.D., F.R.S. (the late) .....	£100
1884	Worthington, James (the late) .....	£100
1885	Derby, the late Earl of .....	£100
1887	Weldon, Prof. W. F. R., F.R.S. (the late) .....	£100
1888	Bury, Henry, M.A., <i>Mayfield House, Farnham, Surrey</i> .....	£100
1888	The Worshipful Company of Drapers, <i>Drapers' Hall, E.C.</i> .....	£315
1889	The Worshipful Company of Grocers, <i>Poultry, E.C.</i> .....	£120
1889	Thompson, Sir Henry, Bart. (the late) .....	£110
1889	Revelstoke, The late Lord .....	£100
1890	Riches, T. H., B.A., <i>Kitwells, Shenley, Herts</i> .....	£230
1902	Gurney, R., <i>Ingham Old Hall, Stalham, Norfolk</i> .....	£100

### III.—Members.

Ann. signifies that the Member is liable to an Annual Subscription of One Guinea.

C. signifies that he has paid a Composition Fee of Fifteen Guineas in lieu of Annual Subscription.

1897	Adams, W. R., 16, <i>Belle Vue Mansions, Devonshire Road, Forest Hill, London</i> .....	Ann.
1900	Aders, W. M., <i>Zeitoun, Cairo, Egypt</i> .....	Ann.
1884	Alger, W. H., 8, <i>The Esplanade, Plymouth</i> .....	C.
*1895	Allen, E. J., D.Sc., <i>The Laboratory, Plymouth</i> .....	Ann.
*1889	Alward, G. L., <i>Enfield Villa, Humberstone Avenue, Waltham, Grimsby</i> .....	Ann.
1892	Assheton, R., M.A., <i>Riversdale, Granchester, Cambridge</i> .....	£20
1904	Aflalo, F. G., 14, <i>Westover Villas, Bournemouth</i> .....	Ann.
1884	Bailey, Charles, M.Sc., F.L.S., <i>Atherstone House, North Drive, St. Anne's-on-the-Sea</i> .....	Ann.
1902	Baker, R. J., <i>Glen View, Mannamead, Plymouth</i> .....	Ann.
1884	Balfour, Prof. Bayley, F.R.S., <i>Royal Botanic Gardens, Edinburgh</i> .....	C.
1884	Bayliss, W. Maddock, D.Sc., F.R.S., <i>St. Cuthberts, West Heath Road, Hampstead</i> .....	Ann.
1884	Bayly, Miss, <i>Seven Trees, Plymouth</i> .....	£50
1884	Bayly, Miss Anna, <i>Seven Trees, Plymouth</i> .....	£50
1884	Beaumont, W. I., B.A., <i>The Laboratory, Plymouth</i> .....	Ann.
1885	Beck, Conrad, 68, <i>Cornhill, E.C.</i> .....	C.
*1889	Beckwith, E. L., <i>The Knoll, Eastbourne</i> .....	Ann.
1887	Beddard, F. E., F.R.S., <i>Zoological Society's Gardens, Regent's Park, N.W.</i> .....	Ann.
1884	Beddington, Alfred H., 8, <i>Cornwall Terrace, Regent's Park, N.W.</i> .....	C.
1897	Bedford, Mrs., 326, <i>Camden Road, London, N.</i> .....	Ann.
1903	Bidder, H. F., 10, <i>Queen's Gate Gardens, London, S.W.</i> .....	Ann.
1893	Bles, A. J. S., <i>Palm House, Higher Broughton, Manchester</i> .....	Ann.
*1884	Bourne, Gilbert C., M.A., <i>Savile House, Mansfield Road, Oxford</i> .....	Ann.
1898	Bowles, Col. Henry, <i>Forty Hall, Enfield</i> .....	Ann.
*1895	Bridge, Prof. T. W., D.Sc., F.R.S., <i>University of Birmingham</i> .....	Ann.
1902	Brighton Corporation, Town Clerk, <i>Town Hall, Brighton</i> .....	Ann.
1886	Brooksbank, Mrs. M., <i>Leigh Place, Godstone, Surrey</i> .....	C.
1884	Brown, Arthur W. W., 62, <i>Carlisle Mansions, Carlisle Place, London, S.W.</i> .....	C.

- 1893 Browne, Edward T., B.A., 141, *Uxbridge Road, W.* ..... Ann.  
 1884 Buckton, G. B., *Weycombe, Haslemere* ..... Ann.  
 1896 Bulstrode, H. T., M.D., 4, *The Mansions, Earl's Court, S.W.* ..... Ann.  
 1889 Burnard, Robert, 3, *Hillsborough, Plymouth* ..... Ann.  
 1897 Byrne, L. W., B.A., 7 *New Square, Lincoln's Inn, London, W.C.*..... Ann.
- 1887 Caldwell, W. H., *Birnam, Chaucer Road, Cambridge* ..... C.  
 1904 Carter, J. M., *Winters Hill, Cookham Dene, Berks* ..... Ann.  
 +1884 Chamberlain, Rt. Hon. J., M.P., 40, *Prince's Gardens, S.W.* ..... Ann.  
 1884 Christy, Thomas Howard, 199, *Bramhall Lane, Stockport*..... C.  
 1887 Clarke, Rt. Hon. Sir E., K.C., 5, *Essex Court, Temple, E.C.* ..... £25  
 1884 Clay, Dr. R. H., *Windsor Villas, Plymouth* ..... Ann.  
 1885 Clerk, Major-General H., F.R.S., "Mountfield," 5, *Upper Maze Hill, St. Leonards-on-Sea, Sussex* ..... £21  
 1886 Coates and Co., *Southside Street, Plymouth* ..... C.  
 1885 Collier Bros., *Old Town Street, Plymouth* ..... C.  
 1900 Cooper, W. F., B.A., *Ashlyns Hall, Berkhamsted*..... Ann.
- \*1885 Darwin, Francis, F.R.S., 13, *Madingley Road, Cambridge*..... C.  
 1885 Darwin, W. E., *Ridgemount, Bassett, Southampton* ..... £20  
 1884 Dewick, Rev. E. S., M.A., F.G.S., 26, *Oxford Square, Hyde Park, W.* ... C.  
 1885 Dixey, F. A., M.A. Oxon., *Wadham College, Oxford* .....£26 5s. and Ann.  
 1906 D'Morgan, W. C., c/o H. S. King & Co., 9, *Pall Mall, London* ..... Ann.  
 1890 Driesch, Hans, Ph.D., *Philosophenweg 5, Heidelberg, Germany* ..... C.  
 +1889 Ducie, The Rt. Hon. the Earl of, F.R.S., *Tortworth Court, Falfield, R.S.O.* £50 15s.  
 1884 Dunning, J. W., 4, *Talbot Square, London, W.* ..... £26 5s.  
 1884 Dyer, Sir W. T. Thiselton, M.A., K.C.M.G., F.R.S., *The Ferns, Witcombe, Gloucester* ..... C.
- 1898 Eliot, Sir C. N. E., K.C.M.G., C.B., *Endcliffe Holt, Endcliffe Crescent, Sheffield* ..... Ann.  
 1891 Ellis, Hon. Evelyn, *Rosenais, Datchet, Windsor* ..... C.  
 1893 Enys, John Davies, *Enys, Penryn, Cornwall* ..... Ann.  
 1884 Evans, Sir John, D.C.L., F.R.S., *Nash Mills, Hemel Hempstead* ..... £20  
 1885 Ewart, Prof. J. Cossar, M.D., *University, Edinburgh* ..... £25
- 1894 Ferrier, David, M.A., M.D., F.R.S., 34, *Cavendish Square, W.*..... Ann.  
 1884 Fison, Sir Frederick W., Bart., 64, *Pont Street, London, S.W.* ..... C.  
 1897 Foster, Richard, *Windsorworth, Looe, R.S.O.* ..... Ann.  
 \*1885 Fowler, G. Herbert, B.A., Ph.D., 58, *Bedford Gardens, London, W.* ... Ann.  
 1884 Fox, George H., *Wodehouse Place, Falmouth* ..... Ann.  
 1886 Freeman, F. F., *Abbotsfield, Tavistock, S. Devon* ..... C.  
 1884 Fry, George, F.L.S., *Carlin Brae, Berwick-on-Tweed* ..... £21
- 1892 Galton, F., F.R.S., 42, *Rutland Gate, S.W.* ..... Ann.  
 1885 Gaskell, W. H., F.R.S., *The Uplands, Shelford, Cambridge* ..... C.  
 1899 Gardiner, Dr. Edw. G., *Woods Hole, Mass., U.S.A.* ..... C.  
 1897 Gibbs, Hon. Henry, 10, *Lennox Gardens, S.W.* ..... Ann.  
 1901 Giles, Col. G. M., *Byfield, Mannamead, Plymouth* ..... C.  
 1885 Gordon, Rev. J. M., *St. John's Vicarage, Redhill, Surrey* ..... Ann.  
 1884 Grove, E., *Norlington, Preston, Brighton* ..... Ann.  
 1899 Guinness, Hon. Rupert, *Elveden, Thetford* .....£35 15s.

- †1884 Günther, Dr. Albert, F.R.S., 2, *Lichfield Road, Kew Gardens* ..... Ann.  
 1900 Gurney, E., *Sprouston Hall, Norwich* ..... Ann.
- 1884 Halliburton, Prof. W. D., M.D., F.R.S., *Church Cottage, 17, Marylebone Road, London, W.* ..... Ann.  
 1884 Hannah, Robert, 82, *Addison Road, Kensington, W.* ..... C.  
 \*1885 Harmer, S. F., D.Sc., F.R.S., *King's College, Cambridge* ..... C.  
 1889 Harvey, T. H., *Cattedown, Plymouth* ..... Ann.  
 1888 Haselwood, J. E., 3, *Lennox Place, Brighton* ..... C.  
 1884 Haslam, Miss E. Rosa, *Ravenswood, Bolton* ..... £20  
 1884 Head, J. Merrick, F.R.G.S., J.P., *Pennsylvania Castle, Isle of Portland, Dorset* ..... Ann.  
 1884 Heape, Walter, *Heyroun, Chaucer Road, Cambridge* ..... C.  
 \*1884 Herdman, Prof. W. A., F.R.S., *The University, Liverpool*..... Ann.  
 1884 Herschel, Col. J., R.E., F.R.S., *Observatory House, Slough, Berks.* ..... C.  
 1889 Heywood, Mrs. E. S., *Light Oaks, Manchester* ..... C.  
 1884 Hickson, Prof. Sydney J., M.A., D.Sc., F.R.S., *Ellesmere House, Wilenslow Road, Withington, Manchester* ..... Ann.  
 1897 Hodgson, T. V., 54, *Kingsley Road, Plymouth* ..... Ann.  
 1884 Holdsworth, E. W. H., F.L.S., F.Z.S., *Lucerne House, Dartmouth* . . . . Ann.  
 \*1905 Holt, E. W. L., 15 *Castle Avenue, Clontarf, Dublin* ..... Ann.  
 1884 Hudleston, W. H., M.A., F.R.S., 8, *Stanhope Gardens, South Kensington, S.W.* ..... Ann.
- 1891 Indian Museum, *Calcutta* ..... Ann.  
 1888 Inskip, Capt. G. H., R.N., 22, *Torrington Place, Plymouth* ..... Ann.
- 1885 Jackson, W. Hatchett, M.A., D.Sc., F.L.S., *Pen Wartha, Weston-super-Mare* ..... Ann.  
 1893 Jago, Edward, *Coldrenick, Liskeard, Cornwall* ..... Ann.  
 1887 Jago-Trelawny, Major-Gen., F.R.G.S., *Coldrenick, Liskeard* ..... C.
- 1899 Kent, W. Saville, F.L.S., *Belsito, Milford-on-Sea, Hants* ..... Ann.
- 1897 Lanchester, W. F., B.A., *The Knott, Lady Margaret Road, Cambridge*... C.  
 1885 Langley, Prof. J. N., F.R.S., *Trinity College, Cambridge* ..... C.  
 \*1895 Lister, J. J., M.A., F.R.S., *St. John's College, Cambridge* ..... Ann.  
 1888 Lopes, The Rt. Hon. Sir Massey, Bart., *Maristow, Roborough, South Devon* ..... Ann.
- 1885 Macalister, Prof. A., F.R.S., *St. John's College, Cambridge*..... Ann.  
 1884 MacAndrew, James J., *Lukesland, Ivybridge, South Devon* ..... Ann.  
 1900 Macfie, J. W. Scott, *Rowton Hall, Chester* ..... C.  
 1884 Mackrell, John, *High Trees, Clapham Common, S.W.* ..... C.  
 1886 MacMunn, Charles A., M.D., *Oak Leigh, Wolverhampton* ..... Ann.  
 1902 Major, Surgeon H. G. T., 24, *Beech House Road, Croydon*..... C.  
 1889 Makovski, Stanislaus, *Saffrons Corner, Eastbourne* ..... Ann.  
 1885 Marr, J. E., M.A., F.R.S., *St. John's College, Cambridge*..... C.  
 1902 Martin, C. H., *The Hill, Abergavenny* ..... Ann.  
 1906 Masterman, A. T., D.Sc., *Board of Agriculture and Fisheries, Delahay Street, London, S.W.* ..... Ann.

1884 McIntosh, Prof. W. C., F.R.S., <i>Nevay Park, Meigle, N.B.</i> .....	C.
1884 Michael, Albert D., <i>Cadogan Mansions, Sloane Square, S.W.</i> .....	C.
*1903 Mill, H. R., D.Sc., 62, <i>Camden Square, London, N.W.</i> .....	Ann.
*1899 Minchin, Prof. E. A., <i>University College, London, W.C.</i> .....	Ann.
1905 Mitchell, P. Chalmers, D.Sc., F.R.S., Secretary Zoological Society, 3 <i>Hanover Square, London, W.</i> .....	Ann.
1885 Mocatta, F. H., 9, <i>Connaught Place, W.</i> .....	C.
1886 Mond, Ludwig, F.R.S., 20, <i>Avenue Road, Regent's Park, N.W.</i> .....	C.
+1896 Murray, Sir John, K.C.B., F.R.S., <i>Challenger Lodge, Wardie, Edinburgh</i>	Ann.
+1884 Newton, Prof. Alfred, M.A., F.R.S., <i>Magdalen College, Cambridge</i> .....	£20
+1884 Norman, Rev. A. M., M.A., D.C.L., F.R.S., <i>The Red House, Berkhamsted, Herts</i> .....	Ann.
1885 Phillips, Chas. D. F., M.D., 10, <i>Henrietta Street, Cavendish Square, W.</i> C.	
1887 Phipson, Mrs., <i>Dasak Bungalow, Nasik Road, Deccan, India</i> .....	Ann.
1886 Power, Henry, C.B., F.R.C.S., 37A, <i>Great Cumberland Place, W.</i> .....	Ann.
1885 Pritchard, Prof. Urban, <i>Combe Hurst, Nutley Terrace, Hampstead</i> .....	Ann.
1884 Pye-Smith, P. H., M.D., 48, <i>Brook Street, W.</i> .....	C.
1893 Quintin, St. W. H., <i>Scampstone Hall, Rillington, Yorks</i> .....	Ann.
1884 Ralli, Mrs. Stephen .....	£30
1885 Ransom, W. B., <i>The Pavement, Nottingham</i> .....	C.
1888 Rawlings, Edward, <i>Richmond House, Wimbledon Common</i> .....	Ann.
1892 Robinson, Miss M., <i>University College, London, W.C.</i> .....	Ann.
1892 Rüffer, M. A., M.D., <i>Conseil Sanitaire, Maritime et Quarentenaire, Alexan- dria, Egypt</i> .....	Ann.
1897 Sandeman, H. D., 4, <i>Elliot Terrace, Plymouth</i> .....	Ann.
1888 Scharff, Robert F., Ph.D., <i>Science and Art Museum, Dublin</i> .....	Ann.
1901 Schiller, F. W., 9, <i>Carlton Road, Blackheath, London, S.E.</i> .....	Ann.
1884 Sclater, P. L., F.R.S., <i>Odiham Priory, Winchfield, Hants</i> .....	Ann.
1884 Sclater, W. L., <i>The Museum, Cape Town</i> .....	Ann.
1885 Scott, D. H., M.A., Ph.D., F.R.S., <i>Old Palace, Richmond, Surrey</i> .....	C.
1903 Scott, S. D., <i>Newich House, Bath Road, Cheltenham</i> .....	Ann.
1884 Sedgwick, A., M.A., F.R.S., <i>Trinity College, Cambridge</i> .....	C.
1888 Serpell, E. W., 19, <i>Hill Park Crescent, Plymouth</i> .....	£50
1900 Sexton, L. E., 17, <i>Collings Park, Higher Compton, Plymouth</i> .....	Ann.
1904 Shaw, Joseph, <i>Bryanston Square, London, W.</i> .....	£13
1885 Sheldon, Miss Lilian, <i>The Murmurs, Exmouth</i> .....	Ann.
*1884 Shipley, Arthur E., M.A., F.R.S., <i>Christ's College, Cambridge</i> .....	C.
1886 Shore, T. W., M.D., <i>Heathfield, Alleyn Park, Dulwich, London, S.E.</i> ...	Ann.
1894 Simpson, F. C., J.P., <i>Maypool, Churston Ferrers, R.S.O.</i> .....	Ann.
1885 Sinclair, F. G., <i>Friday Hill, Chingford, Essex</i> .....	C.
1891 Sinclair, William F., 102, <i>Cheyne Walk, Chelsea, S.W.</i> .....	C.
1884 Skinners, the Worshipful Company of, <i>Skinners' Hall, E.C.</i> .....	£42
1889 Slade, Commander E. J. Warre, <i>Phoenix Farm, Great Bookham, Surrey</i> C.	
1893 Sorby, H. C., LL.D., F.R.S., <i>Broomfield, Sheffield</i> .....	Ann.
1888 Spencer, Prof. W. Baldwin, M.A., F.R.S., <i>University of Victoria, Melbourne</i>	Ann.

- 1884 Stewart, Prof. Chas., F.R.S., *Royal College of Surgeons, Lincoln's Inn Fields, W.C.* ..... Ann.
- 1897 Straker, J., L.L.M., F.Z.S., *Oxford and Cambridge Club, S.W.* ..... C.
- 1884 Sutherland, The Duke of, *Stafford House, St. James', S.W.* ..... C.
- 1894 Sykes, E. R., 4, *Gray's Inn Place, Gray's Inn, London* ..... Ann.
- 1894 Thomas, W. F., *Bishopshalt, Hillingdon, Middlesex* ..... Ann.
- \*1899 Thompson, Prof. D'Arcy W., C.B., *University College, Dundee* ..... Ann.
- 1890 Thompson, Sir H. F., Bart., 19, *Kensington Gardens, London, W.* ..... Ann.
- 1884 Thornycroft, Sir John I., F.R.S., *Eyot Villa, Chiswick Mall* ..... Ann.
- 1888 Thurston, Edgar, *Government Central Museum, Egmore, Madras* ..... Ann.
- 1903 Torquay Natural History Society, *Torquay* ..... Ann.
- \*1897 Travers, J. A., *Tortington House, Arundel* ..... Ann.
- 1891 Vaughan, Henry, 325, *High Holborn, London*..... C.
- 1884 Venning, Mrs., 3, *Wingfield Villas, Stoke, Devonport* ..... £50
- 1884 Walker, Alfred O., *Ulcombe Place, Maidstone* ..... Ann.
- 1884 Walker, P. F., 36, *Prince's Gardens, S.W.* ..... Ann.
- †1884 Walsingham, The Rt. Hon. Lord, F.R.S., *Merton Hall, Thetford* ..... £20
- 1906 Waterhouse, N. E., 3, *Fredericks Place, Old Jewry, London, E.C.*..... Ann.
- 1891 Wildy, A. G., 14, *Buckingham Street, Adelphi, London, W.C.* ..... Ann.
- 1900 Willey, A., D.Sc., *Government Museum, Colombo, Ceylon* ..... Ann.
- 1884 Wilson, Scott B., *Heather Bank, Weybridge Heath* ..... C.
- \*1900 Wolfenden, R. N., M.D., 76, *Wimpole Street, Cavendish Square, London, W.* Ann.
- 1905 Woolf, M. Yeatman, *Wimpole House, Wimpole Street, London, W.* ... Ann.
- 1898 Worth, R. H., 42, *George Street, Plymouth* ..... Ann.
- 1905 Yearsley, Macleod, 10, *Upper Wimpole Street, London, W.* ..... Ann.

#### IV.—Associate Members.

- 1900 Bignell, G. C., F.E.S., *The Ferns, Home Park Road, Saltash, Cornwall.*
- 1889 Caux, J. W. de, *Great Yarmouth.*
- 1889 Dannevig, Capt. G. M., *Arendal, Norway.*
- 1904 Donnison, F., *Deep Sea Fishing Co., Boston.*
- 1904 Edwards, W. C., *Mercantile Marine Office, St. Andrew's Dock, Hull.*
- 1904 Freeth, A. J., *Fish Quay, North Shields.*
- 1904 Hurrell, H. E., 25, *Regent Street, Yarmouth.*
- 1904 Inskip, H. E., Capt., R.N., *Harbour Master's Office, Ramsgate.*
- 1904 Johnson, A., *Fishmongers' Company, Billingsgate Market, London, E.C.*
- 1889 Olsen, O. T., F.L.S., F.R.G.S., *Fish Dock Road, Great Grimsby.*
- 1904 Patterson, Arthur, *Ibis House, Great Yarmouth.*
- 1889 Ridge, B. J., *Newlyn, Penzance.*
- 1901 Sanders, W. J., *St. Elmo, Brixham.*
- 1889 Shrubsole, W. H., 19, *Vancovier Road, Catford, London.*
- 1889 Sinel, Joseph, 8, *Springfield Cottages, Springfield Road, Jersey, C.I.*
- 1890 Spencer, R. L., *L. and N.W. Depot, Guernsey.*
- 1890 Wells, W., *The Aquarium, Brighton.*

## OBJECTS

OF THE

# Marine Biological Association of the United Kingdom.

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THE ASSOCIATION was founded at a Meeting called for the purpose in March, 1884, and held in the Rooms of the Royal Society of London.

The late Professor HUXLEY, at that time President of the Royal Society, took the chair, and amongst the speakers in support of the project were the late Duke of ARGYLL, the late Sir LYON PLAYFAIR, Lord AVEBURY, Sir JOHN HOOKER, the late Dr. CARPENTER, Dr. GÜNTHER, the late Lord DALHOUSIE, the late Professor MOSELEY, the late Mr. ROMANES, and Professor LANKESTER.

The Association owes its existence and its present satisfactory condition to a combination of scientific naturalists, and of gentlemen who, from philanthropic or practical reasons, are specially interested in the great sea fisheries of the United Kingdom. It is universally admitted that our knowledge of the habits and conditions of life of sea fishes is very small, and insufficient to enable either the practical fisherman or the Legislature to take measures calculated to ensure to the country the greatest return from the "harvest of the sea." Naturalists are, on the other hand, anxious to push further our knowledge of marine life and its conditions. Hence the Association has erected at Plymouth a thoroughly efficient Laboratory, where naturalists may study the history of marine animals and plants in general, and where, in particular, researches on food-fishes and molluscs may be carried out with the best appliances.

The Laboratory and its fittings were completed in June, 1888, at a cost of some £12,000. Since that time investigations, practical and scientific, have been constantly pursued at Plymouth. Practical investigations upon matters connected with sea-fishing are carried on under the direction of the Council; in addition, naturalists from England and from abroad have come to the Laboratory, to carry on their own independent researches, and have made valuable additions to zoological and botanical science, at the expense of a small rent for the use of a working table in the Laboratory and other appliances. The number of naturalists who can be employed by the Association in special investigations on fishery questions, and definitely retained for the purpose of carrying on those researches throughout the year, must depend on the funds subscribed by private individuals and public bodies for the purpose. The first charges on the revenue of the Association are the working of the sea-water circulation in the tanks, stocking the tanks with fish and feeding the latter, the payment of servants and fishermen, the hire and maintenance of fishing-boats, and the salary of the Resident Director and Staff. At the commencement of this number will be found the names of the gentlemen on the staff.

In the summer of 1902 the Association was commissioned by His Majesty's Government to carry out in the southern British area the scheme of International Fishery Investigations adopted by the Conference of European Powers which met at Christiania in 1901. In connection with this work a laboratory has been opened at Lowestoft.

The purpose of the Association is to aid at the same time both science and industry. It is national in character and constitution, and its affairs are conducted by a representative Council, by an Honorary Secretary and an Honorary Treasurer, without any charge upon its funds, so that the whole of the subscriptions and donations received are devoted absolutely to the support of the Laboratory and the prosecution of researches by aid of its appliances. The reader is referred to page 4 of the Cover for information as to membership of the Association.

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### NOTICE.

The Council of the Marine Biological Association wish it to be understood that they do not accept responsibility for statements published in this Journal excepting when those statements are contained in an official report of the Council.

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### TERMS OF MEMBERSHIP.

	£	s.	d.
Annual Members . . . . . per annum	1	1	0
Life Members . . . . . Composition Fee	15	15	0
Founders . . . . .	100	0	0
Governors . . . . .	500	0	0

Members of the Association have the following rights and privileges: they elect annually the Officers and Council; they receive the Journal of the Association free by post; they are admitted to view the Laboratory at Plymouth, and may introduce friends with them; they have the first claim to rent a place in the Laboratory for research, with use of tanks, boats, &c.; and have access to the books in the Library at Plymouth.

All correspondence should be addressed to the Director, The Laboratory, Plymouth.