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The Microplankton of Plymouth Sound from the Region beyond the Breakwater.

By

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With Figures 1–9 in the text, and Tables I and II at the end.

THROUGHOUT a complete year from September, 1915, to September, 1916, sea-water samples were taken regularly two or three times a week from beyond the Breakwater in the region of the Knap buoy, 2½ miles from Plymouth shore, from the surface and at 5 and 7 fathoms. The object was to supplement the existing records from the tow nets as it is well known that a very large amount of material is lost even from the finest nets, as Lohmann has shown exhaustively (1908). So far the only plankton records from this region have been from the tow nets, and a glance at the tables given at the end of this paper will show directly, if compared with those by Gough (1903–7) and Bygrave (1911), also Cleve (1899 and 1900), the great difference in numbers of the smaller forms, or their entire absence from the tow nettings. Again, no actual numerical records have been given from this region. At the same time as the water samples were taken, tow nettings, coarse, medium and very fine, were also secured, and these were regularly examined for comparison.

The water samples were estimated by means of the centrifuge after the manner introduced by Lohmann. A water-bottle was used for the 5 and 7 fathom samples, and the surface sample was collected in a Winchester bottle. Experiment showed that there was no difference in the surface samples when collected either with the water-bottle or Winchester, and it was found more convenient for keeping as it was unnecessary always to examine it the day of collection, as was the case with the water-bottle samples. The Winchester samples keep for two or three days at a uniform temperature. If examined the day they are brought in the water-bottle samples are quite as good as the surface samples in the

Winchester for Peridiniales and Protozoa, which perhaps include the most delicate of all the plankton organisms. The samples were all examined fresh when possible; if impossible, which was only seldom, they were preserved by adding strong Flemming's solution at the time of capture as advised by Gran (1912*a*). For most species this method of preservation was found very satisfactory.

For quantitative estimation a certain amount (usually 50 cc.) of the sample water was put in tubes and centrifuged. Five tubes each holding 10 cc. were examined, the tubes pointed at the end after Lohmann's pattern, so that the contents may be emptied out and leave the residue in the point; this residue was removed carefully with a fine pipette, put on a ruled glass slide and the contents counted. The water was then re-centrifuged and the process gone through again. It was found that although re-centrifuging answered very well for diatoms, *Peridinium* and the more sturdy organisms, it was no use for the fragile forms such as the naked Peridiniales and small Infusoria, many of which are most probably destroyed even before they are brought in.

It was found by experiment that centrifuging for ten minutes gave the best results, the largest number of gymnodinians being secured in this way. This is longer than the time taken by Lohmann, but his centrifuge made many more revolutions than ours, the number of ours not being exactly estimated.

The tow nettings were not exhaustively examined, but the most important organisms were noted and their relative abundance. The nets used were of silk with meshes 26, 50 and 150 to the inch respectively, mouth 56 inches in circumference (inside), and bottom 15 inches in circumference. Length of silk clear of the calico to which it is attached at the ends, 39 inches. Area of silk, 1382 inches. Duration of haul, 10 to 15 minutes, or in exceptional cases a few minutes longer.

The following quick method was adopted: anything large first noted with the naked eye, then a certain amount of each sample taken, and when 30 or more of any organism was present it was marked cc; if 20 but under 30, c; if 6 but under 20, +; if more than one but under 6, r; if only a single specimen rr. In this way a rough estimate of what is common in the tow nets is made. In the case of the very fine samples after stirring two separate drops with a pipette are examined and the above method applied.

On the few days when it was impossible to go beyond the Breakwater the samples and tow nettings were taken from the west channel at the side of the Breakwater. For a fortnight in April it was impossible owing to the storms to go out at all. After this, about the 25th, the increase in plankton is large. The samples were as nearly as possible

taken at the same time of day, between 11 a.m. and 1 p.m., and the state of tide, wind, and weather noted.

A great many species get through the meshes of even the finest nets. Those which are nearly always lost are the smaller Peridiniales, especially the *Gymnodiniaceæ*, the small Infusoria, with the exception of the *Tintinnoidea*, small flagellates (very few of which, however, appeared in our samples), Protozoa of various kinds and many of the smaller diatoms. On looking through the Plymouth records in the Fisheries Investigations we find an almost complete absence of all the very small Peridiniales, and with one exception (that of *Gymnodinium lunula*, which owing to its large size is conspicuous) an absolutely complete absence of *Gymnodiniaceæ* which confirms Lohmann's statement that all were lost. *Prorocentrum micans* is almost absent from the tow nettings, here again in agreement with Lohmann, who found a large loss. Infusoria, except the *Tintinnoidea* are practically absent, and among the diatoms we find records of species such as *Chætoceras curvisetum*, which we have found *the* commonest species of this genus in the plankton, only represented at the most by the sign +, usually r or rr. At times it has appeared with us in quantity in the tow nets, but not nearly as frequently as in the water samples. *Paralia sulcata* is seldom to be found in the nets but is abundant in the water samples, and present nearly all the year round. In Gough's lists it is usually marked r or rr, never by either Bygrave or Gough is it marked cc.

Skeletonema costatum is another good example and one specially marked by Lohmann. Although sometimes recorded as cc for Plymouth, the few times it is thus marked bear no comparison with the numbers really contained in the water. This is a particularly abundant species here, and at Kiel it is shown to be in enormous numbers, most of which escape the net. The species of *Nitzschia* are also good examples, *N. closterium* and *N. delicatissima* particularly nearly always being lost by the net.

On the other hand, a good many of the larger species do not get into the water samples in anything like a representative number. For instance, the genus *Biddulphia* only appears very occasionally, when really it forms a most important part of the plankton at a certain season of the year. *Streptotheca thamensis* is another case; this species being very abundant at times in the tow nettings and only occurring in small numbers in the water samples. The genus *Rhizosolenia*, although the relative abundance of the species is usually well shown in the water samples, is yet sometimes very ineffectually represented. For instance, in June *Rhizosolenia Shrubsolei* appeared in all the tow nets for two or three days, particularly on June 19th, especially in the medium net, and the specimens were of very large size. These scarcely got into the water samples, so that the curve taken from the numbers obtained from the water samples gives a wrong impression for this species, although the seasonal distribution is correctly, though roughly, shown.

The Metazoa in the water samples only amount to a few individuals and are of no account, so that the quantitative work practically amounts to an estimation of the unicellular organisms. Whilst counting the diatoms they were estimated, as is usual, by cells; however, for the tow nettings the chains were regarded as individuals, otherwise the method given above would not have been suitable owing to the number of cells in a chain.

The tables at the end of the paper show the average number of organisms in the water samples in 50 cc. for each week. The tow nettings are shown for comparison at the same time (marked in letters). The account of the Metazoa from the tow nettings is given without tables, and they are also taken into account in the survey for each month. A list of the dates on which the samples were taken, giving wind and weather, will be found at the end of the paper.

The largest numbers, on the whole, are found in the surface layer, but there is not much difference, and a large amount of mixture of water seems to take place, so that it is difficult to assign to any particular species its particular habitat in depth. *Skeletonema costatum* is most frequent at the surface, also *Chætoceras* species generally, *Lauderia, Thalassiosira*, and *Mastigloia*. The greatest fluctuations are nearly always from the surface and can usually be traced to the state of the tide, the 5 and 7 fathom layers being much more regular, as was to be expected. *Skeletonema*, as noticed by Gran (1912*b*) is rather more numerous at the surface. *Paralia sulcata*, however, shows all its maximum numbers either at 5 or 7 fathoms, but as this is naturally a bottom form often coming into the plankton, it is not surprising. *Nitzschia delicatissima*, and *Asterionella japonica* also show largest numbers at 5 and 7 fathoms. The state of the tide affects the numbers, more being taken at or just before high tide, fewest at or just before low tide usually. The highest catches usually come with S. and S.W. winds.

The unicellular organisms other than diatoms occur irregularly at all depths.

On comparing the present records with those of Lohmann at Kiel, much that he states is borne out by these results, although many of his numbers are from estimates with filter as well as centrifuge. *Skeletonema costatum*, which he regards as one of the most important diatoms of the plankton, has a curve which is wonderfully in accordance with ours,

Fig. 1 having a large spring and a small summer maximum (Lohmann, 1908, table XII).

Of his numerical results the Peridiniales are relatively in much larger numbers than in the present records. Although here many species are found to occur and several new species are described, the individual numbers are usually enormously less in these records, even when the

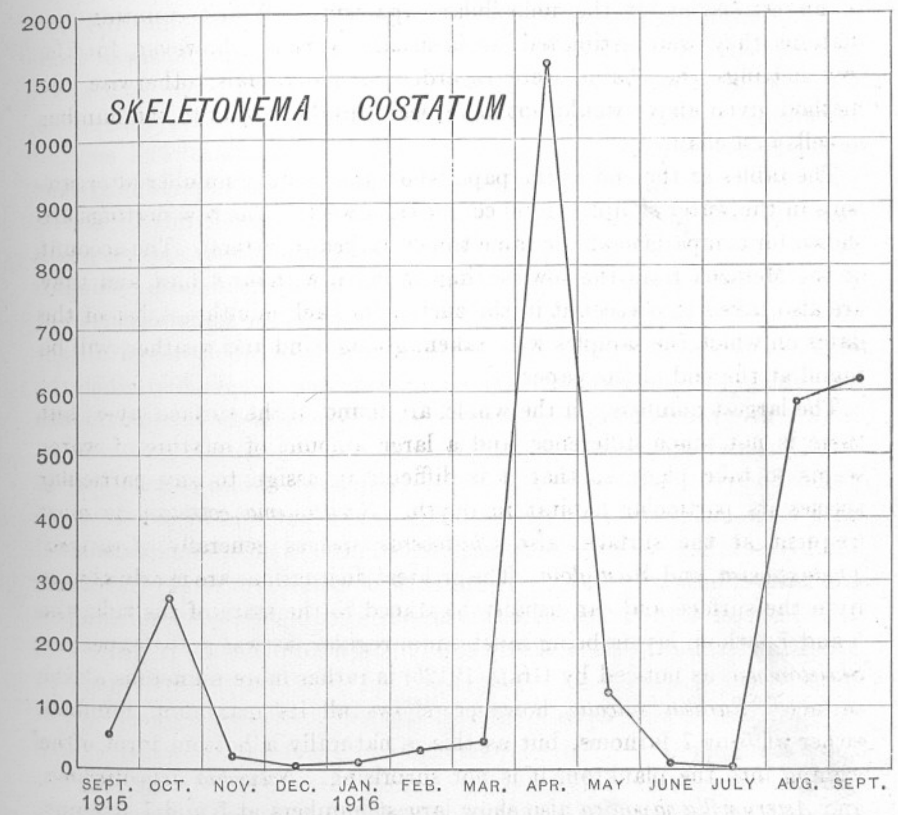

FIG. 1.—Curve of *Skeletonema costatum*, showing average number of individuals in 50 cc. for each month.

season of maximum number agrees. As Lohmann observed at Kiel, so here, there are several amœbæ to be found in the plankton. Ours are of three kinds, one of which is fairly common. With him *Flagellata* are much more numerous than with us, except *Phæocystis*, which is so abundant here in May and June that it interferes with everything, clogging up all the nets. Infusoria Lohmann finds numerous, and there are numerous species of them here, but they are not found in large numbers with the exception of the *Tintinnoidea*. The smaller forms, such as *Laboea* species and *Strombidium caudatum*, very easily collapse and destroy themselves in a moment. *Tiarina fusus* we find at a larger maximum than at Kiel. Most of the new species, both of the Peridiniales and Infusoria found in the plankton by Lohmann, are present here if not in such large quantities; thus we have *Amphidinium crassum*, *Pouchetia parva*, *Cochlodinium pellucidum*, *Laboea strobila*, and many other species hitherto not known from British seas.

The diatoms, although usually in less numbers than Lohmann's, are in some cases more. Nearly all his diatom numbers are, however, from filter examinations, therefore not exactly comparable. One fact which is striking is the relative regularity of the yearly curve of certain species, instead of their showing a marked seasonal distribution. This we find to be the case with *Thalassiothrix nitzschioides*, which is present at Kiel practically all the year round whilst with us it is a pronouncedly winter form. The same is true with most of the *Coscinodiscus* species which also are winter forms here. This is perhaps to be explained by Gough's theory of the distribution of neritic diatoms which he found occurred at certain definite times only in places near the ocean, but stayed all the year round in suitable localities far removed from it. We find much the same seasons for the above diatoms at Port Erin as we have at Plymouth (see Herdman and Scott, 1908–15).

For comparison I have taken from Lohmann's tables certain species with their maximum number in 100 litres and put side by side of these the Plymouth records of the same species in the same amount calculated from the number in 50 cc. The month of maximum is also recorded. It will be seen that in most cases his numbers are higher, in a few instances much higher, but in three cases the Plymouth numbers are higher.

Species.	*Kiel.*	Month of max.	*Plymouth.*	Month of max.
Paralia sulcata	77,000	Nov.	1,000,000	Nov.
Skeletonema costatum	778,000,000	June	25,000,000	April
Guinardia flaccida	360,000	May	20,000	Sept.
Asterionella	1,800,000	Dec.	3,260,000	July (*japonica*)
Prorocentrum micans	5,100,000	Aug.	128,000	Sept.
Glenodinium bipes	2,100,000	May	12,000	Aug.
Ceratium fusus	300,000	Sept.	12,000	Aug.
			P. armata	
Pouchetia parva	50,000	Sept.	30,000	June
Tiarina fusus	11,000	Oct.	14,000	Aug.

As will be seen, the maxima here agree in most cases in being in the spring or autumn. As has been stated above, however, there are several

species which do not agree; for instance, *Coscinodiscus Granii* has a maximum at Kiel in August, whereas I found it confined to the period from November to April, when it is fairly evenly distributed. The maximum of *Prorocentrum micans* in August or September seems to be well established. Ostenfeld (1913) is here also in agreement. *Ceratium fusus* also has its maximum at this time, and *Pyrocystis lunula*, which at Plymouth is only recorded in these months. However, I find that in many cases species having a spring maximum at Kiel have it here in the summer.

A comparison of the present results, with those of Gran (1912) is difficult as his are only for the month of May and from so many stations at various localities and many different depths. However, if we take the Dutch results from the south-western part of the North Sea, which is the nearest to us of all the localities he makes use of, and compare them with the present records for the month of May only, we find the comparison is not without interest. Gran used the centrifuge entirely and the samples were all preserved. He usually took 50 cc. of the sample and calculated from it the number of individuals in a litre. Except in certain cases mentioned below, the numbers are not extremely different. Thus we find the species of *Biddulphia* present in very small numbers (only *B. sinensis* at Plymouth), a large number of several *Chætoceras* species in both (12 species with him, 8 with us). However, whereas there *C. decipiens* and *debile* are the prevailing forms (maximum numbers 11,500 and 6,500 per litre respectively) the prevailing forms here are *C. curvisetum* (maximum number 39,900 per litre) and *C. pseudocrinitum* (maximum number 30,000 per litre). A large number of resting spores of *Chætoceras* species are recorded by Gran and also by Lohmann. They were not recognised and therefore not recorded in the present paper. *Lauderia borealis* (Gran's maximum 2,180 per litre) with us is more abundant (21,580 per litre). *Paralia sulcata* (Gran's maximum 7,180 per litre at 30 m.), with us 700 per litre at 7 fathoms. *Rhizosolenia* species fairly abundant:—

	Dutch records.	Plymouth records.
R. alata	300 (15 m.)	120 surface
R. semispina	160 (20 m.)	500 5 f.
R. Shrubsolei	480 (10 m.)	1,600 5 f.
R. Stolterfothii	8,360 (50 m.)	760 surface

Thalassiosira gravida (Gran's maximum 1,760 per litre, Plymouth 6,320 per litre). *Nitzschia delicatissima* much more abundant at Plymouth, *Nitzschia closterium* more abundant in the Dutch records. Of the Silicoflagellata *Dictyocha fibula* and *Distephanus speculum* are few in numbers as in our records, also the individual numbers of the Peridiniales which are often represented by single examples or by twos and threes. It is, however, among the Infusoria that a great difference is seen, for whereas my own records seldom show more than a few specimens in each sample, the small Infusoria are in fairly large numbers in the Dutch records, especially the species of *Laboea*, which sometimes reach five figures per litre. The Metazoa agree with my records in only being represented by very few individuals.

Herdman's (1908–15) quantitative estimates of the plankton for Port Erin and the south end of the Isle of Man are taken from the tow nets only. These are only comparable with the present records to a certain degree, but some facts stand out as of special interest. Here we find the large spring and smaller autumn maximum for the diatoms, the seasonal distribution of certain genera and their maxima, *Rhizosolenia* species in June; *Chætoceras*, *Thalassiosira* and *Lauderia* in April and May; *Chætoceras* and *Lauderia* again in September and October; all these agree well with our records. The species of *Biddulphia* agree in being almost entirely absent from June to August and being much the most common from November to May. *Coscinodiscus* again agrees in being absent in the summer and early autumn and common in winter and early spring, *Rhizosolenia* species being only common in summer. *Thalassiosira* has its maximum in May both at Port Erin and Plymouth, with a slight second maximum at Plymouth in 1916. *Guinardia* is slightly earlier at Port Erin than at Plymouth. *Lauderia* with a large spring and small autumn maximum at both places, and the same with *Chætoceras*. *Asterionella japonica* appeared in large quantities in May, 1913, at Port Erin. At Plymouth it has a maximum in July and is present on and off from April to January, common through July and August. Apparently this species is irregular in its appearances, as Gough records it from Plymouth as cc in May. The numbers of Peridiniales at Port Erin are enormous compared with the present results; *Ceratium* species and the larger *Peridinium* species forming the basis of the Port Erin records. However, we are in agreement in finding the Peridiniales maximum to occur very shortly after the diatom maximum and the maximum a single one which is only in the summer, May usually at Port Erin, June this year for Plymouth, when the curve shows a conspicuous hump, gradually dwindling in September, after which month very few are present. The smaller Peridiniales are not taken into account in the Port Erin reports, and the *Gymnodiniaceæ*, which turn out to be abundant, are necessarily not noticed as they come through the nets. The same applies to the other small unicellular organisms.

The Diatoms.

In estimating the diatoms, we find they fall naturally into two groups; the first and most important includes the species beginning about April and usually ending about September, the second including those having their maximum in the winter or spring and extending from September

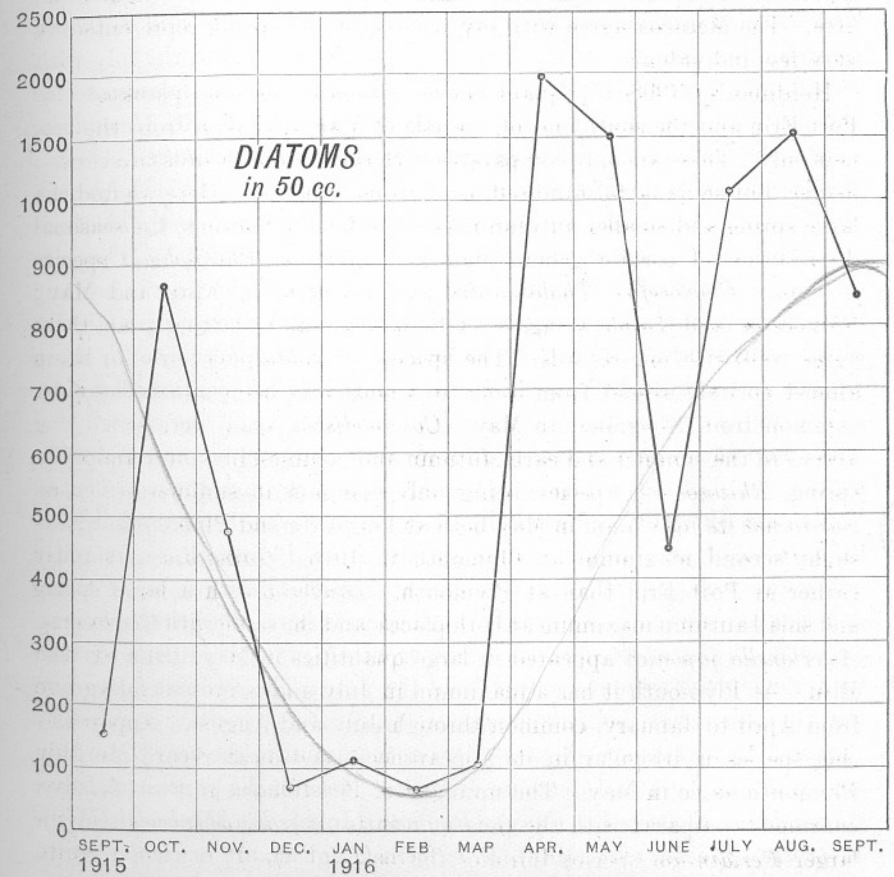

Fig. 2.—Curve showing average number of diatoms in 50 cc. for each month.

or October to the end of March or April and May. In September these groups sometimes overlap, but the two large general maxima occur about April and from August to October, the diatoms of the first group thus being mainly responsible for both the spring and autumn maxima.

The curve here given (Fig. 2) shows the average number of diatoms in 50 cc. monthly throughout the year. The largest maximum is in April, although May comes very near. The autumn maximum here this year is early and occurs in August. It is very nearly as big as the spring maximum. Also in the curve there is another maximum in October, 1915, after which the numbers are very low, until they suddenly rise enormously in April. The October maximum is possibly the ordinary autumn maximum occurring later in 1915 than in 1916. For the rise in April *Skeletonema costatum* is almost wholly responsible; in May *Chætoceras* species are mainly responsible, together with *Nitzschia delicatissima*, *Thalassiosira gravida* and helped by *Rhizosolenia* species and *Lauderia borealis*. For the August maximum *Chætoceras* again is to the fore with *Asterionella japonica*, *Mastigloia* at times in numbers, *Rhizosolenia* species and *Nitzschia* species. The rise in October, 1915, is due to *Mastigloia*, *Chætoceras*, *Lithodesmium undulatum* and *Skeletonema costatum*.

The diatoms of the first or spring and summer group include the genera *Asterionella*, *Chætoceras*, *Lauderia*, *Nitzschia*, *Rhizosolenia* and *Thalassiosira*; those of the autumn and winter group include *Biddulphia*, *Coscinodiscus*, *Paralia*, *Streptotheca* and *Thalassiothrix*. One of the most important diatoms is *Skeletonema costatum*, which, although occurring practically all the year round, yet has certain times of total disappearance for short periods. It cannot be placed in either of the above-mentioned groups as it extends over both.

We find this year the genera *Biddulphia* and *Coscinodiscus* disappear suddenly and do not continue in small numbers through the summer, as is the case generally at Port Erin. Gough, however, has recorded *Biddulphia mobiliensis* in June and August from Plymouth, so it must occasionally be present; also *Coscinodiscus* species very rarely. *Paralia* and *Thalassiothrix* are essentially winter forms here, the latter stopping abruptly in the spring and the former being much commoner in the winter, although occurring throughout the year. The records of Bygrave and Gough are here also in agreement.

Several important species have only one maximum in the year. Monthly curves show a gradual decrease from it. *Asterionella japonica* (July), *Rhizosolenia Stolterfothii* (May), *R. alata* (June), *R. Shrubsolei* (May), *R. hebetata* f. *semispina* (May), *R. setigera* (August), are examples; also *Biddulphia* species and *Coscinodiscus* species (autumn to spring) the curves of which could not be exactly determined because of their presence only sparingly in the water samples. The following are some of the most important species which have two maxima: the larger in April, May or June, usually very much exceeding the second in August or September: *Skeletonema costatum* (April and September), *Chætoceras curvisetum* (May and September), *Lauderia borealis* (April and August), *Thalassiosira gravida* (May and September). These results agree roughly very well with the previous records for Plymouth by Gough and Bygrave.

Large masses of a species of *Mastigloia* in a gelatinous sheath sometimes occur at intervals and swell the number of diatoms largely. In these cases they are usually so numerous that I have estimated them in 10 cc. instead of 50; I have also done this with other species when very numerous.

Table II shows the average number of diatoms in 1 cc. for each month. In the following details of the species the classification of "Nordisches Plankton," Vol. III, Gran (1905) is used.

(1) *Melosira Borreri* Grev. Not common. In water samples, October to March.

(2) *Paralia sulcata* (Ehr.). Occurs almost all the year round in small numbers, but is essentially a winter species. Common from October to April with a maximum in November, then dwindles and picks up again in August. Nearly always goes through the nets. More frequent at 5 and 7 fathoms although common sometimes at the surface. Belongs, properly speaking, to the bottom but very often comes up to be a true member of the plankton.

(3) *Skeletonema costatum* (Grev.). Very common for nearly the whole year, but has periods of disappearance. Rare in December and part of January, June and July. Maximum of 250 per cc. in April, when it helps largely in making the spring diatom maximum. Very numerous in August, September and October. A smaller second maximum in August, and in October, 1915, a still smaller one. Lohmann considers *Skeletonema costatum* the most important diatom at Kiel, where in June it reached a maximum of 780,000,000 per 100 litres. He finds it prefers water of 10 m. depth. Gran (1912*b*) shows it likes surface water, and I have found that although common in all three depths it is usually commonest in the surface samples and its maximum of 12,500 in 50 cc. is from the surface. This is one of the most important of the plankton diatoms at Plymouth, but passes through the net in quantity.

(4) *Thalassiosira gravida* Cleve. This is the only species of the genus found commonly in the water samples. It is abundant from the end of March to the middle of September with an interval of scarcity in July and August. May and June are the months given by Herdman for the maximum of the genus at Port Erin, which agrees well with us. It occurs at all depths, but its maximum in May of 316 in 50 cc. is from the surface.

(5) *T. Nordenskioldii* Cleve. Not very common, occurring at intervals. Frequent in May.

(6) *T. decipiens* (Grun.). Rare.

(7) *T. subtilis* (Ostenf.). This little species with its surrounding matrix occurred only rarely in 1916, although it was frequently noticed in 1915.

(8) *T. condensata* (Cleve). Very rare.

(9) *Lauderia borealis* Gran. An important part of the plankton from May to September, with intervals of scarcity. Helps largely in forming both diatom maxima. Rare from late autumn to early spring. Maximum in May. Its seasonal distribution agrees with Herdman's records for Port Erin. At all depths, but largest numbers at the surface. Maximum of 1,079 in 50 cc. in May from the surface.

(10) *Leptocylindrus danicus* Cleve. Fairly common from May throughout the summer, at other times very rare.

FIG. 3.—*Leptocylindrus sp.* × 700.

(11) *L. sp.* (Fig. 3). A small species which is like *L. minimus* Gran (1912), but never twisted as he describes; occurs fairly commonly in the summer plankton. There are seldom more than two cells in a chain and these are always quite straight. The two chromatophores, size and form agree with Gran's species.

(12) *Guinardia flaccida* (Castr.). Common at intervals from April to September, with a maximum in July. More common in the very fine tow nettings than in the water samples. The large numbers occurring at Port Erin in May and June (maximum in June) are noticeable.

(13) *Hyalodiscus stelliger* Bail. Fairly common from October to February; a winter species. At other times rare.

Genus COSCINODISCUS Ehr.

All the species of *Coscinodiscus* we have found practically absent during the summer, which agrees well with Port Erin; although they continue through the year there except sometimes for one month, they are in very much smaller numbers through the summer. From September to May they occur at times abundantly and are common in the very fine tow nettings.

(14) *Coscinodiscus excentricus* Ehr. Common from September to May.

(15) *C. radiatus* Ehr. Common from September to May. *C. excentricus* and *C. radiatus* are the most abundant species.

(16) *C. sub-bulliens* Jörg. Only noticed from September to December. Not very common.

(17) *C. Granii* Gough. Begins in November and remains till April. Sometimes common in December, January and February.

(18) *Actinocyclus Ehrenbergi* Ralfs. In tow nettings only. Rare. September.

(19) *Actinoptychus undulatus* (Bail.). From the middle of September to the end of April, never very abundant, more frequent in tow nettings than in the water samples. Not seen at all in the summer.

Genus RHIZOSOLENIA (Ehr.) Brightw.

With the exception of *R. robusta* which is the only winter form all the species of *Rhizosolenia* are markedly summer forms; beginning to be abundant in May they continue common until the end of September at all depths. If we compare this with the Port Erin records we find it agrees well except for the fact that at Port Erin there are very few present in August.

The curve (Fig. 4), giving the distribution of the various species, shows *R. Stolterfothii* as much the most abundant with a big maximum in June. As mentioned above, however, *R. Shrubsolei* occurred in enormous numbers in June in the tow nets, of a large size, and was not adequately represented in the water samples. The maximum of the species on the curve ought to rise very much higher. I find that *R. Shrubsolei* and *Stolterfothii* run together to a great extent, although *Shrubsolei* almost disappears in July, whilst *Stolterfothii* continues common well into September. The genus is hardly represented at all from November to April. Its absence being very striking, *R. alata* follows *R. Stolterfothii* closely, although it is not so common. *R. hebetata* form *semispina*, has its maximum in May. *R. setigera* is later, beginning in June and ending in September, with a maximum in August; thus it is later and remains less time than any of the others. All the species are abundant in the tow nets.

(20) *Rhizosolenia Stolterfothii* H. Perag. Perhaps the commonest of the *Rhizosolenia* species. Very common from May to September, with a maximum in June; disappears entirely in December.

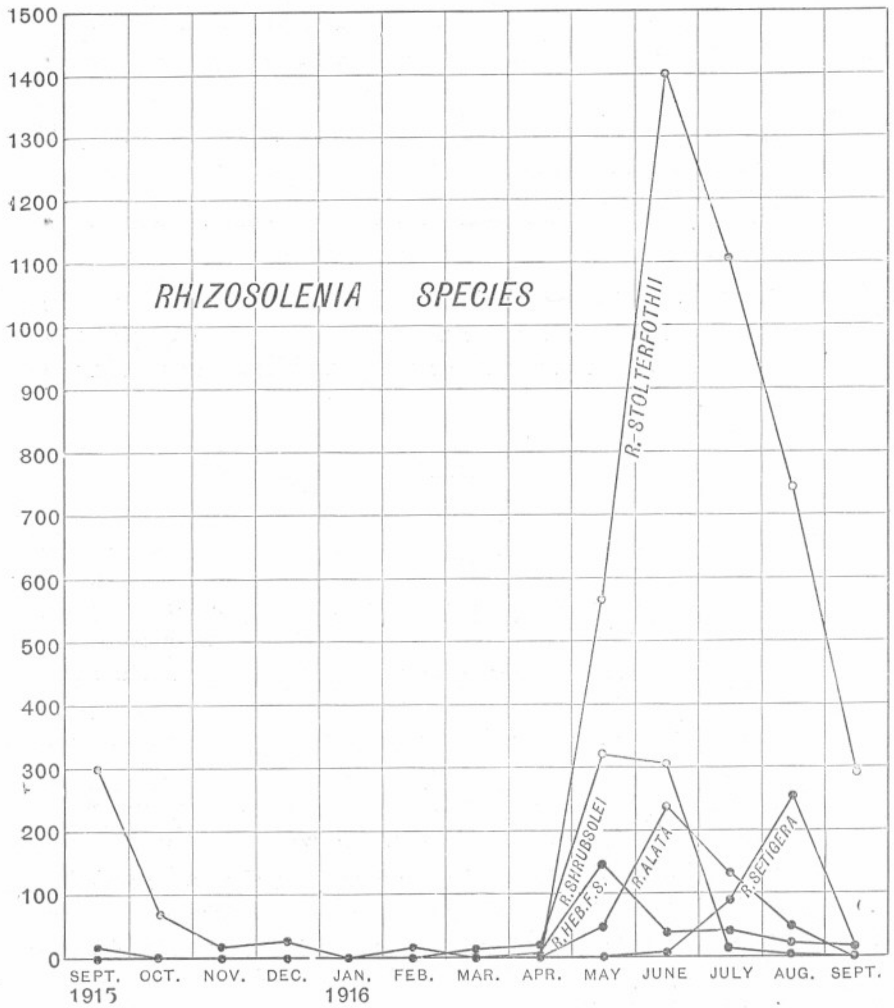

FIG. 4.—Curve showing average number of *Rhizosolenia Shrubsolei, Stolterfothii, alata, setigera*, and *hebetata f. semispina* in 1000 cc. for each month.

In the tow nettings it occurs in long spirals with many cells in each. In the water samples, however, these are broken up and only a few cells cling together, and many single cells are present.

(21) *R. robusta* Norman. This is the only winter *Rhizosolenia* here. It begins in November and, although never common, continues till April. Chiefly in the tow nettings. Very seldom in the water samples.

(22) *R. Shrubsolei* Cleve. Very common in May till the end of June, then dwindles and is rare in August, almost absent in the winter.

(23) *R. setigera* Brightw. Very common in July and August, when it seems to take the place of *R. Shrubsolei*; rare in spring and autumn and almost absent in winter.

(24) *R. hebetata* (Bail.) f. *semispina* (Hensen). Begins in May and is very common till the middle of August, after that is rare and disappears entirely in the winter.

(25) *R. alata* Brightw. Begins to be common in June and continues till August, after that is only rarely found, although a few stragglers are present throughout the year.

(26) *Corethron criophilum* Castr. Most frequent in October but never common. Absent for nearly the whole summer.

Genus CHÆTOCERAS Ehr.

Although scattered throughout the year, all the species occur chiefly in the spring, summer and early autumn, forming an important portion of both maxima. A very large maximum in May (Fig. 5) agrees with the Port Erin records, but the autumn maximum in August is small, not amounting to more numbers than in March. This rise in March is partly due to numbers of *C. densum*, the maximum number of that species in the water samples. This species, however, is large and, like *C. boreale*, does not get much into the water samples. *Chætoceras curvisetum*, which is much the commonest species found, shows two well-marked maxima, a large spring and a small autumn maximum, these agreeing with the Port Erin records for the genus. The fact that on several days in early autumn no *Chætoceras* species were seen in the water samples brings the average for the month down.

(27) *Chætoceras densum* Cleve. Frequent in the tow nettings, but too large to be found much in the water samples. Present most of the year except at times in the summer.

(28) *C. convolutum* Castr. From spring to autumn, sometimes abundant

(29) *C. danicum* Cleve. Rare, at intervals through the year

(30) *C. boreale* Bail. Chiefly in two nettings. Occasionally in spring and early autumn.

(31) *C. decipiens* Cleve. Fairly common in spring and summer, rare in autumn and winter.

(32) *C. teres* Cleve. Chiefly in February and March, common in March.

(33) *C. contortum* Schütt. Occasionally in July, August and September.

(34) *C. didymum* Ehr. Begins in February and continues through the spring and summer until October. Very common in August.

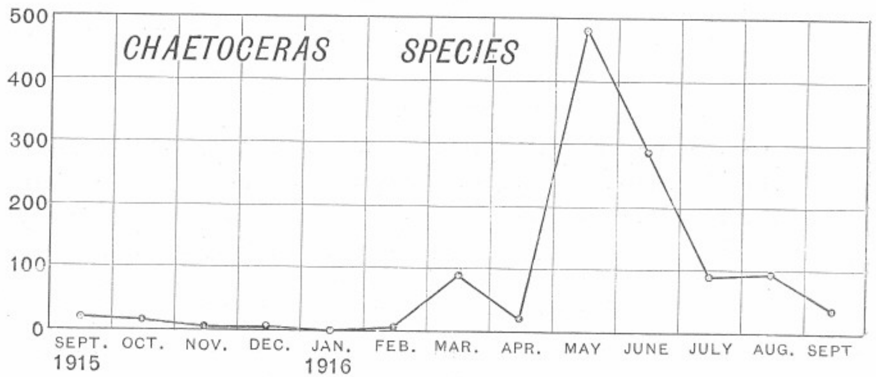

FIG. 5.—Curve showing the average number of *Chætoceras* in 50 cc. for each month.

(35) *C. constrictum* Gran. One of the commonest species from July to the end of September with its maximum in May when it suddenly appeared and disappeared. Resting spores noticed commonly in August forming in the chains. At all depths, but the largest numbers nearly always at the surface.

(36) *C. Willei* Gran. Rare from June to October.

(37) *C. breve* Schütt. Rare in August. This is recorded often by Gough.

(38) *C. laciniosum* Schütt. Occasionally from June to October.

(39) *C. diadema* (Ehr.). Only seen once in August.

(40) *C. pseudocrinitum* Ostenf. Common in May and June, at other times rare. At all depths.

(41) *C. curvisetum* Cleve. The commonest species of *Chætoceras*: beginning in March it continues throughout the summer till the middle of September. Maximum of 37 per cc. at the end of May. This is certainly the most important species of *Chætoceras* here and helps greatly to swell the diatom maximum both in May and August. Largest number at the surface, although it occurs at all depths.

(42) *C. debile* Cleve. Not very common, May and June.

(43) *Chætoceras* spp. Species which could not be identified were common in July and August.

(44) *Eucampia zoodiacus* Ehr. Occasionally from May to October.

(45) *Streptotheca thamensis* Shrubs. Common from September to April, otherwise rarely seen. More frequent in tow nettings than in water samples.

(46) *Cerataulina Bergoni* H. Perag. Fairly common in May and June.

Genus BIDDULPHIA Gray.

The *Biddulphia* species are practically confined to the autumn, winter and early spring, being almost entirely absent in the summer. This agrees fairly well with the Port Erin records, although there, in small numbers only, they are found in the summer. At any rate they may be regarded as winter, or early spring, and autumn forms. *B. mobiliensis, regia* and *sinensis* are all common in the early spring, winter and autumn. Whether *B. regia* and *sinensis* should be regarded as good species is a matter discussed at length by Herdman (1912), who has shown that intermediate forms are to be found and has figured forms from Port Erin which appear to be half *B. sinensis* and half *B. regia* or *mobiliensis*, his final decision being that they are probably all the same species. He therefore regards *B. sinensis* and *B. regia* as distinct forms of *B. mobiliensis*. There seems to be no doubt about the sudden appearance of the exotic species *B. sinensis* in numbers at Port Erin in November, 1909, and also that it suddenly appeared at the mouth of the Elbe in 1903, as is shown by Ostenfeld (1908): having spread from the mouth of the Elbe into various places including the North-East of Scotland it was then found on the Belgian coast, Ostenfeld accounting for its presence there by imagining a reversal of the usual north-going current. Its first appearance at the mouth of the Elbe Ostenfeld thinks is probably due to its being taken there by some ship. In 1908 he predicted its discovery in the Channel, as up to that time it had not been found to occur there. In order to ascertain whether it was present in Plymouth in former years (it certainly is common here now) I examined a large number of old tow nettings mostly from the West Channel, Plymouth, and all from this district. Beginning in 1897 I searched through samples of various dates, particularly autumn, winter and spring, without finding any trace of *B. sinensis* until October, 1909, when it suddenly became abundant and continued so within the limits of its seasonal range as is shown in these records until the present time. It is very distinct and easily recognised and I find it hard to believe it is not a true species distinct from *mobiliensis* and *regia*. It occurs with them and is easily distinguished from them, and this year continues to stay longer than the others. The fact also, quoted by Herdman, that Dr. Allen and Mr. Nelson grew cultures of all three forms, which bred true for a year is strong evidence in favour of their being separate species. In some samples taken by Dr. Garstang in 1897 *P. mobiliensis* and *regia* were common,

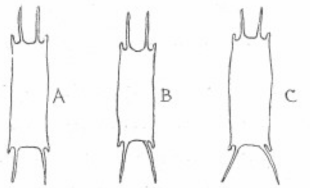

FIG. 6.—Varieties of *Biddulphia regia*. × 60.

and amongst these I found an occasional specimen which showed an approach *to sinensis*.

The figures (Fig. 6) were drawn with the camera lucida, and are very like some of Herdman's figures. Although, however, one end is decidedly like *sinensis* and the cell is elongated (probably soon going to divide), I think these are varieties of *regia* only and not true *sinensis* species. It seems from this that occasionally *B. regia* can show varieties approaching *B. sinensis* and perhaps this is the explanation of Herdman's mixed forms. If this explanation be correct we thus find *B. sinensis* appearing at Plymouth suddenly in October, 1909, and at Port Erin in November of the same year. The difficulty as to its origin is still a puzzle.

(47) *Biddulphia mobiliensis* (Bail.) Grun. Begins to be abundant in the middle of November, keeping up its numbers until the end of March, is scarce in April, finally disappearing at the end of the month, not to reappear until the middle of August and then only singly.

(48) *B. regia* M. Schulze. Much the same as *B. mobiliensis* but not quite so abundant and disappears earlier.

(49) *B. sinensis* Grev. Not so abundant as the other two but fairly common, continues until the end of May.

(50) *B. favus* (Ehr.) v. Heurck. Rare, February and April.

(51) *B. alternans* (Bail.) v. Heurck. Rare, October and early spring.

(52) *Bellerochia malleus* (Brightw.) v. Heurck. Rare, September.

(53) *Lithodesmium undulatum* Ehr. Common from August to October, rare at other times.

(54) *Ditylium Brightwelli* (West) Grun. Appears and disappears periodically from January to September. In March and September very common in the tow nets.

(55) *Fragillaria* sp. Sometimes present in long strings in summer.

(56) *Thalassiothrix nitzschioides* Grun. Common from September to the end of April. A winter species In summer rare or entirely absent.

(57) *Asterionella japonica* Cleve. Important in the late summer. Occurs in single groups rarely at intervals from October to the end of June, then suddenly becomes very common in July, rising to over 478 per cc. at the end of the month, abundant in August and gradually dwindles through September. Present in the tow nettings as well as the water samples. This seems to be erratic in its appearance as Gough records it as cc. in April and May (as *A. glacialis*). The largest numbers occur at 5 and 7 fathoms, maximum at 5 fathoms.

(58) *A. Bleakeleyi* W. Smith. Only occurred twice, November and December.

(59) *Lycmophora Lynbergi* (Kütz) Grun. Rare, at intervals through the year.

(60) *Grammatophora serpentina* Ehr. A littoral species, rare.

(61) *Acnanthes longipes* Ag. Rare, in tow nettings, autumn and early spring.

(62) *Navicula membranacea* Cleve. Fairly common from July to November.

(63) *N.* sp. Many species of *Navicula* occurred through the year which were not identified.

(64) *Pleurosigma* sp. Several species occurred through the year.

(65) *Mastigloia* sp. Occurred at intervals in such numbers as to materially influence the records. The large numbers are always at the surface, although in July and August it occurs at all depths.

(66) *Amphiprora maxima* Greg. Rare, chiefly in autumn and winter.

(67) *Amphora ostracaria* Breb. Rare, only in autumn.

(68) *A.* sp. Rare, September and August.

Genus Nitzschia Hassal.

The species of *Nitzschia* occur throughout the year and, unless entangled in larger organisms, get through the nets in numbers. In *Phæocystis*, *Nitzschia* species entangle themselves to a large extent, chiefly *N. closterium* and a needle-like species which I believe to be *N. delicatissima*. However, when it is entangled it is generally single or there are two together. It is never in a chain or three or five as is often the case with this species when it is free. When not entangled it is not so common.

Fig. 7.—*Nitzschia closterium* W. Sm. Long and short forms. × 350.

(69) *Nitzschia closterium* W. Sm. Occurs throughout the year. Never in very large numbers. Two forms are seen (Fig. 7), the long form with its ends curled slightly and a much smaller form with straight ends. Possibly the latter is the young just after division. In cultures the central part is very often much inflated. At all depths.

(70) *N. seriata* Cleve. Fairly abundant in August and September, rare at other times.

(71) *N. delicatissima* Cleve. In May and June this species plays an important part in the plankton. From July to the middle of September it is fairly common, after that occurring only occasionally. At all depths but largest numbers at 5 and 7 fathoms.

(72) *N. panduriformis* Grev. Very rare, September and October.

(73) *Bacillaria paradoxa* Gmel. Never in large numbers, but occurs throughout the year both in water samples and tow nettings. Almost absent in May and early June.

(74) *Campylodiscus* sp. At least four species of *Campylodiscus* occur in the tow nettings occasionally. Also *Surrirella fastuosa* Ehr. is fairly common. All these are bottom forms and do not strictly belong to the plankton.

THE PERIDINIALES.

In the microplankton the group of Peridiniales comes next to the diatoms in importance. A very large number of these go through the finest net, and practically all the smaller forms including almost the whole of the *Gymnodiniaceæ* are lost. Former tow-net records show hardly any of these. *Ceratium* and the larger *Peridinium* species have been shown to be plentiful, but there is a very marked absence of the smaller

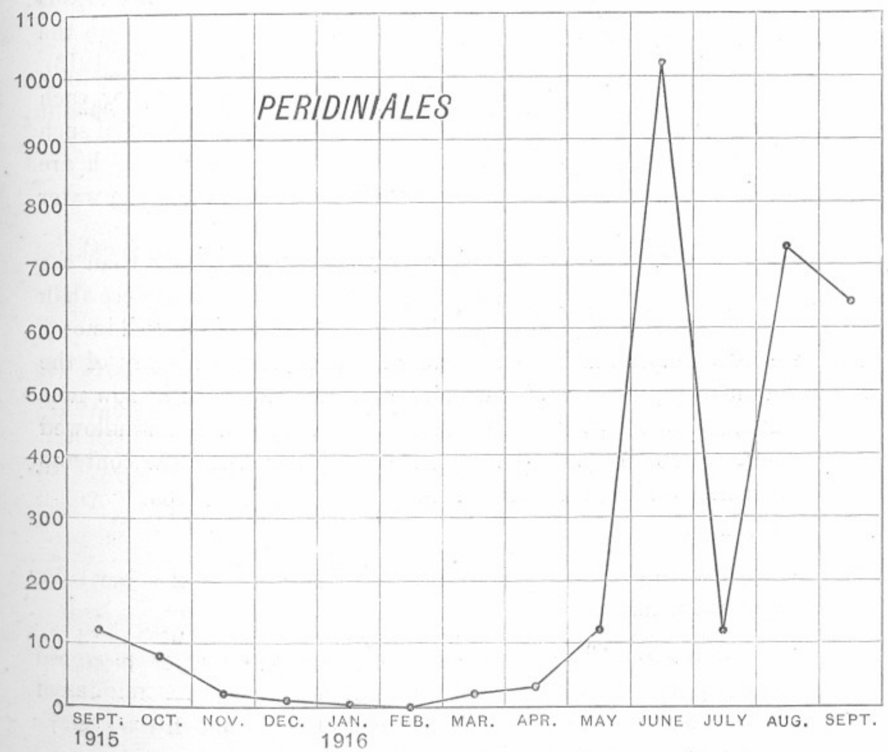

Fig. 8.—Curve showing the average number of Peridiniales in 1000 cc. for each month.

forms. This is perhaps the group which shows the loss from the net to the greatest degree. Because of the number of new species and new records of this group I have given the systematic details in a separate paper of this journal (p. 183). Lohmann has described many new forms from the microplankton, and several of these are found to occur here. In most cases his numbers are much greater than mine ; also the numbers given in Prof. Herdman's records for Port Erin are very large, but the different methods employed make the two records hardly comparable. Probably many of the more delicate forms are lost, but the relative seasonal abundance is well shown by the curve (Fig. 8) which shows June as the maximum month, thus agreeing with other observers. In this curve there is a depression in July which may be due to the fact that most of the samples were preserved in that month, rather than to the fact that the numbers are much less than in August. From September the curve falls and is very low until May, showing an almost complete absence of Peridiniales in the winter. Even if some of the individuals are lost the results show well the relative abundance of the species. *Prorocentrum micans* which is largely lost in the tow nettings is one of the few which has an autumn maximum, thus agreeing with the observations of other workers (Lohmann, 1908; Ostenfeld, 1913). Table 2 shows the average number of Peridiniales per cc. for each month. These numbers possibly do not show the real abundance of such large forms as *Ceratium* and the larger *Peridinium* species, which are often very common in the tow nettings when there are few in the water samples.

The 5-fathom samples are found to be richer in specimens than the 7-fathom samples. Usually they are more abundant at the surface than at 5 fathoms, but the species all occur in all the depths. It is well known that the Peridiniales form a large portion of the food of many of the plankton animals. *Actinotrocha* which sometimes occurs in the tow nets is a good instance of this, and the species which have just been swallowed can nearly always be identified. The following list shows the contents of five specimens taken June 25th, 1915 :—

Specimen.	1	2	3	4	5
Peridinium ovatum . .	1	1	1	2	1
,, pallidum . .	3	—	—	—	—
,, pellucidum . .	—	1	2	9	2
,, sp. . . .	5	—	—	—	—
,, sp. Juv. . .	3	—	—	—	—
Pouchetia armata . .	—	2	—	1	2
Dinophysis acuminata . .	—	2	—	—	—
Other organisms . . .	—	1	—	5	—

FLAGELLATA.

"Nordisches Plankton," Vol. 2.

Phæocystis is certainly by far the most important of the flagellates, which interferes enormously with the catches by blocking up the tow nets in the early summer and entangles in its gelatinous covering many diatoms and Peridiniales. It also serves as food for many of the plankton organisms. I have recorded this species by colonies instead of cells, as it was practically impossible to count the latter.

Halosphæra viridis comes next in importance, its swarm spores occurring oftener in the water samples than the spheres themselves. The other flagellates occur sparingly but belong to the genera recorded by others from plankton and are almost entirely missed by the nets.

Oxyrrhis marina I have placed with the Peridiniales; this species and a small species of *Carteria*, although not often found in the water samples, multiply freely in cultures where they are often found. The numbers obtained for flagellates, with the exception of *Phæocystis*, are much smaller than Lohmann's.

(1) *Phæocystis Pouchetii* (Hariot) Lagerheim. Begins to be common in the middle of May and continues till the middle of June, interfering with all the tow nettings. Rare at other times. Not many colonies get into the water samples. The unidentified flagellates are chiefly swarm spores, probably of *Phæocystis*.

(2) *Dinobryon* sp. (cf. *balticum* (Schütt) Lemm.). Rare in August in the water samples in small colonies. A minute species.

(3) *Carteria* sp. A very small species, rare, in water samples only.

(4) *Trochiscia Clevei* Lemm. Rare, September and May.

(5) *Halosphæra viridis* Schmitz. Not uncommon from September to February. Very frequent in summer, especially the swarm spores, usually swimming freely but sometimes still in the parent sphere.

COCOSPHAERALES.

"Nordisches Plankton," Vol. 2.

Pontosphæra Huxleyi Lohmann. This is the only species found. It occurs occasionally in summer and in early autumn is sometimes abundant.

Coccoliths of other species are very rarely seen.

SILICOFLAGELLATA.

"Nordisches Plankton," Vol. 2.

The usual two species occur fairly commonly in the water samples.

(1) *Dictyocha fibula* Ehr. From September to December and from March to September. Commonest in September.

(2) *Distephanus speculum* (Ehr.) Haeckel. Throughout the year, except in mid-winter, rather more abundant than *Dictyocha*. Commonest in September and October.

RHIZOPODA.

Amœbæ, as Lohmann has pointed out, are not uncommon in the plankton. He records two forms, the largest number being 75,000 in 100 litres, but usually much less. He found July and August were the months in which they occur, and they were only found in depths of 5 and 10 m. I find them from May to October, the greatest number being 140 in a litre. However, I have seen them much commoner than this in surface samples in 1915 when they were not counted. They occur in the surface water and also from 5 and 7 fathoms, the greatest number being from the surface. They are to be found either by examining the water directly or keeping it for a day or two, and, I think, there is no doubt that they are really free-living and do not come from harbouring in other animals. Three forms occur, one very much more common than the others. I have designated them A, B and C. B is very common, A and C only occurred once each. A prominent feature of all is the form of the pseudopodia, which are all spiky when fully outstretched and in the forms A and B give the animal the appearance of a heliozoon. However, they were constantly observed to retract and were in reality perfectly soft although apparently firm.

Form A (Fig. 9, A, 1, 2 and 3), a very minute species, pale greenish brown with very long and exceedingly slender spine-like pseudopodia. Greenish and brown granules inside. Circular even when the pseudopodia are retracted.

Form B (Fig. 9, B, 1, 2 and 3). Very common, larger than A, hyaline and perfectly colourless. Perhaps this is the same species as Lohmann's No. 2. The pseudopodia stick out in regular spikes, much shorter and thicker than in A. These move in various ways and can be completely retracted. May to October. Maximum in May.

Form C (Fig. 9, C, 1, 2 and 3). A very clear and also perfectly colourless form with a conspicuous central nucleus. At one end only is a small frill of spiky pseudopodia. These are usually in the same position, but are capable of being changed and appearing in another place.

All these Amœbæ are entirely lost by the nets.

Heliozoa indet. Rare, only in November.

Foraminifera indet., including *Polystomella* sp., occurred fairly frequently in the tow nets, especially in winter when they were stirred up from the bottom.

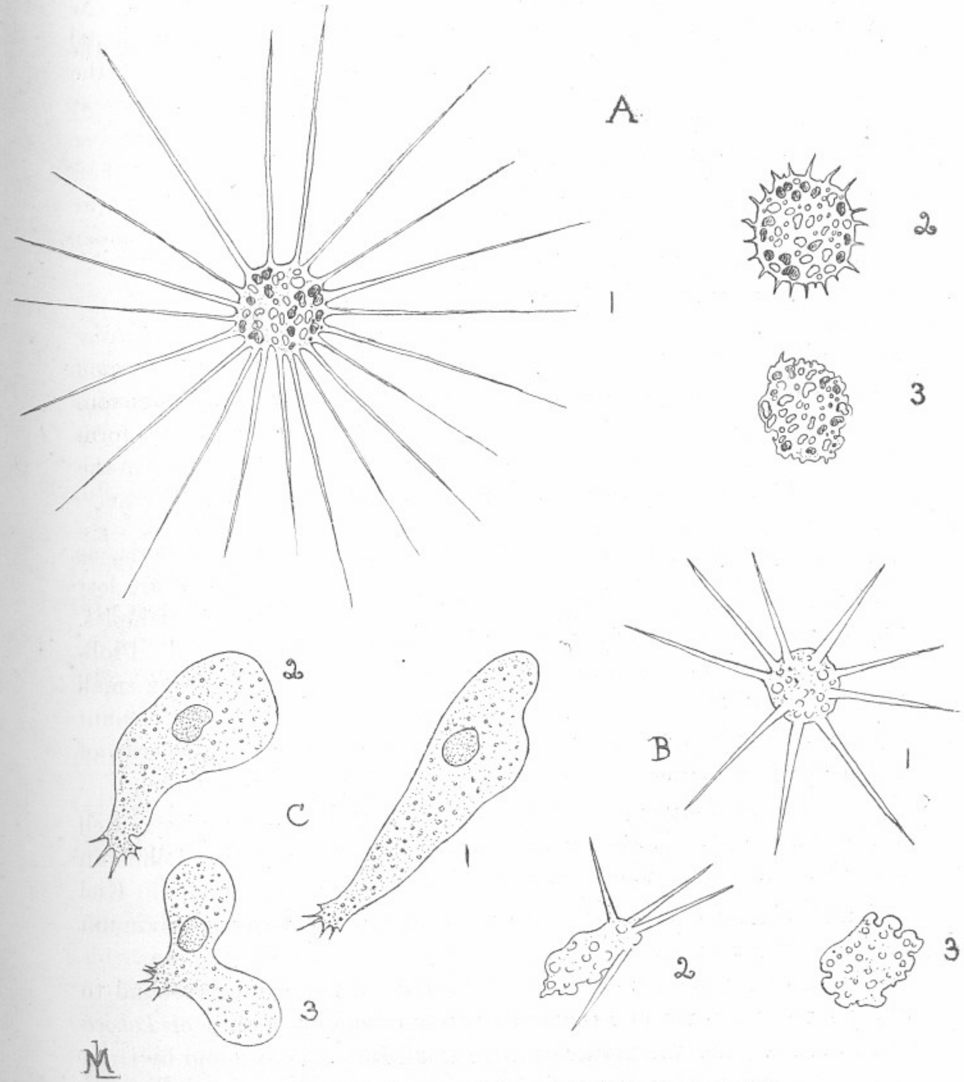

FIG. 9.—Amœbæ from the plankton. A × 500, B and C × 350.

RADIOLARIA.

"Nordisches Plankton," Vols. 3 and 17.

(1) *Acanthochiasma fusiforme* Haeckel. At intervals throughout the year, sometimes abundant in June and October.

(2) *Lithomelissa setosa* Jörg. Rare, November and December.

(3) *Amphimelissa setosa* Cleve. Rare, October to May.

SUCTORIA.

"Nordisches Plankton," Vol. 16.

(1) *Paracineta limbata* Maup. Rare, November to January.

(2) *Acenita tuberosa* Ehr. v. *Fraiponti* (Fr.). Only once in October.

(3) *Ephelota crustaceorum* Haller. Once in November on the legs of a Copepod.

INFUSORIA.

"Nordisches Plankton," Vol. 15.

The Tintinnoidea are much the most abundant of the Infusoria, as Lohmann found. However, a large number of small Infusoria are lost completely by the nets, and these are fairly common in the water samples. Many of them are exceedingly fragile and very easily destroyed. Probably many of them are lost. Among those commonly found is a small species of *Mesodinium* allied to *M. pulex*, which is very difficult to count as it jumps about and collapses before it can be preserved. Species of *Laboea* are also common. Others unidentified are many and varied.

Tintinnopsis ventricosa which is common in the water samples as well as the tow nettings has a maximum of 300 in a litre in June Lohmann found its maximum was 8800 in 100 litres. However, *T. beroidea* at Kiel had a maximum of 1,200,000 per 100 litres, while here its maximum number was 460 in a litre.

Several of the species originally described by Lohmann are found to occur here and some of Leegaard's newly described species of *Laboea* and its allies. The abundance of these small Infusoria as found by Gran from the Dutch waters does not agree with our records.

(1) *Lachymaria* sp. Only occurred once, water samples, May.

(2) *Coleps* sp. A small species shaped like a flower-pot with square ends, water samples, rare, August.

(3) *Tiarina fusus* Cl. and L. Fairly common in August and September, rare in July and October, chiefly in water samples.

(4) *Mesodinium* sp. Common in water samples.

(5) *Nassula* sp. Rare from May to August, water samples.

(6) *Strombidium caudatum* From. Rare in summer, water samples.

Genus LABOEA Lohmann.

The species of this genus, so far as I have seen, all have a yellow colour. They are common in the summer but occur all through the year although very rare in winter. Some of the most delicate of the Infusoria. Never found in the tow nettings.

(7) *Laboea conica* Lohm. The commonest species of the genus. Occurs fairly often through the summer, but never in large numbers.

(8) *L. strobila* Lohm. Occasionally from July to November and also in January.

(9) *L. acuminata* Leegaard. Occasionally through the year, chiefly in May.

(10) *L. spiralis* Leegaard. Rare, May and July.

(11) *L.* sp. All through the year several unidentified species occurred, except for part of December and January.

(12) *Lohmanniella oviformis* Leegaard. Rare, only in August, water samples.

(13) *Euplotes vannus* O.F.M. Once only in July, water samples.

(14) *E.* sp. Rare, September, water samples.

(15) *Tintinnus subulatus* Ehr. From July to October, not uncommon, most frequent in August.

(16) *Tintinnopsis beroidea* (Stein). Very common, both in tow nettings and water samples, but especially in the former early in November, middle of December, end of March and again through July and August; at other times not so frequent. Almost absent through October and the latter part of September.

(17) *T. campanula* (Ehr.). Occasionally at intervals from August to March, not observed from April to July. Both in tow nettings and water samples.

(18) *T. ventricosa* Cl. and L. Common at intervals throughout the year. Commonest in September. In both tow nettings and water samples, but commonest in the water samples.

(19) *Cittarocyclis denticulata* Ehr. Occasionally from August to October. This species is abundant close to the shore.

(20) *C. edentata* Brendt. Once only in October, water samples.

(21) Infusoria indet. Chiefly in the summer and early autumn in numbers.

THE METAZOA.

The Metazoa in the water samples being negligible the following is an account of the tow nettings examined as described above through the same period as the water samples and from the same locality.

CŒLENTERATA.

The medusæ are chiefly confined to the coarse and medium tow nets. Beginning at the end of January with *Phialidium hemisphericum* they continue for the rest of the year until nearly the end of November when they are absent for the winter. Ctenophores and Siphonophores represented chiefly by *Pleurobrachia pileus* and *Muggiœa atlantica* are common in the summer, although *Pleurobrachia* was not so numerous as usual this year, possibly owing to the April storms and the coldness of May and June.

The medusæ are specially interesting because they carry other animals parasitically and thus serve as effective transports. Those chiefly so utilised are *Cosmetira pilosella, Phialidium hemisphericum, Obelia* sp., *Turris pileata* and *Stomotoca dinema*; perhaps the species most frequently so used, and necessarily so as they are the commonest, are *Phialidium hemisphericum* and *Obelia* sp. *Phialidium* serves as host for larval trematodes, larval pycnogonids and larval *Peachia*. *Obelia* has not been noticed as a host for *Peachia* larvæ, probably because it is too heavy to be carried by so small a medusa. *Cosmetira* serves as host for all three, *Turris pileata* and *Stomotoca dinema* for larval trematodes. The trematodes are always the late cercaria stage of *Pharyngora bacillaus* (Molin), which reaches maturity in the mackerel (Lebour, J.M.B.A., 1915). This occupies the manubrium and mesoglœa. It is interesting in this connexion that E. T. Browne (P.Z.S., 1896) notes that a species of cercaria infects the mesoglœa of *Phialidium temporarium* (i.e. *P. hemisphericum*) in Valencia Harbour, and that *Halcampa* (i.e. *Peachia* larva) also selected this medusa, attaching itself to the generative organs. I find that *Halcampa* attaches itself to the medusa margin as well as the inside of the generative organs. The pycnogonid *Anaphia petiolata* Kröyer lives in the larval state tightly folded up in the manubrium of *Phialidium, Obelia* and *Cosmetira* (Lebour, J.M.B.A., 1915).

ANTHOMEDUSÆ.

"The Medusæ of the World," Mayer.

(1) *Steenstrupia rubra* Forbes. Begins in April and is common till the middle of June when it disappears.

(2) *Hybocodon prolifer* L. Ag. Begins at the end of March, is common through April, very common in May up to the middle, then dwindles and disappears in the beginning of June.

(3) *Sarsia prolifera* Forbes. Rare, in June only.

(4) *S. tuberosa* Lesson. Once only in June.

(5) *S. eximia* Allman. Once only in September.

(6) *Slabberia halterata* Forbes. Once only early in September.

(7) *Stomotoca dinema* L. Ag. Begins in July, is common through the month, becomes less common and disappears in November.

(8) *Turris pileata* (Haeckel). Fairly common now and then in June, July and August, rare in September and October.

(9) *Bougainvillia brittanica* Forbes. Once only in June.

(10) *Rathkea octopunctata* Haeckel. Begins in the middle of February, one of the first medusæ to appear, becomes very common in April and the beginning of May, disappears in the middle of June. It, however, reappears in September as a single specimen.

(11) *Willsia stellata* Forbes. Once only at the end of August.

LEPTOMEDUSÆ.

(12) *Obelia* sp. Medusæ extremely abundant. Begins at the end of February, very common from May to October, leaves off at the end of November and is absent through December, January and most of February.

(13) *Cosmetira pilosella* Forbes. Begins in May, very common on and off from June to September.

(14) *Clytia volubilis* Lamouroux. Once only in April.

(15) *Phialidium hemisphericum* (Gron.). Perhaps the commonest of the medusæ here. Begins at the end of January, is common from May to October and continues till the middle of November.

(16) *Saphenia gracilis* Forbes and Goods. Rare in May. On June 14th the nets were full of it and it was abundant once in August.

SEMÆOSTOMEÆ.

(17) *Chysaora* sp. Once in November.

(18) *Aurelia* sp. Ephyræ. One on January 24th. Continues fairly commonly from February to the beginning of April, then stops. One occurred on September 6th.

SIPHONOPHORA.

(19) *Muggiæa atlantica* J. T. Cunn. Once at the end of January, rare in February, but continues till September, when it is very common.

CTENOPHORA.

(20) *Pleurobrachia pileus* Fab. Fairly common, February to July, and from September to November, chiefly young forms.

(21) *Bolina infundibulum* Fab. On June 14th the nets were full of it with *Saphenia gracilis*. In October, 1915, it was fairly common.

(22) *Beroë cucumis* (Fab.). In October and November, 1915, and in May to August, 1916, rare.

ZOANTHARIA.

(23) *Arachnactis Bournei* Fowl. Larva of *Cerianthus Lloydii* Gosse. From March to June, common.

(24) *Peachia* sp. larva (=*Halcampa chrysanthellum* (Peach) of Haddon), common, May and June to the middle of July, on medusæ.

PLATYHELMINTHES.

Amongst these are some interesting larval trematodes which occur in the free state, having been captured probably in the interval of changing hosts. Also two parasitic in medusæ and in *Sagitta*, both of which eventually enter fish as their final host.

(1) *Pharyngora bacillaris* (Molin). What I believe to be the free-swimming tailed cercaria of this species occurred once in fair numbers on January 28th, 1916. It is described in a separate paper (p. 201) of this Journal. The late cercaria without a tail is found parasitic in medusæ and in *Sagitta*, besides being sometimes free in the sea at intervals throughout the year. Commonest in June.

(2) *Derogenes varicus* (O. F. Müll.). Occurs in *Sagitta bipunctata* in the late cercaria stage in June. In old material of previous years it is quite common.

(3) Turbellarian indet. Occurred occasionally in August and November.

NEMATODA.

Unidentified trematodes occurred occasionally free in the autumn and winter; a larval *Ascaris* (described in another paper of this Journal, p. 201) is common in *Sagitta bipunctata*.

ANNELIDA.

E. J. Allen, "Polychæta of Plymouth and the South Devon Coast, etc.," J.M.B.A., 1915.

The annelids with the exception of *Tomopteris* and *Autolytus* are all larval forms.

(1) *Autolytus longiferiens* De St. Joseph. Occurred once at the end of January with eggs, twice with eggs at the beginning of September, and one male.

(2) *A. rubropunctatus* (Grube). Once in September, 1915, twice in November, once in August and twice in September, 1916, always with eggs.

(3) *A. pictus* (Ehlers). Once in September and once in November, 1915. Once in September, 1916, always with eggs.

(4) *A.* sp. These were allied to *A. Edwarsi*, a small species, three with eggs and one male, always in September.

(5) *Polynoë* sp. juv. Once in December and once in the end of March.

(6) Spionid larva, occasionally from November to March. Rarely in May and July.

(7) *Magelona* sp. larva. Fairly common in July and August.

(8) *Pœcilochætus serpens* Allen, larva. Occurred in small numbers every month except December and April. Commonest in May and August.

(9) *Cirratulus* sp. juv. Once only early in March.

(10) Terebellid larva. Present every month, but not usually in large numbers except once in November, then rare till the end of February, when it increases and is very common in May. The houses of the very young larvæ are extremely pretty, the animal using all sorts of small organisms to cover itself, especially

diatoms, but sometimes the case is entirely of sponge spicules. As the worm grows the house becomes transparent and hyaline.

(11) *Pectinaria* sp. larva. Only found rarely in October and December.

(12) Annelid larvæ indet. Occurred occasionally but particularly from January to the end of March when they were at times abundant in very young stages.

(13) *Tomopteris heligolandicus* Greef. Begins in the middle of June and is very common in July, rare in September and October. Young forms chiefly from July to September.

CHÆTOGNATHA.

Sagitta bipunctata (Q. & G.). Present throughout the year, scarce in most of March, April, May and June. Very common most of the rest of the year.

POLYZOA.

Cyphonautes larva. Fairly common from September to the end of March, rare from April to August. Commonest at the end of March.

PHORONOIDEA.

Actinotrocha larva. Only seen in July and September, 1916. More common in 1915.

ROTIFERA.

Synchæta sp. Rare, September, October and March.

CRUSTACEA.

Copepoda.

Sars, G. O., "Crustacea of Norway, Copepoda."

(1) *Calanus finmarchicus* Gunner. Common on and off from the end of April to the beginning of November, generally present in small numbers at other times.

(2) *Paracalanus parvus* Claus. Unusually scarce this year except at certain times. Very common in May, common parts of August, September and October. Very common for part of November, then becomes rare or absent.

(3) *Pseudocalanus elongatus* Boeck. Perhaps the commonest copepod here. Exceedingly common all through the year except from the middle of May to the end of July, when it becomes rarer and is sometimes absent.

(4) *Centropages typicus* Kröyer. Common in September and October, 1915, scarce or absent through the winter, rather more abundant in May, becoming rare again in August.

(5) *C. hamatus* Lillj. Common in September and October, 1915, then absent until August, when it is very common on the 16th.

(6) *Isias clavipes* Boeck. Fairly common in May, rare in June.

(7) *Temora longicornis* Müller. Very common all through the summer and in the middle of February, common in parts of November, but rather rare in winter.

(8) *Anomalocera Patersoni* Templeton. From September to the beginning of November; not common.

(9) *Labidocera Wollastoni* Lubb. Not common, in July.

(10) *Candacia armata* Boeck. Rare through the winter, common in July and September.

(11) *Parapontella brevicornis* Lubb. Common in February and March and occasionally in May, otherwise rare; absent from October to February.

(12) *Acartia clausii* Giesbr. I find this species of *Acartia* the only one present in 1916. It is exceedingly abundant most of the year, very common on and off from May to the beginning of January and very seldom absent altogether.

(13) *Longipedia Scotti* G. O. Sars. Once only in February.

(14) *L. minor* Scott. Once in water samples and once in the tow nets, June.

(15) *Euterpina acutifrons* (Dana). Rare, October to December.

(16) *Idyæa furcata* Baird. Once only in December.

(17) *Amphiascus similis* Claus. Rare, September and October.

(18) *Oithona similis* Claus. More or less common throughout the year except from November to January. Very common in the middle of February and the middle of May.

(19) *O. nana* Grubb. Rare, January to May.

(20) *O. plumifera* Baird. Rare, from February to May, and in September.

(21) *Coryceus anglicus* Lubb. Present most of the year, but rarest in the summer. Through October and November it agrees with *Pseudocalanus* in its abundance, but becomes scarce in December.

(22) *Thaumaleus longispinosus* Brown. Once only in September, 1915, with eggs.

(23) *Caligus rapax* M. Edw. Free in the tow nettings in September, December and March. On one occasion a female with eggs was present ; an unusual occurrence in the free state.

Copepod nauplii are common on and off for most of the year. At the end of January they were very abundant, also at the end of May and beginning of July. *Calanus* and *Temora* are the commonest forms identified.

Cirripedia.

" Nordisches Plankton," Vol. 11.

Balanus nauplii occur in the beginning of February, are very common in the middle of February and continue till the beginning of May, when they dwindle and disappear except for a straggler or two in June. In the end of July they reappear and stay till the beginning of October. Cypris stages begin in the end of April and continue until the end of May, are rarer in June and disappear in July. A few were seen in September and February. The fact that there are two seasons for these larvæ (which is borne out by other Plymouth records) probably means that the July forms are a different species, as at Port Erin only the spring larvæ occur.

Cladocera.

" Nordisches Plankton," Vol. 1.

(1) *Evadne Nordmanni* Lovén. Begins in the end of April and grows very common in May, is common through the summer until the middle of September when it disappears.

(2) *Podon intermedius* Lillj. Very similar in occurrence to *Evadne,* but is more frequent in August and September.

Amphipoda.

Sars, G. O., " Crustacea of Norway, Amphipoda."

(1) *Apherusa bispinosa* (Bate). Occurred once in October and once in January.

(2) *A. Clevii* Sars. A few specimens once in August and twice in June.

(3) *Caprella* sp. Once at the end of August.

Amphipoda indet. Rarely in April and September.

Isopoda.

" Nordisches Plankton," Vol. 14.

(1) *Idotea viridis* (Slabber). Rare in November and March.

(2) *Gnathia maxillaris* (Mont.). Young larva, free, rare, December. Praniza larva once in the middle of May.

(3) *Microniscus* sp. On Copepods, chiefly *Calanus*, *Acartia* and *Pseudocalanus,* from September to December, rare in March, most frequent in September.

(4) *Bopyrina* sp. Rare, January and February.

Cumacea.

Sars, G. O., " Crustacea of Norway, Cumacea."

(1) *Pseudocuma cercaria* (P. G. van Ben). Very rare, September and February.

Schizopoda.

" Nordisches Plankton," Vol. 12.

(1) *Nyctiphanes Couchii* T. Bell. Not common, in the beginning of May only, immature.

(2) *Macropsis Slabberia* Van Ben. Rare, December only.

(3) *Siriella Clausii* G. O. Sars. Once only in October.

(4) *Leptomysis mediterranea* G. O. Sars. Not common, November to January.

Euphausicdæ larvæ. Not common, October, November, March to May and August.

Stomatopoda.

Squilla Desmaresti Risso, larva. Once only in October, 1915.

Macrura.

These are all larval forms ; starting with *Carcinus mœnas* early in January they gradually increase and are very common through the spring and early summer, and although plentiful through August and September, fall off considerably in October, being only represented by stray stragglers through the winter.

(1) *Leander* sp. larva. On and off from May to November. Single specimens at the end of February. Commonest in July.

(2) *Galathea* sp. larva (Sars, G. O., "Bidrag til Kundskaben om Decapodernes Forhandlingar," Arch. Math. Naturw., 13, 1889–90). Begins at the end of January and continues common till May, when it dwindles and disappears in September, commonest in March.

(3) *Eupagurus* sp. larva (Sars, *ibid.*, 1889–90). Very rare at the beginning of January, continues rare through March to the end of April when it is common, continues fairly common till the middle of May, rare from June to October. Older stages occasionally in the summer.

(4) *Hippolyte* sp. larva (Sars, "Account of the Postembryonal Development of Hippolyte varians Leach," Arch. Math., etc., 32, 1911). Common June to September, specially abundant in September, continues into November, and was found twice in December, rare in the spring.

(5) *Crangon vulgaris* L. larvæ (Sars, "Bidrag til Kundskaben om Decapodernes Forhandlingar," Arch. Math., etc., 14, 1890). From February to September, never very common.

(6) *Ægeon fasciatus* Risso, larva (Gurney, R., "The Metamorphoses of the Decapod Crustaceans Ægeon (Crangon) fasciatus, etc.," P.Z.S., Vol. II, 1903). One specimen in January. On and off from May to September.

(7) *Ceraphilus nanus* (Kröyer), larva (Sars, *ibid.*, No. 14). Rare, September and October.

Crangonidæ larvæ indet. Occurred occasionally from June to October.

Other Macruran larvæ indet. chiefly allied to *Hippolyte*, common in July and August.

(8) *Jaxea noctiana, Trachilifer* larva (Bouvier, J.M.B.A., X, N.S., 1913). Occurred once on August 16th, 1916. Unusual to find it so far inland.

Brachyura.

(9) *Porcellana* sp. zoea (Sars, *ibid.*, 13). One specimen on March 23rd, then begins at the end of April and in June and July is very common, continues till the middle of October.

(10) *Eurynome aspera* (Penn.) zoea (Cano, G., "Sviluppo œ Morphologia degli Oxyrhynchi," Mitt. Zool. Stat. Neapel, X, 1893). Rare, March and July.

(11) *Cancer pagurus* L. zoea (Pearson, J., "Memoir on Cancer the Edible Crab," 16th Lancs Sea Fish. Lab. Rep. for 1907). From the middle of January to March, common.

(12) *Portunus* sp. zoea (Williamson, C. H., "Report on Larval and Later Stages of Certain Decapod Crustacea," 28th Ann. Rep. Fish. Board Scotland, 1907). Many species, begin early in March, become very common in April and continue till September, less common from October to November, after which they disappear.

(13) *Carcinus mœnas* Leach zoea (Williamson, C. H., "On the Larval and Early Young Stages and Rate of Growth of the Shore Crab" (Carcinus mœnas Leach) 21st Ann. Rep. of Fish. Board for Scotland, 1903). The first of the Brachyura larvæ to appear, arrives early in January, is specially abundant in February and continues till May, after that very scarce.

(14) *Corystes cassivelaunus* (Penn.) zoea (Gurney, R., "The Metamorphosis of Corystes cassivelaunus (Penn.)," Q.J.M.S., 1903). From the middle of February to July, fairly common, rare in September.

Brachyura zoea indet. With a long spine like Corystes fairly common in September.

Megalopa indet. Scarce, from May to November.

PYCNOGONIDA.

Norman, A. M., "The Podosomata (=Pycnogonida) of the Temperate, Atlantic and Arctic Oceans," J. of the Linn. Soc. Zool., Vol. XXX.

(1) *Anaphia petiolata* (Kröyer) juv. In June, September and October free, with the hind legs not fully developed. In the larval stage living in medusæ common from July to September.

(2) *Pallene brevirostris* Johnston. Occurred once at the end of October.

Mollusca.

Polycera quadrilineata (Müll.). Once only in September, 1915.

Larval *Gasteropoda*. On and off nearly all the year, commonest in July. Rare in mid-winter.

Larval *Lamellibranchiata*. On and off, not very common for most of the year. Commonest in September, rare in winter.

Limacina balea Müller *retroversa* (Flemm.). Common in the middle of September, 1915. Occurred occasionally from July to October. Common once in August, 1916.

ECHINODERMATA.

Holothurian juv. Rare in December and January.

Ophiopluteus. Begins in March, very common towards the end of the month, dwindles in April and disappears in May. Occurs again in August and September, common in September.

Echinopluteus. A few occurred once in the middle of November, 1915, begins in May, not common. Very common at intervals in July and August.

Auricularia. Rare, January and February.

Very young Echinoderm larvæ in March.

TUNICATA.

Oikopleura dioica Fol. Common from February to May and from August to September, otherwise not very common and occurring at intervals. Commonest in early April and early August.

Appendicularian indet. Rare in August till November, and in February.

Fish eggs and young fish were occasionally present.

A Survey of the Plankton in each month both from water samples and tow nets.

1915. *September* (21st to 30th).

Winds mainly S. and S.E. Weather fairly fine. Shows both groups of diatoms. *Coscinodiscus* species, *Biddulphia mobiliensis* and *regia* beginning, *Rhizosolenia* which is almost at the end of its season not common except *R. Stolterfothii*, which is still abundant. *Skeletonema*, *Chætoceras constrictum* and *Asterionella* common, *Paralia* fairly common. Very few Peridiniales except *Prorocentrum micans* which is near its maximum and *Ceratium fusus*. Of the other unicellular groups *Laboea* species occur in small numbers, *Tintinnopsis ventricosa* is abundant and *Pontosphæra Huxleyi* occurs singly several times.

Of the Cœlenterates *Phialidium hemisphericum* and *Obelia* medusæ with young *Pleurobrachia* are common, but no other species. Amongst the Annelids *Autolytus longiferiens* and *rubropunctatus* occur singly with eggs and a few larvæ of various kinds are present. *Sagitta* is very common, *Cyphonautes* present but not abundant.

Many copepods occur, *Acartia*, *Calanus* and *Pseudocalanus* are the commonest, also common are *Centropages typicus* and *hamatus* and *Temora* and *Coryceus* is common at the end of the month. Brachyura zoeæ and the larva of *Hippolyte* are common, *Porcellana* zoeæ and *Podon intermedius* are common in the middle of the month and dwindle or disappear at the end. *Limacina balea* f. *retroversa* was common once in the middle of the month.

Chief forms—*Asterionella japonica*, *Chætoceras constrictum*, *Rhizosolenia Stolterfothii*, *Skeletonema costatum*, *Prorocentrum micans*, *Phialidium hemisphericum*, Obelia sp., *Sagitta bipunctata*, *Calanus finmarchicus*, *Pseudocalanus elongatus*, *Acartia Clausii*, *Centropages typicus*, Brachyura zoeæ and *Hippolyte* larvæ.

October.

S.E. winds prevalent. Chiefly fine weather. *Asterionella* common until the middle, then dwindles and disappears. *Biddulphia* species not yet common. *Chætoceras* species common at the beginning and fall off in numbers towards the end, *Lithodesmium undulatum* common until the middle, *Mastigloia* sp. very abundant from the middle to the end of the month.

Nitzschia closterium common. *Paralia* on the increase. *Rhizosolenia Stolterfothii* common at the beginning but absent at the end, *Skeletonema* common and *Streptotheca thamensis* present with it nearly all the month. Of the Peridiniales *Ceratium bucephalum* is fairly common, *C. fusus* present in small numbers, *Prorocentrum micans* continually present, *Peridinium divergens* sometimes fairly common.

Laboea species still present in small numbers, and *Tintinnopsis ventricosa*, *Pontosphæra* more frequent, very common at the end of the month. Of the Cœlenterates *Stomotoca dinema* and *Turris pileata* occur although only *Phialidium hemisphericum* and *Turris pileata* are common. Besides *Pleurobrachia* which is sometimes common, *Beroë* and *Bolina* both occur. Annelid larvæ rare. *Sagitta* very common, *Cyphonautes* continues but is rare.

Of the copepods *Calanus* is still common, but *Pseudocalanus*, *Temora* and *Acartia* are the commonest ; *Coryceus* is also very common and seems to follow *Pseudocalanus* closely in numbers, *Centropages typicus* and *hamatus* fall oft in numbers. All the larval Crustacea are much less numerous.

Chief forms—*Asterionella japonica*, *Chætoceras constrictum*, *convolutum* and *densum* at the beginning, *Mastigloia* sp. from the middle of the month, *Nitzschia closterium*, *Skeletonema costatum*, *Ceratium bucephalum*, *Prorocentrum micans*, *Phialidium hemisphericum*, *Obelia* sp., *Sagitta bipunctata*, *Calanus finmarchicus*, *Temora longicornis*, *Pseudocalanus elongatus*, *Coryceus anglicus* and *Acartia Clausii*.

November.

N.E. winds prevalent. Mostly cold.

Asterionella much reduced in numbers. *Biddulphia mobiliensis* and *regia* both come on and are very common from the middle to the end of the month. *Chætoceras* species greatly reduced, almost disappearing. *Guinardia* common towards the end of the month, also *Hyalodiscus stelliger*, *Mastigloia* sp. in large numbers at the beginning, absent after the 8th. *Paralia* becomes abundant, *Skeletonema* very common with *Streptotheca* common also. *Ceratium bucephalum* and *Prorocentrum micans* much scarcer, the latter absent altogether at the end of the month. *Tintinnopsis beroidea* very common at times through the month. Hardly any cœlenterates except *Phialidium* and *Obelia*, and these disappear at the end of the month. *Autolytus pictus* and *rubropunctatus* appear with eggs. *Sagitta* very common, copepods abundant, *Calanus* becoming scarce, *Centropages* almost absent, *Paracalanus* common, *Acartia*, *Pseudocalanus* and *Coryceus* very common. Crustacea larvæ practically absent.

Chief forms—*Biddulphia* species, *Guinardia flaccida*, *Hyalodiscus stelliger*, *Mastigloia* sp., *Paralia sulcata*, *Skeletonema costatum*, *Streptotheca thamensis*, *Tintinnopsis beroidea*, *Sagitta bipunctata*, *Paracalanus parvus*. *Pseudocalanus elongatus*, *Acartia Clausii* and *Coryceus anglicus*.

December.

S.W. winds prevalent. A good deal of overcast and showery weather.

Biddulphia mobiliensis very common, *regia* not so common, *sinensis* rare. *Chætoceras* almost absent, *Coscinodiscus* species begin to be common, especially *C. excentricus*, *Rhizosolenia Stolterfothii* which has been dwindling in numbers disappears at the end of the month. *Skeletonema* common early, rare at the end of the month. All Peridiniales rare. *Tintinnopsis beroidea* common till the middle of the month. Copepods scarce except *Pseudocalanus* and *Acartia*, *Calanus* rare and absent for a large part of the month.

Chief forms—*Biddulphia mobiliensis*, *Coscinodiscus excentricus*, *Skeletonema costatum*, *Tintinnopsis beroidea*, *Sagitta bipunctata*, *Pseudocalanus elongatus* and *Acartia Clausii*.

1916. *January.*

Nearly all S. and S.W. winds. Weather mostly fine.

Biddulphia mobiliensis and *regia* common. *Coscinodiscus excentricus* common, *Paralia* common, *Skeletonema* rare until the end of the month

when it becomes common again. *Streptotheca* following it in much the same abundance, *Thalassiothrix* common at the end of the month. Peridiniales practically absent. One specimen of *Muggiæa atlantica* at the end of the month, one *Aurelia* ephyra on the 24th. *Sagitta* very common. Copepods rare except *Pseudocalanus*, nauplius stages increase and are very common at the end of the month, zoea stage of *Carcinus mœnas* and *Cancer pagurus* begins in the middle of the month. *Galathea* larva begins at the end. Young fish and fish eggs present.

Chief forms—*Biddulphia mobiliensis* and *regia*, *Coscinodiscus excentricus*, *Paralia sulcata*, *Sagitta bipunctata*, *Pseudocalanus elongatus*, copepod nauplii, Brachyura zoeæ and *Galathea* larvæ in the second half of the month.

February.

S. and S.W. winds at the beginning, N.E. at the end. Stormy weather mostly till the end of the month.

Biddulphia mobiliensis and *regia* common, *sinensis* more frequent. *Chætoceras* begins again at the end of the month, *C. curvisetum*, *convolutum* and *teres* common. *Coscinodiscus excentricus* common, *radiatus* fairly common. *Paralia* common, *Skeletonema* and *Streptotheca* very common. *Thalassiothrix* common at the end of the month. Practically no Peridiniales. Single specimens of *Phialidium* and *Obelia*. *Rathkea octopunctata* becomes common at the end of the month. Ephyræ of *Aurelia* present on the 10th and increase at the end of the month. *Pleurobrachia* and *Muggiæa* present. *Sagitta* not so common, Terebellid, larvæ fairly common, *Cyphonautes* larvæ fairly common on the 10th.

Copepods common up to the 17th, then scarce, probably owing to the N.E. winds coming on. *Calanus* rare, *Temora* and *Oithona similis* very common on the 17th, *Pseudocalanus* common all the month. *Parapontella brevicornis* at the latter end, *Carcinus mœnas* zoea very common. *Galathea* larva common, *Crangon vulgaris* larva fairly frequent. *Corystes* zoea begins and *Levander*. Copepod nauplii fairly common and *Balanus* nauplii very common, beginning on the 5th. *Oikopleura dioica* fairly common.

Chief forms—*Biddulphia mobiliensis* and *regia*, *Coscinodiscus excentricus* and *radiatus*, *Paralia sulcata*, *Skeletonema costatum*, *Streptotheca thamensis*, *Temora longicornis*, *Oithona similis*, *Carcinus mœnas* zoea, *Galathea* larva, *Balanus* nauplius and *Oikopleura dioica*.

Here we find a rush of larval Crustacea especially towards the end of the month.

March.

Prevailing winds N.E. and N. with S.W. in the middle and end. Weather usually cold.

Biddulphia mobiliensis very common, *regia* not so common, *sinensis* increasing. *Chætoceras curvisetum* very common, *teres* and *convolutum* common. *Coscinodiscus excentricus* common, *radiatus* not so common. *Ditylium Brightwelli* common at times, *Rhizosolenia Shrubsolei* begins to be abundant in the middle and is very common in the end, *Paralia* fairly common through the month, *Skeletonema* and *Streptotheca* very common, *Thalassiosira gravida* begins to be fairly common in the middle and becomes very common at the end, the same with *Thalassiothrix*. *Tintinnopsis beroidea* is very common at the end of the month. A few *Phialidium* and *Obelia* medusæ present. *Rathkea octopunctata* occurs the whole month, getting common towards the end. *Hybocodon prolifer* begins in the middle and gets common towards the end. Terebellid larvæ are common through the month. *Poecilochætus* larva rare, *Sagitta* occurs all through the month but is not common. *Cyphonautes* very common at the end of the month.

Copepods not very abundant except *Pseudocalanus*, which is very common, *Calanus* rare but present throughout the month, *Acartia*, *Temora* and *Parapontella* fairly common, *Carcinus mænas* zoea common at the beginning but absent towards the end, *Portunus* sp. zoea begins. *Corystes* zoea occurs through the month but is not common, *Galathea* larva common at the beginning, rare towards the end, *Crangon vulgaris* larva through the month but not common. Copepod nauplii increase at the end of the month. *Balanus* nauplii very common all through the month. Larval Gasteropoda all through the month, common at the end. Larval Lamellibranchiata not so common. *Ophiopluteus* larvæ through the month, common at the end, *Auricularia* larva present once at the beginning. *Oikopleura* fairly common through the month. Young fish rare, fish eggs fairly common.

Chief forms—*Biddulphia mobiliensis*, *Chætoceras curvisetum*, *teres* and *convolutum*, *Coscinodiscus excentricus*, *Skeletonema costatum*, *Streptotheca thamensis*, *Rathkea octopunctata*, Terebellid larvæ, *Pseudocalanus elongatus*, *Balanus* nauplius, *Ophiopluteus* larvæ and *Oikopleura dioica*.

April.

Winds N., E. and S. South at the end. Between 10th and 25th so strong that no samples were taken, after that S. wind and abundant plankton. All calm many days when the samples were taken after the storms.

Biddulphia mobiliensis not so common, *regia* rare, *sinensis* more common, *Lauderia* common, *Nitzschia delicatissima* common at the end, *Skeletonema* very common, *Streptotheca* very common at the beginning, rare at the end, *Thalassiosira gravida* common. *Ceratium fusus*, *Peridinium* spp. and *Prorocentrum* not very common but occur throughout the month. *Phæocystis* very common at the end. *Phialidium* and *Obelia* become common at the end of the month, *Steenstrupia rubra* and *Clytia volubilis* occur rarely, *Rathkea octopunctata* very common, *Arachnactis*, *Muggiæa* and *Hybocodon* occur through the month but not commonly except *Hybocodon* at the end of the month. Terebellid larvæ fairly common, *Sagitta* rare.

Calanus very common at the end of the month, *Temora and Pseudocalanus* very common. *Portunus* sp. zoea very common, copepod nauplius and *Balanus* nauplius very common. Cypris stage of *Balanus* begins at the end of the month. Young fish and fish eggs rare.

Chief forms—*Chætoceras curvisetum*, *Lauderia borealis*, *Skeletonema constatum*, *Thalassiosira gravida*, *Rathkea octopunctata*, *Temora longicornis*, *Pseudocalanus elongatus*, *Portunus* sp. zoea, *Balanus* and copepod nauplii.

May.

Prevailing winds S. and S.W. Sometimes E. and N.W. Weather variable, fine at the end with S. and S.W. winds.

Chætoceras species common, especially *C. curvisetum* and *pseudocrinitum*, *Lauderia* very common at the beginning, dwindles at the end of the month. *Mastigloia* sp. in large numbers from the middle to the end of the month, *Nitzschia delicatissima* very common, *Rhizosolenia* species increasing, *R. Shrubsolei* very common, *R. Stolterfothii* gradually increasing so that it is very common at the end of the month, *R. hebetata* and *semispina* very common from the middle to the end of the month. *R. alata* occurs through the whole month but is not common. *Skeletonema* very common. *Thalassiosira gravida* common. Various Peridiniales occur but not in large numbers. Infusoria too in small numbers abound. *Phæocystis Pouchetii* is very common through the whole month. Amœbæ fairly common. *Phialidium* and *Obelia* are very common and various other medusæ are present. *Sagitta* is not common and disappears at the end of the month. *Calanus*, *Temora*, *Acartia* and *Pseudocalanus* are abundant, *Paracalanus* very common early in the month, several other copepods present in smaller numbers. *Portunus* sp. zoea is common, Megalopa stages appear in the middle of the month. Various other Crustacea larvæ are present, of these *Eupagurus*, *Porcellana* and *Corystes* are common. *Evadne Nordmanni* and *Podon intermedius* are common in the middle of the month, copepod nauplii are common and *Balanus* nauplii very common in the beginning, the cypris stages being commoner in the middle of the month when they abound.

Chief forms—*Skeletonema costatum, Rhizosolani Shrubsolei, Stolterfothii* and *hebetata* f. *semispina, Mastigloia* sp., *Thalassiosira gravida, Lauderia borealis, Chætoceras curvisetum, Phæocystis Pouchetii, Phialidium hemisphericum, Obelia* sp., *Calanus finmarchicus, Temora longicornis, Acartia Clausii, Pseudocalanus elongatus, Portunus* sp., zoeæ and *Balanus* nauplii and cypris stages.

June.

Prevailing winds N., S. at end of month. Weather mostly cold and dull.

Cerataulina Bergoni fairly common at the beginning, *Chætoceras* dwindles but *C. curvisetum* and *pseudocrinitum* are still common at the beginning and an undetermined species is common through the month particularly in the tow nets. *Leptocylindrus danicus* is fairly common and *Mastigloia* is occasionally present in large numbers. *Nitzschia delicatissima* is very common till the middle of the month and falls off towards the end. *Paralia* is rare, Rhizosolenia species very common, *R. Shrubsolei* and *Stolterfothii* very common through the month, *R. hebetata* f. *semispina* very common towards the end, *R. alata* gradually increasing, to be very common in the middle and continuing so till the end of the month. *Skeletonema* not common. *Thalassiosira gravida* rare. Maximum of the Peridiniales. *Amphidinium crassum* begins, *Ceratium fusus* fairly common, *Dinophysis* species, *Diplopsalis pillula, Glenodinium bipes, Gymnodinium rhomboides, Pouchetia armata, Spirodinium spirale* and *glaucum* all at a maximum. Various species of *Peridinium* fairly abundant. Various Infusoria occur, although never in large numbers. *Phæocystis* very common till the middle of the month when it disappears. Medusæ abound, especially *Phialidium* and *Obelia*. On the 14th *Saphenia gracilis* was very abundant, and with it a large number of *Bolina infundibulum*. The day was cold and dull with a north wind. On the same day *Spirodinium glaucum* and *Dinophysis acuminata* were at a maximum. The larva of Peachia sp. (Halcampa) was very common on medusæ. *Sagitta* rare.

Copepods not very abundant, *Calanus, Temora* and *Acartia* common. *Pseudocalanus* very rare, *Portunus* sp. zoea very common, Megalopa stages fairly common, larvæ of *Hippolyte* and *Porcellana* very common on the 21st. Copepod nauplii not so common, *Balanus* cypris stage disappears after the beginning of the month. *Anaphia petiolata* and larval Gasteropoda common at the end of the month.

Chief forms—*Guinardia flaccida, Rhizosolenia* species, *Glenodinium bipes, Gymnodinium rhomboides, Pouchetia armata, Spirodinium spirale* and *glaucum, Phialidium hemisphericum, Obelia* sp., *Calanus finmarchicus, Temora longicornis, Acartia Clausii, Portunus* sp. zoea, *Hippolyte* and *Porcellana* larvæ.

July.

S. and S.W. winds prevail. Fairly fine most of the month.

Asterionella very common all the month. *Chætoceras constrictum* very common, *C. curvisetum*, very common at the end of the month only. *Guinardia* very common in the middle, not so common at the beginning and end of the month. *Rhizosolenia* species very common, *R. alata* and *R. Stolterfothii* very common all the month, *R. Shrubsolei* not so common, *R. setigera* begins and gradually gets common, being very common at the end of the month. Peridiniales not so numerous. *Ceratium fusus* very common in the middle of the month. *Prorocentrum* increasing. Infusoria fairly common, especially *Tintinnopsis beroidea*, which at times is exceedingly abundant. *Phialidium* and *Obelia* very common. Other medusæ scarce. *Calanus, Temora, Acartia* and *Pseudocalanus* very common. *Portunus* sp. zoea and *Porcellana* zoea very common. Copepod nauplii common. *Echinopluteus* common at the end of the month.

Chief forms—*Asterionella japonica, Chætoceras constrictum, Rhizosolenia* species, *Ceratium fusus, Tintinnopsis beroidea, Phialidium hemisphericum, Obelia* sp., *Portunus* and *Porcellana* zoeæ.

August.

Prevailing winds S., some E. and some W. Mostly fine weather.

Second diatom maximum at the beginning of the month caused chiefly by *Mastigloia, Asterionella, Chætoceras, Lauderia, Rhizosolenia* and *Skeletonema* which are all very common. *Chætoceras constrictum* the commonest. *C. didymum* very common on the 10th. *Lithodesmium* scarce at the beginning but very common at the end of the month. *Rhizosolenia alata* is very common until after the middle when it becomes scarce and very rare at the end of the month. *R. hebetata* f. *semispina* very common at the beginning, disappears at the end, *R. setigera* very common after the middle but scarce at the end, *R. Stolterfothii* very common for the whole month. *Skeletonema* very common for most of the month, Peridiniales fairly frequent, especially *Prorocentrum micans*. Infusoria fairly abundant, especially *Tintinnus subulatus* and *Tintinnopsis beroidea*. *Dictyocha* and *Distephanus* begin in the middle of the month, *Phialidium* and *Obelia* very common. *Muggiæa atlantica* becomes common at the end of the month. Copepods abundant. *Calanus, Centropages typicus* and *hamatus* fairly common, *Acartia* and *Pseudocalanus* very common, *Candacia armata*, *Coryceus* and *Paracalanus* common at times. Brachyura zoeæ and other crustacea larvæ rare. *Evadne Nordmanni* and *Podon intermedius* common. *Balanus* nauplii very common at times. Echinoplutei very common on the 10th, Ophioplutei fairly common through the month. *Oikopleura* fairly common.

Chief forms—*Asterionella japonica*, *Chætoceras constrictum*, *Rhizosolenia Stolterfothii*, *Ceratium fusus*, *Prorocentrum micans*, *Tintinnus subulatus*, *Tintinnopsis beroidea*, *Phialidium hemisphericum*, *Obelia* sp., *Acartia* and *Pseudocalanus*, *Evadne Nordmanni* and *Podon intermedius*.

September (till the 18th).

Prevalent winds W. and N.W. Usually fine weather.

Asterionella much scarcer, *Chætoceras curvisetum* very common again, other *Chætoceras* species not so common. *Lithodesmium* and *Lauderia* fairly common. *Rhizosolenia* species rare except *R. Stolterfothii*, *Skeletonema* still very common. Peridiniales scarce except *Ceratium fusus* and *Prorocentrum micans* which is at its maximum. Infusoria fairly abundant, especially *Tintinnopsis* species. *Dictyocha* and *Distephanus* at their maximum. Few medusæ except *Phialidium* and *Obelia*. *Muggiæa* very common. *Sagitta* common.

Copepods fairly abundant, *Calanus* and *Temora* common, *Acartia* and *Pseudocalanus* very common. Various crustacea larvæ in small numbers, *Evadne* disappears at the beginning, *Podon* is common through the month. Copepod and *Balanus* nauplii very common. *Lamellibranchiata* larvæ common at times. Ophioplutei very common.

Chief forms—*Chætoceras curvisetum*, *Rhizosolenia Stolterfothii*, *Skeletonema costatum*, *Prorocentrum micans*, *Tintinnopsis beroidea*, *Muggiæa atlantica*, *Acartia*, *Clausii*, *Pseudocalanus elongatus*, *Podon intermedius*, *Ophiopluteus*.

The dates on which the plankton samples were taken, with wind and weather, morning tide and time at which taken. * Indicates that the samples were taken from the west channel. P Indicates preserved samples.

1915.		Weather.	Wind.	Greenwich time.	Morning tide.
September	21 P	fine	E.	11.30 a.m.	4.7
	*23 P	drizzling	S.	abt. 11 a.m.	5.38
	*25 P	fine	S.	12 noon	6.49
	27 P	fine	N.W.	12 noon	7.45
	29 P.	showery	N.	11.30 a.m.	8.40

		Weather.	Wind.	Greenwich time.	Morning tide.
October	1 P.	cloudy	S.S.W.	11 a.m.	9.41
	*4 P	overcast	S.S.E.	12 noon	1.10
	6	fine	S.S.W.	abt. 11 a.m.	3.37
	11	very fine	S.	12 noon	7.5
	13	fine	S.S.W.	abt. 11 a.m.	8.25
	15	unsettled	N.E.	abt. 11 a.m.	9.58
	*18	very fine	W.N.W.	abt. 12 noon	1.28
	*21	heavy showers	S.S.W.	abt. 11 a.m.	4.28
	27	calm	E.N.E.	11.30 a.m.	7.44
	29	fine, dry	E.N.E.	12.20 p.m.	8.25
November	1	dull, gusty	E.S.E.	11 a.m.	11.45
	3	fine, clear	E.N.E.	11.45 a.m.	1.49
	5	fine, cold	N.N.E.	11.45 a.m.	3.44
	8	cloudy, rain	S.W.	11 a.m.	5.59
	*11	rough, rain	S.	11 a.m.	8.18
	15	calm, cold	E.	12 noon	12 noon
	17	fine, cold	E.	12.45 p.m.	2.8
	19	cold, clear	E.	11.10 a.m.	3.52
	22	cold, dull	N.E.	11.15 a.m.	5.52
	24	fine, cold	E.N.E.	11.40 a.m.	6.58
	26	misty, smooth	N.E.	11.45 a.m.	8.2
	29	wet, rough	S.S.E.	11.40 a.m.	9.15
December	2	wet, rough	E.	12.15 p.m.	0.27
	9	wet, rough	S.S.W.	11.30 a.m.	7.23
	13	fine, cold	N.N.W.	11.30 a.m.	10.38
	16	fine, cold, showery	E.N.E.	12.25 p.m.	1.8
	*20	misty, calm	N.	11.30 a.m.	4.53
	22	misty, warm, smooth	S.W.	11.30 a.m.	6.13
	*29 P	strong wind, rain	S.	11.30 a.m.	10.23
1916.					
January	3 P	sunny, heavy swell	S.W.	11.30 a.m.	3.36
	* 5 P	sunny, sea mod.	—	11.30 a.m.	5.34
	8 P	fair	N.W.	11.30 a.m.	8.5
	11 P	dull, warm	—	11.30 a.m.	10.45
	*14	fair	W.	2.5 p.m.	noon
	18	swell	S.W.	2.45 p.m.	4.3
	24	fine	W.	11.25 a.m.	8.12
	*26	nasty sea	S.W.	11.20 a.m.	9.38
	28	fine	S.	11.15 a.m.	10.39
	31	dull	N.E.	11.40 a.m.	1.35

		Weather.	Wind.	Greenwich time.	Morning tide.
February	5	heavy sea	S.	11.35 a.m.	7.7
	*8	cold, clear	S.W.	11.40 a.m.	8.59
	10	dull, cold	S.W.	11.20 a.m.	10
	17	cold, sunny, nasty sea	S.W.	11.30 a.m.	4.54
	*21a	stormy	N.E.	10.45 a.m.	7.22
	25	snow showers	N.E.	11.10 a.m.	9.32
	28	fine	N.E.	11 a.m.	noon
March	1	fine, smooth	E.	11.15 a.m.	3.55
	8	snow showers	N.	11.5 a.m.	8.22
	*10	cold, rough	N.E.	11 a.m.	9.21
	14	stormy	E.	10.50 a.m.	0.31
	16	fine	S.W.	noon	3.21
	21	misty, calm	N.	noon	6.52
	23	cold, calm	N.	11.10 a.m.	8.1
	27	cold, wet	S.E.	11.10 a.m.	11.4
	29	cold, sunny	S.W.	11.30 a.m.	1.21
	31	calm, dull	S.	12.20 p.m.	4.1
April	4	calm, sunny	N.	11 a.m.	6.49
	6	calm, sunny	E.	11.50 a.m.	7.50
	10	calm, sunny	S.	11.50 a.m.	10.5
	25	calm, sunny	S.	11.10 a.m.	11.8
	27	sunny, warm	S.	12.15 p.m.	1.16
May	1	sunny, warm	E.	11.20 a.m.	5.5
	3	calm, misty	S.	12 noon	6.21
	5	showery, gusty	E.	11 a.m.	7.25
	9	showery, gusty	S.W.	11.50 a.m.	9.43
	12	rain, smooth	S.	12.45 p.m.	0.29
	15	rather rough, dull	W.	11.20 a.m.	3.40
	17	showery, dull	—	11.25 a.m.	5.15
	19	fine, warm	E.	0.15 p.m.	6.48
	22	fine, breezy	N.W.	10.25 a.m.	9.8
	24	fine, cloudy	S.	11.40 a.m.	11.4
	26	fine	S.W.	11 a.m.	0.44
	29	fine, warm	S.	10.40 a.m.	3.49
	31	fine, warm	S.	10.40 a.m.	5.20
June	2	fine, warm	N.W.	11.40 a.m.	6.35
	6	cold, rough	W.toN.W.	10.48 a.m.	8.46
	8	fine, cold	S.	11.20 a.m.	10.8
	12	cold, dull	W.	10.25 a.m.	1.49
	14	cold, dull	N.	10.25 a.m.	3.55
	19	cold, fair	N.W.	10.45 a.m.	8.16

		Weather.	Wind.	Greenwich time.	Morning tide.
	21	dull, cold	S.	11 a.m.	9.50
	27	cold, fine	S.	11.45 a.m.	3.13
	29	stormy, showery	S.	10.40 a.m.	5.3
July	4 P		S.	10.30 a.m.	5.3
	7 P	heavy swell	S.S.W.	10.40 a.m.	9.38
	11 P	fair	S.W.	10.45 a.m.	noon
	13 P	heavy sea	S.W.	12 noon	3.28
	18 P	fine	N.	10.50 a.m.	8.5
	21 P	very fine	S.	3 p.m.	10.2
	25 P	very fine	S.W.	10.50 p.m.	1.13
	27	very fine	N.W.	11.15 a.m.	3.46
August	1	misty	S.E. & S.W.	1.30 p.m.	7.12
	3	very fine	S.	11.5 a.m.	8.9
	8*a*	fine	E.	11 a.m.	11.32
	10	very fine	W.	10.55 a.m.	1.40
	16	windy, rough	S.	11.35 a.m.	7.43
	18	fine	S.	11.15 a.m.	8.57
	22	fine	E.	11 a.m.	11.42
	28	fine	S.	11.40 a.m.	5.39
	31	misty, swell	S.	11.10 a.m.	7.17
September	4	showery	W.	10.20 a.m.	9.25
	6	very fine	S.	11 a.m.	11.11
	8	very fine	N.E.	10.40 a.m.	11.35
	11	showery, fine	N.W.	10.40 a.m.	5.8
	13	fine	W.	10.40 a.m.	6.38
	15	fine	W.	noon	7.49
	18	fine	N.W.	10.30 a.m.	9.24

[*a* These samples were taken at 4 and 6 fathoms.]

LITERATURE.

1911. Bygrave, W. "Report on the Plankton of the English Channel in 1906." M.B.A. Inter. Fish. Inv., Cd. 4641, 1906–8.

1899. Cleve, P. T. "Plankton Researches in 1897." Kong. Svensk. Vetensk. Akad. Handl., Bd. 32, No. 7.

1900. —— "The Plankton of the North Sea, English Channel and the Skaggerak in 1899." *Ibid.*, Bd. 32, No. 2.

1903*a*. Gough, L. "Plankton, English Channel, February, March, May, August and November, 1903 and 1904." Bull. d. Rés. acq. pend. l. c. pér. pub. p. l. Conseil Intern. p. l'Explor. de la Mer.

1905. Gough, L. "Report on the Plankton of the English Channel, in 1903." M.B.A. Intern. Fish. Inv , Cd. 2670, 1902–3.

1907. —— *Ibid.*, Cd. 3837, 1904–5.

1912*a*. Gran, H. H. "Preservation of Samples and Quantitative Determination of the Plankton." Publication de Circonstance, No. 62.

1912*b*. —— "The Plankton Production of the North European Waters in the Spring of 1912." Bull. Planktonique.

1908–15. Herdman, W. A. and Scott, A. "An Intensive Study of the Marine Plankton around the South End of the Isle of Man," etc. Parts I–VIII, Rep. for 1907–14 of the Lancs. Sea Fish. Lab.

1915. Leegaard, C. "Untersuchungen über einige Planktonciliaten des Meeres." Nyt. Mag. f. Naturv., Bd. 53, hft. 1.

1908. Lohmann, H. "Untersuchungen zur Feststelluug des Vollständigen Gehaltes des Meeres an Plankton." Wiss. Meeressunter, n.d.d. Komm. z. wiss. unters d. deutsch Meere in Kiel," Vol. X.

1908. Ostenfeld, C. H. "On the Immigration of *Biddulphia sinensis* Grev., etc." Meddel f. Komm. f. Havundersøgelser, Bd. I.

1913. —— "Phytoplankton og Protozoei." De Danske Farbandes Plankton, I, Aar. 1898–1901.

TABLE I

The Microplankton of Plymouth Sound from the region beyond the Breakwater, showing the average number of individuals in 50 cc. for each week, also relative abundance in the tow-nettings. The numbers show the individuals in the water samples, the letters their relative abundance in the tow-nettings.

Month	1915. September.	October.					November.				December.				1916. January.					February.		
Week ending	25	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29	5	12	19
Diatomaceæ.																						
1. Melosira Borreri Grev.	rr					0·3				rr	0·2					r	0·2		0·2 r	r	r	
2. Paralia sulcata (Ehr.)	22 c	32 +	7 rr	28 +	28 r	25 +	91 +	22	85 +	44	53 +	63 +	62 +	28 +	78 +	121 +	81 +	80 r	67 r	26 r	49 +	62 r
3. Skeletonema costatum (Grev.)	34 +	129 cc	850 cc	108 +	293 cc	29 +	43 cc	19 r	19 cc	11 cc	15 cc	2 +	6 +	2 +	rr	0·7	8	35	17 c	17 cc	16 cc	13 +
4. Thalassiosira Nordenskiöldii Cleve	0·5 +		2				0·1	r	1		rr											
5. „ decipiens (Grun)		0·2	1																			
6. „ gravida Cleve	0·1		1	0·1			0·2 rr		0·6 rr	1 r	0·5	0·5	0·3 r	0·5 r						0·7	1·3	0·6
7. „ subtilis (Ostenf.)										c			r	rr					rr		rr	
8. „ condensata (Cleve)										0·1												
9. Lauderia borealis Gran			r							0·6 r	0·8 rr	2	0·3 rr	1 rr				1	0·3	2	0·5 rr	
10. Leptocylindrus danicus Cleve									rr		rr	rr	0·3 rr	0·5								
11. „ sp.		4			0·8					1	0·2		1									
12. Guinardia flaccida (Castr.)	0·2 r	0·2 +	r	0·7 +	0·2 rr	0·2 rr	+	+	1 c	cc	r		+	0·2 rr			r					
13. Hyalodiscus stelliger Bail.	r	0·3	rr	0·1 +	0·3 r	r	0·6 +	0·2 r	0·4 cc	1 c	+	0·3 +	1 +	0·7 r	0·6 +	3 +	1 c	1 +	0·5 +	1 r	0·5 +	2 rr
14. Coscinodiscus excentricus Ehr.		0·6	0·2		0·2		rr	rr	0·3 +	0·2 +	0·5 +	0·6 +	cc	0·5 c	3 r	0·7 +	0·5 +	0·3 +	0·2 cc	c	1 cc	cc
15. „ radiatus Ehr.	0·4 r	0·3 r	r	0·1 r	r	0·5 rr	0·2 r	r	0·1 r	0·1 +	0·2 +	+	0·5 r	0·7		0·4 c	r	+	0·4 +	0·2	+	cc
16. „ sub-bulliens Jörg.	0·2 r	0·1 r		0·4 r		+	r		rr	+				rr								
17. „ Granii Gough										r	rr		0·5 +	r	0·3 r	r	r	0·3	+	r	r	
18. Actinocyclus Ehrenbergi Ralfs.		rr																				
19. Actinoptychus undulatus (Bail.)	0·1 r			0·1 +	rr	rr	r	0·2 r	0·2 r	0·3 +	0·5 r	0·3	r	0·2 rr		0·2	0·2 rr	0·3 r	0·2 r	r	r	r
20. Rhizosolenia Stolterfothii H. Perag.	19 c	13 c	5 r	1 cc	8 rr		rr	2	+	1 +	1 r	5 rr	2 +			0·4						
21. „ robusta Norman								r	r	r	r				rr	r	rr	rr				
22. „ Shrubsolei Cleve	c	1 r	0·2	0·3 c	rr	rr	r	r	+	+	rr	0·3	0·7				rr		r		r	
23. „ setigera Brightw.	0·2	0·1 rr	0·2	0·1	0·2 rr		rr	rr												0·1 rr		rr
24. „ hebetata f. semispina (Hens.)		0·2 r	+		r		0·1															
25. „ alata Brightw.				0·1 c		r				r									r			
26. Corethron criophilum Castr.	0·3	0·1 r	0·7 r	0·4 c	0·7 +	r	0·2 r	1	+	0·1	0·2 rr		0·2 rr									
27. Chætoceras densum Cleve	0·4 c	7 r	3 c	0·6 r	0·3 rr	r	r	+	+	c	+	1	0·7 r					r	r	r	+	2 r
28. „ convolutum Castr.	c	0·1 +	8 +	0·8	5	rr				r									rr	rr		
29. „ danicum Cleve							r	0·2 rr	0·1 +	r			r						rr			
30. „ boreale Bail.			c	r			rr		+													
31. „ decipiens Cleve		rr			1			r	0·7 r	+	r		0·3 r				rr		r	r	r	
32. „ teres Cleve																			+	rr	r	r
33. „ contortum Schütt																						
34. „ didymum Ehr.	1 r	1		0·3 r	0·3				rr		0·8								rr	rr		rr
35. „ constrictum Gran.	3 c	23 cc	25 cc	+	11 rr	1 rr	1 r		r	r			0·5 r				rr		rr	r	r	rr
36. „ Willei Gran.	rr		+																			
37. „ laciniosum Schütt	c	0·8 rr	0·5 rr	r	1 r	rr	rr	r	0·1 r										rr		rr	r
38. „ breve Schütt																						
39. „ diadema (Ehr.)																						
40. „ pseudocrinitum Ostenf.					rr		rr	1														
41. „ curvisetum Cleve																						
42. „ debile Cleve																						
43. „ sp.																						
44. Eucampia zoodiacus Ehr	0·1 r	0·4	0·3 r		0·5																	
45. Streptotheca thamensis Shrubs.	0·2 +	1 +	1 c	3 cc	9 cc	0·7 +	0·3 +	0·5 r	0·3 cc	0·3 c	r	r	0·2 +	+	2 rr	0·2 +	+	0·3 +	0·1 cc	0·2 +	0·3 cc	3 +
46. Cerataulina Bergonii H. Perag.				r					0·1 r													
47. Biddulphia mobiliensis (Bail.)	+	0·3 r	0·3 r	0·3 +	1 +	+	0·1 +	c	0·1 cc	0·6 cc	0·2 cc	2 cc	2 cc	1 cc	3 cc	cc	0·5 cc	2 c	0·4 cc	+	0·7 cc	2 cc
48. „ regia M. Schulze	+	rr	+	+			r	+	cc	0·1 c	0·2 +	+	0·2	r	+	r	+	r	cc	+	cc	cc
49. „ sinensis Grev.									c	r	rr	r					0·2		r		0·2 r	
50. „ favus (Ehr.) v. Heurck									r											rr		
51. „ alternans (Bail.) v. Heurck									0·8 r		r								r			r
52. Bellerochia malleus (Brightw.)		r																				
53. Lithodesmium undulatum Ehr.	0·3 +	3 +	5 cc	+	0·7 c		rr		0·1		0·3			0·2	0·6	r	r	0·6	r			
54. Ditylium Brightwelli (West) Grun																	rr	0·3 rr	r		+	r
55. Fragillaria sp.	r							r								2			rr			
56. Thalassiothrix Nitzschioides Grun	4 +	3 r	r	1 r	0·5	0·3	1 r	4	4 r	5 r	4 r	5 r	2 r	0·3	0·6		4 r	4	5 cc	rr	3 +	rr
57. Asterionella japonica Cleve	2 c	23 +	4 cc	0·1 +	3 r	r	2 r		+								4 rr			r	3 rr	
58. „ Bleakeleyi W. Sm.													0·2									
59. Lycmophora Lynbergi (Kütz) Grun					0·2																	
60. Grammatophora serpentina Ehr.		0·1			0·5					0·1	0·2			rr	0·3	0·3						rr

Month	[February]	March.				April.					May.				June.				July.					August.				September.			
Week ending	26	4	11	18	25	1	8	15	22 None taken	29	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	2	9	16	23
1. Melosira Borreri Grev.	0·2 r	0·2 r	0·3 rr	c	0·3 rr	rr												rr												r	
2. Paralia sulcata (Ehr.)	53 r	14 r	8 rr	12	14 r	35 r	20 rr	7		23	9 rr	8	3 rr	2	3 rr	5 rr	2	3		7 rr	2 rr	2		3 r	4	24 rr	rr	19 rr	4 rr	17 rr	19
3. Skeletonema costatum (Grev.)	40 cc	15 cc	36 r	53 c	29 c	58 cc	34 +	194 cc		4348 cc	191 c	84 +	79 +	156 r	122 cc	5	2	0·7	12	6 rr	1 rr	3 rr	8 rr	26 rr	108 cc	341 cc	302 cc	2042 cc	74 cc	700 cc	139 +
4. Thalassiosira Nordenskiöldii Cleve	2	0·8			1			2			23 r	7		0·6																	
5. „ decipiens (Grun)					0·3	0·4						0·3																			
6. „ gravida Cleve	0·5	0·2 r	0·5	0·7	20 +	21 cc	13 r	24 c		61 +	51 +	69	20 c	36	35 +	4		2 rr	2 r				3 rr	2	4 r	0·3 rr	2	0·3	7	14 r	33 r
7. „ subtilis (Ostenf.)		r			r	0·2 rr	rr	2																						0·5	rr
8. „ condensata (Cleve)						0·4 rr																									
9. Lauderia borealis Gran	rr	3 rr	8 rr	0·7 r	6 +	7 r	2 +	20 +		90 c	373 cc	9	2 r	0·1	2	5	1	2	8 r		0·2		2 r	2 +	12 r	24 r	60 c	10 rr	4 rr	6	7 r
10. Leptocylindrus danicus Cleve											0·9 rr	4	3	4	7	18 r	11	23 rr	33 rr	4	1	1 rr	29 +	4	21 rr	6 rr	11 r	0·7 rr	4	5 r	r
11. „ sp.																			4		5 rr	1	35	9	15 rr	9	71		5	0·4	
12. Guinardia flaccida (Castr.)						r				rr	0·6 r	r	c	+	c	2 c	1 cc	2 cc	0·5 +	0·8 +	1 cc	3 cc	1 +	0·3 r		1 c	0·7 +		1 +	0·6 cc	+
13. Hyalodiscus stelliger Bail.	1 r	0·2	0·7	0·2	0·2	0·5	0·3 rr			0·5	rr	0·2	0·3	0·2	rr			r			r	r		rr		3 +	rr		r	0·7 +	1 r
14. Coscinodiscus excentricus Ehr.	0·2 cc	cc	0·5 +	0·2 +	2 cc	1 cc	0·2 +	0·3 +																					0·3 r	0·5 r	rr
15. „ radiatus Ehr.	0·7 +	1 r	1 r	0·8 r	1 r	0·7 +	1 +	0·3 rr		0·2 r														1	1	rr		0·2 rr		rr	
16. „ sub-bulliens Jörg.		r	rr			rr	0·2			rr	r	r	r		rr														0·1	rr	
17. „ Granii Gough	+	r		r	+	r	r	rr											rr		rr	r	r	r	r	r				r	
18. Actinocyclus Ehrenbergi Ralfs.																														0·2	
19. Actinoptychus undulatus (Bail.)	0·3 r			0·3	0·3	2	0·2			0·2																r					
20. Rhizosolenia Stolterfothii H. Perag.						r					10 +	6 +	11 c	6 +	25 cc	222 +	90 cc	51 cc	74 cc	37 c	81 cc	98 cc	98 cc	83 cc	41 cc	16 cc	42 cc	19 cc	19 cc	4 cc	1
21. „ robusta Norman	rr					rr	rr			rr	rr																				
22. „ Shrubsolei Cleve	rr	+	0·5 +	0·2 +	+	0·3 cc	1 +	+		0·8 +	2 cc	2 +	3 cc	7 cc	14 cc	41 cc	14 +	5 cc	1 c	1 c	1 +	+	+			1 r	3 r	0·2 rr	0·1 rr	+	
23. „ setigera Brightw.	r	0·3 r	rr	0·2 rr	rr	0·1 r	rr	rr		rr	rr	2	4	5	0·4					2 r	1 +	6 r	3 cc	31 cc	25 cc	8 cc	0·3	0·3 rr	0·1 rr	0·5 rr	
24. „ hebetata f. semispina (Hens.)		rr			rr	r					+	cc	cc	cc	12 cc	2 cc	3 cc	3 cc	1 +	3 r	1 cc	1 cc	0·8 cc	1 cc	1 cc	1 rr	0·3 r		0·5	0·3	
25. „ alata Brightw.	rr	rr			r	r	rr	rr		rr	0·1 r	0·5 rr	0·6 r	1 r	0·2 r	6 +	8 cc	17 cc	20 cc	17 cc	11 cc	1 cc	cc	4 cc	4 cc	0·8 cc	2 cc	0·5 r	r	+	
26. Corethron criophilum Castr.		rr				0·2 rr																	cc			r		rr	0·7 r	0·6 r	
27. Chætoceras densum Cleve	0·8 r	1 +	4 c	2 cc	5 r	r		r		r	4 r	2 rr	3 +	5 c	3 +	1 r	1 +	0·5 r			0·7			1		rr	r		1 +	1 +	
28. „ convolutum Castr.		cc	7 cc	0·8 cc	r	r		r		3 r	5 rr	3	0·1	6 rr	0·4	1		3	4 r	2	5 rr	6 +	15 r	5	4			0·5 rr	rr	0·5	
29. „ danicum Cleve			0·2			rr		r													0·3 rr	0·3	1 r				r		0·1	rr	0·5 rr
30. „ boreale Bail.			r								2		rr											rr					3		
31. „ decipiens Cleve		r	2 +	0·7 r	0·7 r	2 +	0·7	2		9 r	6 r	2 +	2 r	13	24	0·8		1	3	0·7		1 r	15 r	rr	rr		rr		1 rr	0·7	
32. „ teres Cleve	+	c	2 c	4 cc	4 +	0·6 +	r	r		1 r																					
33. „ contortum Schütt																				1			3	4	3			0·7			
34. „ didymum Ehr.		+	1 rr		2	r	0·3			r	r	r								0·5 rr	rr		5 c	7 +	12 cc		rr				
35. „ constrictum Gran.		1				rr				2 +	2	9		2	195	1				24 cc	33 cc	68 cc	43 cc	189 cc	66 cc	5 rr	2 +	3 rr	6 r	r	rr
36. „ Willei Gran.																		1	0·5					1	7		rr				
37. „ laciniosum Schütt	rr									0·8				0·2				2	1	0·5			0·5						0·6 r	rr	
38. „ breve Schütt																								0·5			1				
39. „ diadema (Ehr.)																															
40. „ pseudocrinitum Ostenf.	rr											35	41 rr	215 r	216 +	7			2				8				4	6	r	0·7	2
41. „ curvisetum Cleve		c	5 cc	1 cc	4 c	cc	+	21 cc		16 r	12 +	30 +	24 +	118 cc	522 cc	130 cc	7 rr	8 r	3 rr		2	5	15 cc	5 cc	4 r	rr	r	0·5 r	9 +	53 cc	21 +
42. „ debile Cleve										r		3	1 rr	3	15 rr	3											2		4	5 r	rr
43. „ sp.															168	17	4	14	46	14			62 +	12	34 rr	6	8	r			
44. Eucampia zoodiacus Ehr			rr	rr								1						rr	rr	0·3	0·7 rr	0·8	4 r	rr	0·3 r	rr		0·3	3 +	1 +	3 rr
45. Streptotheca thamensis Shrubs.	1 cc	3 cc	3 cc	2 cc	2 cc	4 cc	3 cc	1 c		0·5 +	rr									r		0·3		rr	rr	r	0·7 +	0·2 cc	0·6 cc	1 cc	4 c
46. Cerataulina Bergonii H. Perag.										3 rr	5 rr	7	1	0·3	4 r	30 r	2								rr						1
47. Biddulphia mobiliensis (Bail.)	cc	0·7 c	0·7 cc	0·7 +	2 cc	1 cc	0·7 +	rr											rr							rr	rr	rr		0·1	
48. „ regia M. Schulze	cc	c	+	r	+	0·1 +	0·2 r																					rr			
49. „ sinensis Grev.	c		+	0·3 r	0·2 r	0·1 c	1 c	0·6 r		0·5 +	0·2 c	0·7	r	0·1 rr							rr								r	r	
50. „ favus (Ehr.) v. Heurck																															
51. „ alternans (Bail.) v. Heurck	rr					rr																									
52. Bellerochia malleus (Brightw.)																															
53. Lithodesmium undulatum Ehr.					0·2														rr			0·5	0·2	0·5 r	0·7 +	0·5 +	0·7 cc	8 cc	4 cc	3 cc	0·5
54. Ditylium Brightwelli (West) Grun	0·2 +	+		rr	0·7 +	0·3 cc	rr	r			0·2			0·1	rr				0·8 rr	+	rr	0·2		0·2	0·5 r	r	rr	0·2 r	0·3 +	1 cc	1 +
55. Fragillaria sp.			rr	rr											2 rr					rr	rr									0·6	
56. Thalassiothrix Nitzschioides Grun	1 cc	1 c	1 r	1 r	4 +	9 cc	4 +	4 +		8 r	rr						0·5			0·2		1	0·8	r	0·3 +	0·8 rr	4	4 rr	6 +	9 r	3 rr
57. Asterionella japonica Cleve			rr	rr	r	r	rr	6 r		9 r	3 rr	2		1 +	rr	1				1650	11	116 r	1336 c	1268 cc	943 cc	43 +	3 +	37 cc	7 +	8 +	6
58. „ Bleakeleyi W. Sm.																															
59. Lycmophora Lynbergi (Kütz) Grun					0·2	0·1				rr						0·2			0·2					0·5	0·8	0·2				0·1	
60. Grammatophora serpentina Ehr.	0·2																									0·2					

TABLE I—*continued.*

The Microplankton of Plymouth Sound from the region beyond the Breakwater, showing the average number of individuals in 50 cc. for each week, also relative abundance in the tow-nettings. The numbers show the individuals in the water samples, the letters their relative abundance in the tow-nettings.

Month		1915. September	October					November				December				1916. January					February		
Week ending		25	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29	5	12	19
61. Acnanthes longipes Ag.			r			0·2																	
62. Navicula membranacea Cleve	9	0·1 +	16	0·3 r	12 c	3 +	5	12 +	21 +	1 r	2 rr												
63. ,, sp.		2 r	2 rr	1 +	4	4 rr	4 r	3 r	2	2 r	2 r	2 rr	2	2 r	0·5 r	0·3	0·3 r	1	1	1	1 r	0·5	2
64. Pleurosigma sp.		1 r	1 rr	0·3 r	2 r	2 rr	2 rr	2 rr	1	4 r	2 r	5 rr	3 r	2	0·8	3	3	3 r	4	2	0·5	3	3
65. Mastigloia sp.	0·2	0·4	0·7 0·4		10	2003 rr	348	1650	70				rr										
66. Amphiprora maxima Greg		0·1	0·1								0·1 rr		rr		rr	0·3	0·1 rr	0·2		0·1			
67. Amphora ostracaria Bréb.	0·1	1			rr																		
68. ,, sp.		rr	rr			0·2				rr		rr											
69. Nitzschia closterium W. Sm.		1	0·7	0·7	49	129	5	5	2	2 rr	1	2	1	2	0·5			0·2		2	0·3	0·3	0·3
70. ,, seriata Cleve		0·1 r			0·2	1		0·3	0·5	0·2 rr													
71. ,, delicatissima Grev.		0·1										r		rr									
72. ,, panduriformis Grn.		0·1			0·2	0·1	4			rr						0·3	0·1				0·2		
73. Bacillaria paradoxa Gm.		1	3 r		2 +		+	r	r	r	2 r	4 +	r	1 r	4 +		r	3 r	r	7 c	+	+	r
74. Campylodiscus and Surrirella spp.		rr	0·2 rr	r	r	r	0·2 rr	0·5 r	r	rr	rr	0·2 rr	r		r		0·1 rr		rr	rr		r	
Peridiniales																							
75. Exuviella compressa (Bailey)		0·2	0·1		0·2																		
76. Prorocentrum micans Ehr.		5 +	4 r	0·6 rr	6 +	4	2	2	0·2	0·3		0·2	0·3		0·2			rr	0·3				
77. Dinophysis acuta Ehr.																							
78. ,, acuminata Cl. & L.																							
79. ,, homunculus v. tripos Lemm.																							
80. ,, ovum Schütt						0·2																	
81. ,, rotundatum Cl. & L.		r	0·1	0·2	0·1	0·2																	
82. Glenodinium bipes Pauls	1	0·5										0·2								0·1			
83. Protoceratium reticulatum Cl. & L.																							
84. Goniaulax triacantha Jörg.	0·1																						
85. ,, polygramma Stein					0·3																0·2		
86. ,, spinifera (Cl. & L.)	1		1																				
87. ,, scrippsæ Kofoid	0·3																						
88 ,, polyedra Stein														rr									
89. Amylax lata Meunier	0·6	0·1	0·1		0·1																		
90. Diplopsalis lenticula Bergh	0·3	r	r		r		r	r	r	rr	r												
91. ,, pillula Ostf.																							
92. Peridinium orbiculare Pauls.														r	0·2 rr								
93. ,, cerasus Pauls.																							
94. ,, roseum Pauls.																							
95. ,, ovatum (Pouchet)														rr			rr			rr			
96. ,, pedunculatum Schütt														rr									
97. ,, pallidum Ostf.			0·1																				
98. ,, pellucidum (Bergh.)																		rr		rr	rr		
99. ,, oceanicum Vanh.																							
100. ,, divergens Ehr.	0·1	0·1 r	0·1 r	r	0·1 c	+	0·3 +	r	+		r								r				
101. ,, crassipes Kofoid	0·3 rr	1																			0·5 rr		
102. ,, conicum (Gran.)	1	0·3 r	0·1 r	3	0·1 r	0·2 rr	0·3	0·1 r	0·2	r	rr			r	r								
103. ,, Thorianum Pauls.																							
104. Peridiniaceæ juv. et indet.																							
105. Pyrophacus horologicum Stein		0·5																					
106. Oxytoxum Milneri Murr. & Whitt.	0·1																						
107. Ceratium platycorne v. Daday	0·1	0·3			r				rr		+	r	r	r	rr								
108. ,, bucephalum (Cleve)	0·2	0·1 r	r	r	0·1 cc	0·8 +	c	0·1 +	0·2 +	+	+			rr									
109. ,, tripos (O. F. Müll.)																							
110. ,, tripos f. lineata (Ehr.)												rr											
111. ,, arcticum (Ehr.)													r							rr		rr	
112. ,, macroceros (Ehr.)		0·1			rr		rr	rr	r		rr	rr		r									
113. ,, furca (Ehr.)	0·3	0·7			r	rr	rr													0·1			
114. ,, fusus (Ehr.)	3	0·5 r	0·2 r	rr	+	0·7			r		0·1	1			0·2								
115. Amphidinium crassum Lohm.	0·1 rr	0·1																					
116. Gymnodinium teredo Pouchet		0·1		0·2			0·7 rr	0·6		0·3			r	r	r								
117. ,, pseudonoctiluca Pouchet	3	r																					
118. ,, viridis n.sp.																							
119. ,, rhomboides Schütt	3	3						0·1															
120. ,, triangularis n.sp.																							

Month		March				April					May				June				July					August				September			
Week ending	26	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	2	9	16	23
61. Acnanthes longipes Ag.	r						rr																								
62. Navicula membranacea Cleve										2			0·5			2		0·1 r	4	r	10 cc	r	2 +	rr	0·8	+	+		2 r	3 r	2
63. ,, sp.	2		r		rr		r				0·2	1	2	4	0·4	2	0·5	0·7	1	0·8	0·7	0·3	5	1	1	2	0·7	5	4 rr	4 rr	4
64. Pleurosigma sp.	2	0·8 rr	2	0·7 r	2	2 r	2 r	3 rr		2 rr	rr	0·5	1 r	0·4 rr	0·3	0·5	0·2 r	1 rr	0·8		r	0·7 r	0·2 rr	rr	0·3	2		1	0·7	3	2
65. Mastigloia sp.											0·7	136	112	578	166	71	173	150			20	67	162	1133		25					
66. Amphiprora maxima Greg						0·1	0·3			0·2		rr	rr									r		0·2	rr	rr					
67. Amphora ostracaria Bréb.																															
68. ,, sp.											0·1										0·2 r			0·2	0·2 r			rr			
69. Nitzschia closterium W. Sm.	0·2		0·7	0·8	0·8	1	1	3		5 rr	3 r	6	3	2 rr	0·7	6	0·3		0·8	0·2	0·7 rr	0·7	10 rr	2	3	3	5 r	7 rr	8 rr	5 rr	3
70. ,, seriata Cleve			0·2							0·2									0·8 rr	2	0·2		15 cc	4	6	6	21 rr	0·3	2	3	
71. ,, delicatissima Grev.										rr	167 cc	2367 cc	906 cc	179 cc	28 cc	210 cc	5 cc	2	1	3	3	2	22 +	0·3	15 r	4	24 r	5 rr	6 r	16	16
72. ,, panduriformis Grn.																															
73. Bacillaria paradoxa Gm.	0·5 +	r	2		2	2	1 c	c					1				1	r		rr			1			2 +			0·4	1	rr
74. Campylodiscus and Surrirella spp.					rr									rr		0·1 rr		r		0·2 r		0·2 r						0·2	r	rr	
Peridiniales																															
75. Exuviella compressa (Bailey)																				0·7 rr			0·5								
76. Prorocentrum micans Ehr.		0·2	0·2		0·8	0·1	0·7	0·3 rr		0·2	0·3	0·3	0·5	1	1 r	2	0·5		2	0·3 rr	0·8 rr	0·7	3 rr	7 rr	10 rr	17 rr	19 rr	17 r	14 r	24 r	12 r
77. Dinophysis acuta Ehr.		rr													rr			0·2 r		rr	0·2 +		0·2 +	3 +	0·3 rr						
78. ,, acuminata Cl. & L.															0·5	3	6	2	0·5				0·3	0·8	1	0·3		0·5		0·9	3
79. ,, homunculus v. tripos Lemm.																										rr					
80. ,, ovum Schütt											0·4		0·1	0·7		1	0·3 rr		0·2		0·2				0·5		rr		rr		
81. ,, rotundatum Cl. & L.																0·4	0·2	0·8 rr	0·8	0·2	0·2 rr		0·7	0·2 rr	0·3 rr	r	0·6	0·5	0·1		
82. Glenodinium bipes Pauls										0·2	0·7	2	0·3	1	3 rr	38	12	0·5	0·5					0·2			0·3				
83. Protoceratium reticulatum Cl. & L.																0·7	0·3	0·5	rr					0·2			0·3				
84. Goniaulax triacantha Jörg.																0·2	0·2		0·2			0·2		0·8	4						
85. ,, polygramma Stein																							0·2		0·3						
86. ,, spinifera (Cl. & L.)													0·1					0·5	1					0·5							
87. ,, scrippsæ Kofoid													0·1	0·1				0·2				0·5	1	0·3	0·3		3	0·2	0·8		
88 ,, polyedra Stein								rr					0·6				0·7							0·3							
89. Amylax lata Meunier																0·2								0·2						0·1	0·6
90. Diplopsalis lenticula Bergh																0·2								0·2				0·3	0·1		
91. ,, pillula Ostf.																7	2	0·7	1												
92. Peridinium orbiculare Pauls.																															
93. ,, cerasus Pauls.							0·5 rr	0·3		0·3 rr	1 rr	0·3		0·1	0·3	1	2	2	3 rr		0·2		0·2	0·5 rr	1	0·3		0·2	0·1	0·5	
94. ,, roseum Pauls.																		0·3	1									0·2			
95. ,, ovatum (Pouchet)						r	0·7 +	rr		rr	+	rr	r			rr		0·2 r	0·5 rr			r		0·2 r	0·2 r	0·2 +	r	0·2 r	0·3 r	0·4 cc	r
96. ,, pedunculatum Schütt														0·1	r																
97. ,, pallidum Ostf.														0·1					0·2		0·3 rr			1 r		+	r		0·1		
98. ,, pellucidum (Bergh.)		r	rr		rr	0·1	1 +				0·6 +	1	0·4 r		0·1 rr	0·7 +	0·5	1 r	0·2	0·2 rr	0·2	0·2	0·5	1 r	0·7 r		0·3	0·5		0·1	
99. ,, oceanicum Vanh.																								rr							
100. ,, divergens Ehr.		rr	rr								r		rr		c	0·2	0·2	0·2 rr	rr	r	r	r		r	0·2		rr	rr	rr	cc	
101. ,, crassipes Kofoid																												+	r		
102. ,, conicum (Gran.)		+	rr	0·3 r	+	0·2 r				rr	0·5 cc	0·7 rr	0·1	r	0·7	0·2	4	0·4 r	0·7 r	rr			rr		0·8 r	0·2 rr	+	0·2	0·7 r	0·1 +	
103. ,, Thorianum Pauls.	r																		rr				rr								
104. Peridiniaceæ juv. et indet.				0·2												2	1	4	2			0·2	5	77 r	11	2	2	2	3	5	3
105. Pyrophacus horologicum Stein																									r				rr	rr	
106. Oxytoxum Milneri Murr. & Whitt.																									0·2						
107. Ceratium platycorne v. Daday																															
108. ,, bucephalum (Cleve)																		r			r	rr		0·2	r	0·2 +	r	0·8 r	r	0·1 r	
109. ,, tripos (O. F. Müll.)																			0·7								rr			0·1 r	
110. ,, tripos f. lineata (Ehr.)																	0·5			0·2	rr									0·2	2
111. ,, arcticum (Ehr.)																								0·3				0·3		rr	
112. ,, macroceros (Ehr.)	rr																							rr				0·2		0·1 rr	
113. ,, furca (Ehr.)							rr									0·2														0·1 rr	0·3
114. ,, fusus (Ehr.)	0·2			rr	r	r	r	r			0·3 r		+	0·3 rr	c	r	0·3 +	0·3 +	0·2 +	0·8 +	1 cc	0·3 r	0·2 rr	0·3 cc	2 r	1 +	3 c	1	0·5 rr	1 +	
115. Amphidinium crassum Lohm.																0·2	0·2	0·3	2				0·3	0·2				0·3		0·2	
116. Gymnodinium teredo Pouchet		0·2	0·2								0·1			rr	0·1	0·7	0·3			rr			1					0·3			
117. ,, pseudonoctiluca Pouchet															0·2																
118. ,, viridis n.sp.																		0·2													
119. ,, rhomboides Schütt					0·1								0·4 rr	0·1	0·7	7	7	1	1				1	1	2	0·7	1	0·3	0·2	2	
120. ,, triangularis n.sp.																0·5															

TABLE I—continued.

The Microplankton of Plymouth Sound from the region beyond the Breakwater, showing the average number of individuals in 50 cc. for each week, also relative abundance in the tow-nettings. The numbers show the individuals in the water samples, the letters their relative abundance in the tow-nettings.

Month	1915. September	October					November				December				1916. January					February			
Week ending	25	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29	5	12	19	26
121. Gymnodinium minor n.sp.																							
122. Spirodinium fissum Levander																							
123. ,, spirale (Bergh.)				0·1			0·2				0·2	r	r	0·2					0·1				r
124. ,, crassum Pouchet																							
125. ,, glaucum n.sp.																							
126. Cochlodinium helix (Pouchet)																							
127. ,, pellucidum Lohm.																							
128. Pouchetia armata Dogiel																							
129. ,, parva Lohm.																							
130. ,, fusus Schütt																							
131. Polykrikos Schwarzii Bütsch.		0·1																					
132. Gymnodiniaceæ juv. et indet.																							
133. Pyrocystis lunula Schütt				rr																			
134. Oxyrrhis marina Duj.																							
Flagellatæ.																							
135. Phæocystis Pouchetii (Hériot)																							
136. Dinobryon sp.																							
137. Carteria sp.																							
138. Trochiscia Clevei Lemm.				0·1																			
139. Halosphæra viridis Schmitz		0·1	0·2	0·1	0·2		0·1				0·3												
140. Flagellata indet.	0·1																						
Coccosphaerales.																							
141. Pontosphaera Huxleyi Lohm.	0·2	0·2			0·3																		
Silicoflagellatæ.																							
142. Dictyocha fibula Ehr.				0·2				0·2		0·1			0·3				0·2		0·1				
143. Distephanus speculum (Ehr.)	0·1	0·2	0·3	1	1	0·3	0·4	0·2	0·2				0·1										
Gymnomyxa.																							
144. Amœba sp.			0·2			0·2		0·3															
145. Foraminifera indet.	r	0·1 r	0·2 r	0·2 c	0·5 r	0·3 r	0·1 rr	0·2 r	+	0·2 r	0·2 rr	0·6 +	0·8		rr	0·4 +	0·3	0·3	1 r	1 r	0·7 r	2 r	1
146. Heliozoa indet.										rr													
147. Acanthochiasma fusiforme Haeckel		0·1 rr		0·2	0·3	2	1	0·7								rr							+
148. Lithomelissa setosa Jörg.									rr	rr				rr									
149. Amphimelissa setosa Cleve						0·2	0·1			r													
Suctoria.																							
150. Paracineta limbata Maup.								0·2															
151. Acineta tuberosa Ehr. v. Fraiponti Fr.			rr		0·2																		
Infusoria.																							
152. Lachrymaria sp.																							
153. Coleps sp.				0·1																			
154. Tiarina fusus Cl. & L.																							
155. Mesodinium sp.																			0·1	0·2			0·2
156. Nassula sp.																							
157. Strombidium caudatum From.		0·1					0·2																
158. Laboea conica Lohm.	0·8		0·1				0·1						0·2						0·1	1	0·2		
159. ,, strobila Lohm.	0·4	0·2					0·1																
160. ,, acuminata Leegaard	0·1			0·1																			
161. ,, spiralis Leegaard							0·1		0·1														
162. ,, sp.	2	1	2	0·4	0·5		0·8	0·2	0·6	0·5			0·3										
163. Lohmaniella oviformis Leegaard																							
164. Euplotes vannus O.F.M									0·1														
165. ,, sp.																							
166. Tintinnus subulatus Ehr.	0·1			r	0·2		rr		rr														
167. Tintinnopsis beroidea (Stein)						0·5 r	5 cc	0·2 rr	0·5 cc	0·3 rr	1 cc	0·3	2 cc	6 c	rr	0·4 +	2 +	4 +	0·5 +	2 +	0·2 rr	0·3	0·5
168. ,, campanula (Ehr.)	+	0·2 r	r	r					0·2	rr						rr							
169. ,, ventricosa Cl. & L.	3 +	0·9 +	2 +	0·7 +	1 rr		rr		rr		0·3	0·6	rr		0·3				0·1		rr	0·3	0·2
170. Cittarocyclis denticulata Ehr.		r	+				0·1									0·2							
171. ,, edentata Brendt																							
172. Infusoria indet.			1	0·							0·2			0·3				0·3	0·1				0·2

Month	March				April					May				June				July					August				September			
Week ending	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	2	9	16	23
121. Gymnodinium minor n.sp.																0·5		0·2					0·2							
122. Spirodinium fissum Levander															8								0·2		0·3				0·2	
123. ,, spirale (Bergh.)				0·1							1	0·5 rr	0·4	0·3	2	4	0·8	0·3				1	0·3	2	0·3	0·3	0·3	0·2	0·7	
124. ,, crassum Pouchet																	0·3					0·2								
125. ,, glaucum n.sp.											0·2		0·6 rr	0·1	12	21	1	1	0·2				0·5	0·7	0·7	2	0·7	0·1	1	2
126. Cochlodinium helix (Pouchet)																								0·3						
127. ,, pellucidum Lohm.																														
128. Pouchetia armata Dogiel										0·2																				
129. ,, parva Lohm.																						0·2			0·2		0·3		0·1	
130. ,, fusus Schütt																														
131. Polykrikos Schwarzii Bütsch.																				rr									0·2 r	
132. Gymnodiniaceæ juv. et indet.		0·2							0·8	0·5	1	1	0·5	1	9	5	1	1		0·2 r		0·2	1	r	0·2	0·3	0·7 rr		0·5	
133. Pyrocystis lunula Schütt																0·3	rr		0·2	0·2 rr	0·2									
134. Oxyrrhis marina Duj.															rr															
Flagellatæ.																														
135. Phæocystis Pouchetii (Hériot)										19	70	12	8	4	11	0·2						1								
136. Dinobryon sp.																						3	0·7							
137. Carteria sp.																	0·3	0·3				1								
138. Trochiscia Clevei Lemm.										0·1																				
139. Halosphæra viridis Schmitz									0·2								0·2	0·2			0·5	0·2	0·2	0·2	0·2					
140. Flagellata indet.									0·3				0·1	0·1				0·3			0·3	1	0·7	0·2	0·7			1	0·5	0·6
Coccosphaerales.																														
141. Pontosphaera Huxleyi Lohm.																												0·1		
Silicoflagellatæ.																														
142. Dictyocha fibula Ehr.			0·2	0·2	0·2					0·1		0·1	0·1	0·1	0·2		0·3					0·2					0·5	1	1	0·3
143. Distephanus speculum (Ehr.)	0·2	0·2	0·5	0·2	0·2	0·5	1		0·7																	0·6	1	0·3		
Gymnomyxa.																														
144. Amœba sp.											0·2	1	4	0·5	0·2	1	0·7						0·3	0·2				0·6	0·1	
145. Foraminifera indet.	0·5 r			0·2 r	0·2						0·2														r			0·4	rr	
146. Heliozoa indet.																										0·3				
147. Acanthochiasma fusiforme Haeckel		rr		rr														0·2				0·2 rr	0·2	0·2	rr		0·3			
148. Lithomelissa setosa Jörg.					rr						rr																			
149. Amphimelissa setosa Cleve										0·1																				
Suctoria.																														
150. Paracineta limbata Maup.																														
151. Acineta tuberosa Ehr. v. Fraiponti Fr.																														
Infusoria.																														
152. Lachrymaria sp.											0·2																			
153. Coleps sp.																								0·2 r	rr			0·1		
154. Tiarina fusus Cl. & L.																	0·2			0·2			0·5	3 rr	0·7 +		0·8	0·3 rr	1	
155. Mesodinium sp.		0·3	0·7	0·3			2		0·7	0·1	1	1		0·1	0·2							0·2		0·2	0·2		0·2	1	1	
156. Nassula sp.											0·2							0·2					0·2	0·5		0·3				
157. Strombidium caudatum From.																							0·2							
158. Laboea conica Lohm.		0·5	0·5	0·2						0·3	0·5	0·1	0·3	0·2	1		1	0·2	0·2		0·5	0·7	0·5	0·2	0·3				0·5	
159. ,, strobila Lohm.																	0·3	rr	1 r	0·3								0·1		
160. ,, acuminata Leegaard	0·2													0·1	0·2							0·2	0·2					0·1	0·3	
161. ,, spiralis Leegaard											0·2	0·1								1	0·8							0·2	0·1	
162. ,, sp.	0·3		0·3 rr	0·2	0·2	0·2			0·2	0·2	1 r	0·4 r	0·1 r		0·7	0·5	r	0·7	0·7	0·2	0·5	0·7 r		0·3	0·7	2				
163. Lohmaniella oviformis Leegaard																							0·2							
164. Euplotes vannus O.F.M																														
165. ,, sp.		0·2							0·5				0·2																	
166. Tintinnus subulatus Ehr.																	0·3			r	0·7		0·3	11 rr	1	1 rr	1 rr	0·3	0·7	0·3
167. Tintinnopsis beroidea (Stein)	r		0·3 rr	0·3 r	2 cc	1 r	0·6 r		0·2 r	rr								0·2 r	0·5	1	1	2 cc	2 cc	6 r	3 r	5 +	0·7 r	3 +	1 rr	0·6 rr
168. ,, campanula (Ehr.)																							0·3 rr	rr	0·3 r	0·6	rr	0·1 rr	0·1 r	
169. ,, ventricosa Cl. & L.		r				0·3 +				0·8 r		0·8	1	4 r	1	3	1 rr	1	0·3	0·7	4 rr	2	0·3	0·3	0·3	3	1 rr	1 r	0·6 r	r
170. Cittarocyclis denticulata Ehr.																												0·3	rr	
171. ,, edentata Brendt																														
172. Infusoria indet.		0·3 r					0·3		0·5		3	0·9	1		0·2							2	0·2	0·3			1	3	3 +	1

TABLE II

Average number of Diatoms and Peridiniales in 1 cc. for each month.

	Diatoms. In 50 cc. Surface.	5 fath.	7 fath.	Total in 150 cc.	Average in 1 cc.	Average in 1 cc. for month.	Peridiniales. Surface.	fath. 5	7 fath.	Total in 150 cc.	Average in 1 cc.	Average in 1 cc. for month.
1915. September 21	82	61	55	198	1·32		8	15	14	37	0·24	
,, 23	113	104	76	293	1·95		5	8	1	14	0·09	
,, 25	191	104	77	372	2·48	2·99	6	7	7	20	0·13	0·12
,, 27	355	84	191	630	4·28		8	2	7	17	0·11	
,, 29	334	233	184	751	5·01		8	9	3	20	0·13	
October 1	321	247	282	850	5·66		1		1	2	0·01	
,, 4	901	1895	944	3740	24·93		3	2		5	0·03	
,, 6	868	402	505	1775	11·83			2	2	4	0·02	
,, 11	143	166	451	760	5·06		8	9	6	23	0·15	
,, 13	468	150	62	680	4·53		13	12	8	33	0·22	
,, 15	358	168	70	596	3·97	17·41	5	3	5	13	0·09	0·08
,, 18	13213	225	119	13575	90·50		7	11	3	21	0·14	
,, 21	403	235	845	1483	9·88		9	6	2	17	0·11	
,, 27	995	60	27	1082	7·21		5	5	2	12	0·08	
,, 29	1143	362	74	1579	10·53		4	1	2	7	0·04	
November 1	3469	522	73	4064	27·09		6	1	2	9	0·06	
,, 3	3647	48	52	3747	24·98		11	5	2	18	0·12	
,, 5	6114	197	185	6496	43·36		3		2	5	0·03	
,, 8	535	53	79	667	4·44			2		2	0·01	
,, 11	68	62	87	217	1·44			1		1	0·006	
,, 15	168	101	213	482	3·21	9·5	1		1	2	0·01	0·02
,, 17	50	158	86	294	1·96		3			3	0·02	
,, 19	52	99	189	340	2.26				2	2	0·01	
,, 22	102	35	70	207	1·38							
,, 24	81	64	123	268	1·78							
,, 26	114	68	29	211	1·40				1	1	0·006	
,, 29	90	104	69	263	1·75		1	1	1	3	0·02	
December 2	131	71	78	280	1·86		5	1		6	0·04	
,, 9	72	99	95	266	1·77		1			1	0·006	
,, 13	65	74	83	222	1·48							
,, 16	59	103	154	316	2·10	1·5						0·008
,, 20	52	77	60	189	1·26		1	1		2	0·01	
,, 22	16	23	24	63	0·42			1		1	0·006	
,, 29	41	137	101	279	1·86							
1916 January 3	59	184	119	362	2·41							
,, 5	47	118	422	587	3·91							
,, 8	53	99	92	244	1·62							
,, 11	109	85	144	338	2·25							

TABLE II—*continued.*

Average number of Diatoms and Peridiniales in 1 cc. for each month.

	Diatoms. In 50 cc. Surface.	5 fath.	7 fath.	Total in 150 cc.	Average in 1 cc.	Average in 1 cc. for month.	Peridiniales. Surface.	5 fath.	7 fath.	Total in 150 cc.	Average in 1 cc.	Average in 1 cc. for month.
1916. January 14	139	52	116	307	2·04							
,, 18	104	171	115	390	2·60	2·19	1			1	0·006	0·003
,, 24	122	132	77	331	2·20							
,, 26	105	97	78	280	1·86			2		2	0·01	
,, 28	89	94	136	319	2·12							
,, 31	20	34	139	139	0·92		3	1		4	0·02	
February 5	90	47	23	160	1·06							
,, 8	127	128	126	381	2·54							
,, 10	34	44	11	89	0·59			1		1	0·006	0·002
,, 17	83	71	129	283	1·88	1·62						
,, 21	110	74	101	285	1·90							
,, 25	160	43	145	348	2·32		1			1	0·006	
,, 28	81	34	45	160	1·06		1			1	0·006	
March 1	57	38	4	99	0·66		1			1	0·006	
,, 8	147	57	145	349	2·32							
,, 10	83	40	54	117	1·18		1		2	3	0·02	
,, 14	81	59	20	160	1·06		2			2	0·01	
,, 16	273	48	19	340	2·26	2·07	1			1	0·006	
,, 21	49	143	58	250	1·66			2		2	0·01	0·02
,, 23	120	151	98	369	2·46			2	1	3	0·02	
,, 27	275	51	70	396	2·64		14	1	1	16	0·10	
,, 29	195	171	129	495	3·30		1	3	1	5	0·03	
,, 31	153	127	207	487	3·24		1			1	0·006	
April 4	53	120	100	273	1·82		1	6	2	9	0·06	
,, 6	46	106	113	265	1·76		1	4	3	8	0·05	
,, 10	712	85	74	871	5.80	38·56			2	2	0·01	0·03
,, 25	2340	1517	2972	6829	45·52		3	1		4	0·02	
,, 27	12,680	4705	3303	20,688	137·92		3	1	1	5	0·03	
May 1	1909	1142	1368	4419	29·46		9	1	5	15	0·10	
,, 3	1498	641	262	2401	16·00		13	5	4	22	0·14	
,, 5	415	229	415	1059	7·06		1	7	4	12	0·08	
,, 9	3331	1466	4592	9389	62·59		4	19	6	29	0·19	
,, 12	1911	2354	3141	7406	49·37		12	2	1	15	0·10	
,, 15	510	832	537	1879	12·52	30·42	6	12	8	26	0·17	0·12
,, 17	1751	3281	1442	6474	43·16		1	6	5	12	0·08	
,, 19	1271	1034	381	2694	17·96			4		4	0·02	
,, 22	997	1502	1429	3928	26·18		13	15	7	35	0·23	
,, 24	6451	213	93	6757	45·04		1	16	10	27	0·18	

TABLE II—*continued.*

Average number of Diatoms and Peridiniales in 1 cc. for each month.

	Diatoms. In 50 cc. Surface.	5 fath.	7 fath.	Total in 150 cc.	Average in 1 cc.	Average in 1 cc. for month.	Peridiniales. Surface.	5 fath.	7 fath.	Total in 150 cc.	Average in 1 cc.	Average in 1 cc. for month.
1916. May 26	1160	125	88	1373	9·13		1			1	0·006	
,, 29	4628	366	1377	6371	42·47							
,, 31	3468	1412	308	5188	34·58		14	10	19	43	0·28	
June 2	2017	296	173	2486	16·57		5	20	4	29	0·19	
,, 6	1719	703	468	2890	19·26		107	62	55	224	1·89	
,, 8	557	671	606	1834	12·22		223	70	74	367	2·44	
,, 12	1052	205	107	1364	9·09		56	97	124	277	1·84	1·02
,, 14	357	99	155	611	4·07	9·12	93	67	38	198	1·32	
,, 19	879	306	149	1334	8·89		21	35	24	80	0·53	
,, 21	181	156	82	419	2·79		53	13	15	81	0·54	
,, 27	326	205	119	650	4·33		24	8	13	45	0·30	
,, 29	266	189	271	726	4·84		47	27	6	80	0·53	
July 4	71	176	116	363	2·42			6	2	8	0·05	
,, 7	73	10,155	83	10,311	68·74		1	8	2	11	0·07	
,, 11	253	200	180	633	4·22		4	2	6	12	0·08	
,, 13	100	347	136	583	3·88	21·39	8	2		10	0·06	
,, 18	292	504	337	1133	7·55		2	5		7	0·04	0·12
,, 21	824	227	169	1220	8·13		1	5	1	7	0·04	
,, 25	2521	125	764	3410	22·73		12	35	6	53	0·35	
,, 27	1164	5421	1434	8019	53·46		7	20	22	49	0·32	
August 1	4588	987	7833	13,410	89·40		87	103	182	272	1·81	
,, 3	746	1655	1002	3403	22·68		39	63	11	113	0·75	
,, 8	655	586	894	2135	14·23		38	17	55	110	0·73	
,, 10	1702	821	3389	5912	39·41		26	46	42	114	0·76	
,, 16	1043	523	1193	2759	18·39	31·78	25	42	20	87	0·58	
,, 18	142	263	62	467	3·11		15	14	6	35	0·23	
,, 22	1136	432	292	1860	12·40		58	39	5	102	0·68	0·73
,, 28	7276	1743	1439	10,458	69·72		43	22	12	77	0·50	
,, 31	360	2041	103	2504	16·69		50	35	6	91	0·60	
September 4	416	30	129	575	3·83		23	12	2	37	0·24	
,, 6	863	490	352	1705	11·36		16	38	10	64	0·42	
,, 8	1363	1508	2397	5268	35·12	17·11	32	82	53	167	1·11	
,, 11	3505	1278	1020	5803	38·68		59	87	16	152	1·01	0·64
,, 13	271	843	103	1217	8·11		51	39	9	99	0·66	
,, 15	292	243	300	835	5·56		40	33	19	92	0·60	
,, 18							26	23	lost.	49	0·49	

The Peridiniales of Plymouth Sound from the Region beyond the Breakwater.

By

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With Figures 1–14 in the text.

THE following list includes all the Peridiniales identified in the plankton throughout the year from September, 1915, to September, 1916, from the water samples, details of which will be found in another paper in the same journal (p. 133). Also from the plankton in the tow nets in the same year and a portion of the summer 1915. As is shown in the above-mentioned paper, the summer is the time for nearly all the Peridiniales, June being the maximum month. After October very few are seen in the water samples, although in the tow nettings the larger and stronger forms, such as *Ceratium* and *Peridinium*, are still present.

The new and least-known forms belong to the *Gymnodiniaceæ*, which have no cellulose sheath. Perfectly transparent and extremely thin cases, however, are often seen which may be close fitting or many times larger than the gymnodinian. *Pouchetia* and various species of *Cochlodinium* are instances of this (see Plate II, Fig. 14). The *Gymnodiniaceæ* are perhaps the most interesting of the Peridiniales, as many of them obtain nourishment holozoically and often the food can be determined. Throughout June the flagellate *Phæocystis pouchetii* was excessively abundant, and this furnished food for many gymnodinians (e.g. *Gymnodinium rhomboides* and *G. triangularis*, see Plate I, Figs. 6 and 7).

Division stages in this group are often seen which in the genera *Gymnodinium* and *Spirodinium* take place usually, if not always, in the free state and not in capsules as in *Pouchetia* and others (Pouchet, 1885; Dogiel, 1906).

Although no special investigation has been made closer inshore, the examination of a few samples of water show that many of the species occur near the land, such as *Gymnodinium* and *Spirodinium* species and *Dinophysis*, besides several species of *Peridinium*.

In the following list 60 species are recorded. Of these 5 of *Gymnodinium*, 2 of *Spirodinium*, and one of *Cochlodinium* are new. Twenty-one species are, I believe, new records for British seas and 28 are new records for the Plymouth area. In addition to those recorded and described there are many which I have not been able to identify. Some of these are young forms, others collapsed before they could be properly observed, and others were distorted. Among these there are probably many new species belonging to the *Gymnodiniaceæ*.

The classification adopted is that of Paulsen (1908) in "Nordisches Plankton." Those marked * are new to Plymouth, those marked N.R. are new records for British seas.

PROROCENTRACEÆ.

Genus Exuviella Cienk.

(1) * *Exuviella compressa* (Bailey) Ostenfeld. Occasionally in water samples in the summer.

Genus Prorocentrum Ehrenberg.

(2) *Prorocentrum micans* Ehrenberg. From May to October in the water samples, rarely in tow nettings. Commonest in the late summer. Its maximum early in September.

PERIDINIACEÆ.

Genus Dinophysis Ehrenberg.

(3) *Dinophysis acuta* Ehrenberg. Fairly frequent in very fine tow nettings, not so common in the water samples. May to October.

(4) *D. acuminata* Cl. and L. Common in water samples, usually gets through the very fine net. There is a small form of this species which occurs more rarely than the type in the spring and early summer.

(5) *D. ovum* Schütt. Occasionally in water samples.

(6) *D. rotundatum* Cl. and L. Common in water samples.

(7) *D. homunculus* Stein v. *tripos* Gourr. Occurred once only in tow nettings, August, 1916.

Genus Glenodinium (Ehrenberg) Stein.

(8) * *Glenodinium bipes* Pauls. Common from May to September. Abundant in May and June with its maximum in early June. This species is so small that it always gets through the very fine net. It is exceedingly active and lives many hours in a bottle of sea-water.

Genus Protoceratium Bergh.

(9) * *Protoceratium reticulatum* (Cl. and L.). Occurs fairly commonly in water samples from May to September, commonest in August.

Genus Goniaulax Diesing.

(10) * *Goniaulax triacantha* Jörgensen. Rare, in water samples, May to September.

(11) *G. polygramma* Stein. Rare, in water samples, May to September.

(12) *G. spinifera* (Cl. and L.). This is the commonest species of *Goniaulax*. May to September.

(13) N.R. *G. scrippsæ* Kofoid. Occasionally in the water samples, July to September.

(14) *G. polyedra* Stein. Occasionally in water samples, May to September.

Genus Amylax Meunier.

(15) N.R. *Amylax lata* Meunier. Occurred a few times singly. Slightly smaller than the type.

Genus Diplopsalis Bergh.

(16) *Diplopsalis lenticula* Bergh. Fairly common in very fine tow nettings and in water samples. May to September.

(17) N.R. *D. pillula* Ostf. This minute species is abundant in June in the water samples, very often with *Glenodinium bipes*.

Genus Peridinium Ehrenberg.

Sub-genus Protoperidinium Bergh.

(18) *Peridinium orbiculare* Paulsen. Occurs rarely in the water samples.

(19) * *P. cerasus* Paulsen. This little species is one of the commonest and easily recognised. Occurs fairly frequently but never in large quantities in the water samples.

(20) * *P. roseum* Paulsen. Very like the last species but larger and flatter. Occurs rarely in the water samples.

(21) *P. ovatum* (Pouchet). Common in late summer but rare in May and June. Specimens with broad and conspicuously striated interspaces between the plates are as common as the typical forms and are probably older, as Mangin (1913) has already noted. More common in tow nettings than in water samples.

(22) *P. pedunculatum* Schütt. Very rare, in water samples only.

(23) *P. pallidum* Ostf. This and the following species are both common, the present species being larger is commoner in the tow nettings.

(24) *P. pellucidum* (Bergh). Common in water samples.

Sub-genus EUPERIDINIUM Gran.

(25) *P. oceanicum* Vanh. Rare in tow nettings.

(26) *P. divergens* Ehrl. Abundant in the tow nettings, especially in August and early September. Following Meunier (1910) I have reunited the *P. depressum* of the "Nordisches Plankton" with this species.

(27) *P. crassipes* Kofoid. Not very common in the tow nettings in August and September.

(28) *P. conicum* (Gran). This species and *P. divergens* are almost the only peridinians to be found in winter: although not abundant *P. conicum* is found throughout the year both in tow nettings and water samples. Commonest in early spring.

(29) N.R. *P. Thorianum* Paulsen. Rare in water samples in June. Meunier (1910) gives good figures of this species, which resemble the Plymouth form more than do Paulsen's. The present specimens have small knobs conspicuously ornamenting the skeleton which are very characteristic.

Genus PYROPHACUS.

(30) N.R. *Pyrophacus horologicum* Stein. Occurred very rarely in tow nettings in August.

Genus OXYTOXUM Stein.

(31) N.R. *Oxytoxum Milneri* Murr. and Whitt. I have referred to this species, a very small Oxytoxum about half the size of the type but agreeing with it in form. Only one specimen was found in August in the water samples.

Genus CERATIUM Schrank.

(32) N.R. *Ceratium platycorne* V. Duday. Rare, occurred singly two or three times in the tow nettings.

(33) *C. bucephalum* (Cleve). Occurred sparingly in tow nettings in early summer, more frequently in the late summer months.

(34) *C. tripos* (O. F. Müll.). Occasionally in water samples and tow nettings. A variety which approaches the form *lineata* (Ehrb.) and which I have referred to this variety occurs more frequently (Fig. 1). This has a short and straight apical horn, the hind horn nearly straight and the right horn about one-third as long as the left. The usual markings are longitudinal striations from the apex to the girdle, sometimes also with reticulations.

FIG. 1.—*Ceratium tripos* (O. F. Müll.) f. *lineata* (Ehrb.). × 466.

Although apparently nearest to the form *lineata*, the apical horn is very much shorter—less than half the length from its apex to the girdle.

(35) * *C. arcticum* (Ehrb.). Very rare, in tow nettings, 1915.

(36) *C. macroceras* (Ehrb.) Cleve. Rare in tow nettings.

(37) *C. furca* (Ehrb.). Occasionally, in tow nettings and water samples in summer.

(38) *C. fusus* (Ehrb.). The commonest *Ceratium* here. Occurs both in tow nettings and water samples and is often the only peridinian present in the winter. Maximum in October.

GYMNODINIACEÆ.

By far the greater portion of the Peridiniales of this area belong to this group and are missed almost entirely by the tow nets, only a few of the larger forms being retained by them.

Genus AMPHIDINIUM Cl. and L.

(39) N.R. *Amphidinium crassum* Lohmann. I have referred to this species, a form between *A. crassum* and *A. longum* of Lohmann, but which is slightly larger than either of these (Fig. 2). The shape of the body is not so pointed posteriorly as in *A. longum* but not so broadly rounded as in *A. crassum*, the greatest breadth being in about the centre of the body. The nucleus is posterior as in both forms, and a coloured body, greenish, is situated just in front of the nucleus and behind the transverse groove, with small refractive bodies scattered round it. This is perhaps the remains of ingested food material. A thin transparent covering can sometimes be seen detaching itself from the body. Length

FIG. 2.—*Amphidinium crassum* Lohmann. × 466. N=nucleus.

of body 0·030 mm. The only record so far of this species is by Lohmann from Kiel.

Genus GYMNODINIUM Stein.

(40) N.R. *Gymnodinium teredo* Pouchet. Fairly common in July and August in the water samples in 1915, less common in 1916. This is the only gymnodinian found here in the winter months, but then only rarely. It turns up singly nearly all the year round. Many abnormalities and deformities occur and a variety of shapes is seen.

(41) N.R. *G. pseudonoctiluca* Pouchet (Fig. 3). To this species I refer one which agrees well with one condition of the above species, but which I never saw with the long contractile tentacle described by Pouchet (1885). It only occurred twice, the first time in medium tow nettings in July, 1915, and the second time in the water samples in June, 1916. It is rather smaller than the type (length 0·10 mm.). The ventral surface on each side of the longitudinal groove is pulled out into a flap, the left flap slightly longer than the right. The bright yellow chromatophores radiate from the centre. The longitudinal groove is more marked than in Pouchet's figures. The nucleus is in the centre of the body.

(42) *G. viridis* n. sp. (Fig. 4). Closely related to the last species is one also found only singly and which is less than half the size. In shape it is much like *G. pseudonoctiluca* with a cap-like anterior

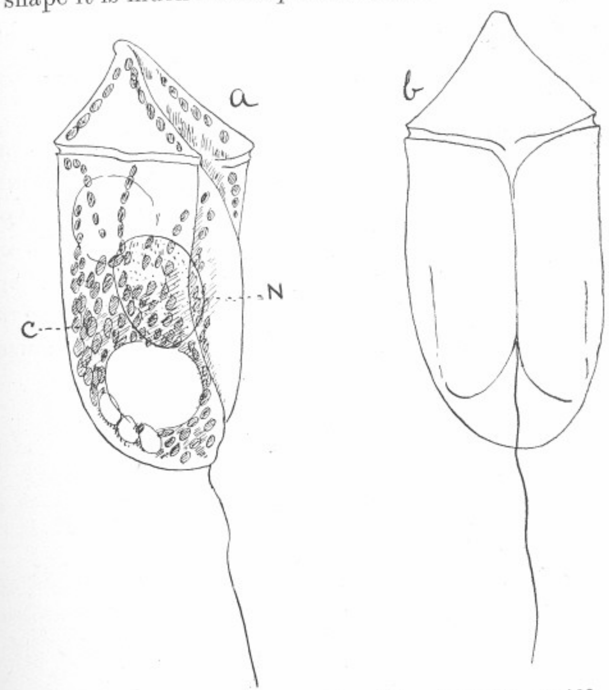

FIG. 3.—*Gymnodinium pseudonoctiluca* Pouchet. × 466.
a side view, *b* ventral view. N=nucleus. C=chromatophores.

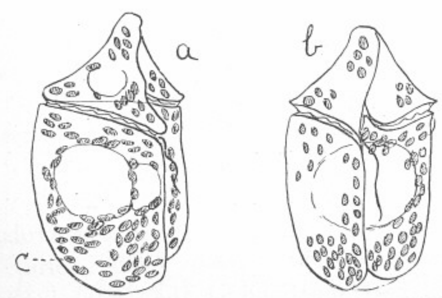

FIG. 4.—*Gymnodinium viridis* n. sp. × 466.
a side view, *b* ventral view. C=chromatophores.

end; the longitudinal groove, however, reaches back slightly over the dorsal surface posteriorly so that the hind end is divided. The chromatophores are of a greenish yellow colour, not bright yellow as in *P. pseudonoctiluca*. Length 0.06 mm. Occurred once in June.

(43) *G. achromaticum* n. sp. (Fig. 5). Related to *G. viridis* but without chromatophores. Perfectly colourless and transparent, transverse groove conspicuously left-handed, longitudinal groove reaching to the extreme posterior end. Apex somewhat excentric. Body covered with longitudinal striæ. Nucleus posterior. One specimen only in July, 1915.

(44) N.R. *G. rhomboides* Schütt (Fig. 6). One of the commonest in this area appears to be the species figured by Schütt (1895, Plate XXI, Figs. 63, 1 and 2) with the above name. Apparently no description of it exists except the short diagnosis in "Nordisches Plankton" (p. 99). Certain aspects of my specimens agree very closely with Schütt's figures, and I have therefore taken the name given by him rather than create a new one.

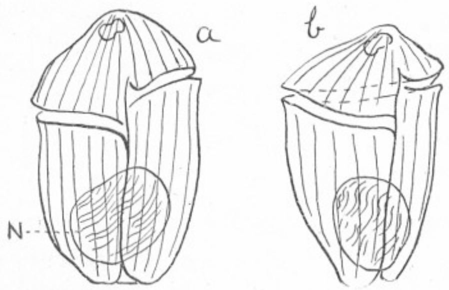

FIG. 5.—*Gymnodinium achromaticum* n. sp. × 466. *a* ventral view, *b* side view. N=nucleus.

The species referred to by Dogiel (1906) as *Gymnodinium spirale* v. *obtusum* is from his figures certainly a true *Gymnodinium* and not a *Spirodinium*, to which now *G. spirale* and all its varieties have been transferred. The original figures by Bergh of *G. spirale* show it to be a *Spirodinium* with the ends of the transverse groove far apart, moreover Schütt's figure of v. *obtusum* shows also the same character. Dogiel's species probably belongs to *G. rhomboides* or else some closely related form. His specimens, however, are very much larger than mine. His figures of the stages in division show it in another form which is also common with us and which I have found in division and very similar to Dogiel's figures. Schütt's figure 63, 1 is also of this type, and apparently this is the form before and during division. These two forms I have therefore placed together as *Gymnodinium rhomboides*. The body is elongated, oval or rhomboidal, the transverse groove is only slightly displaced and left-handed,

the longitudinal groove is inconspicuous. The whole surface is covered with longitudinal striæ, those on the anterior portion being further apart than those posteriorly. Remains of food in

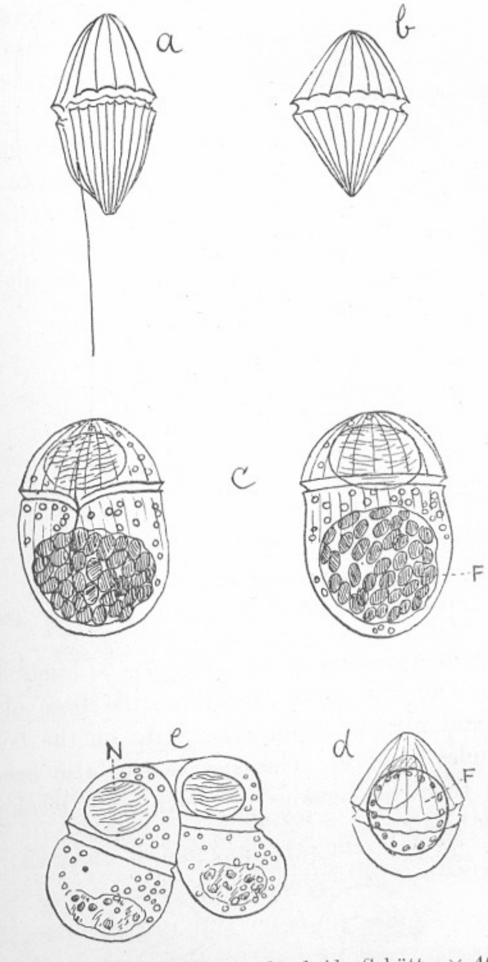

FIG. 6.—*Gymnodinium rhomboides* Schütt. × 466
a side view, *b* dorsal view, *c* ventral and dorsal views of older forms containing food masses of *Phæocystis*, *d* young form containing a *Thalassiosira*, *e* division. N=nucleus. F=food.

a ball is often seen in the hind portion of the body. Nucleus anterior. The body colourless with no chromatophores. Its food consists very often of *Phæocystis pouchetii* when that flagellate is abundant, at other times of diatoms; remains of *Thalassiosira* and *Coscinodiscus* were also found inside the body. Division takes place in the free state as described and figured by Dogiel.

This is perhaps the commonest gymnodinian and occurs close to the shore as well as beyond the Breakwater. Length of body 0·040 mm. to 0·050 mm

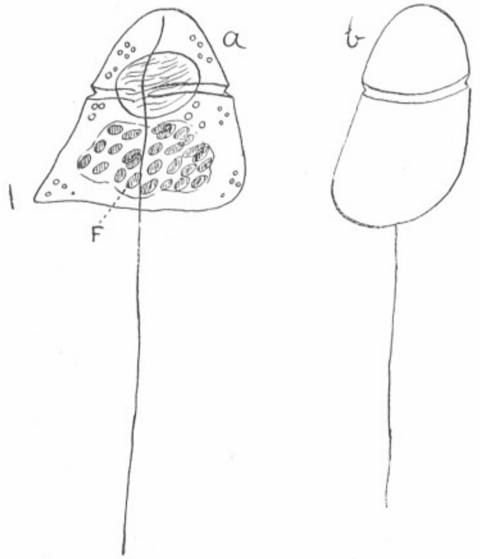

FIG. 7.—*Gymnodinium triangularis* n. sp. × 466.
a ventral view showing contained *Phæocystis*, *b* side view. F=food.

(45) *Gymnodinium triangularis* n. sp. (Fig. 7). Closely related to *G. rhomboides*, but triangular in outline (the base of the triangle posterior) and without longitudinal striæ on the body. Rare in water samples in May. This species had also been feeding on *Phæocystis pouchetii*, remains of which were recognisable inside it. Length 0.045 mm.

FIG. 8.—*Gymnodinium minor* n. sp. × 466.
a dorsal view, *b* ventral view. N=nucleus.

(46) *Gymnodinium minor* n. sp. (Fig. 8). This little species is transparent and destitute of any sculpture. It is nearly spherical but with the posterior end slightly narrower than the anterior. Transverse groove left-handed and only slightly displaced, longitudinal groove reaching to the posterior end. Nucleus nearly

central; green masses, probably food material, at the anterior end. Length 0·028 mm. Occasionally in water samples May to July.

(47) *Gymnodinium filum* n. sp. (Fig. 9). Body long and narrow, tapering to a thread-like point posteriorly. Anterior end conical. Transverse groove almost straight, longitudinal groove reaching about three-quarters of the way to the posterior end. Nucleus behind the centre. A dark brown mass (probably food remains) in front of and at the side of the nucleus. One specimen was found with no coloured body. Body clear and colourless with no striæ. Length 0·065 mm. Rare in water samples July, 1915. Very fragile and easily collapses.

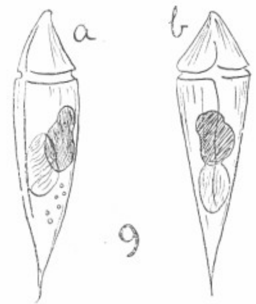

FIG. 9.—*Gymnodinium filum* n. sp. × 466
a side view, *b* ventral view.

Genus SPIRODINIUM Schütt.

(48) N.R. *Spirodinium fissum* (Levander) Lemmermann. Occurs occasionally in August and September in water samples. Conspicuous from its yellow colour and peculiar dorso-ventral flattening. Division in the free state was noticed in September.

(49) N.R. *Spirodinium spirale* (Bergh) (Fig. 10). This species is exceedingly common in the water samples in many varieties. The typical form which agrees with Pouchet's description and figure (1885, p. 67, Plate IV, Fig. 30) is usually much smaller than his specimens and generally colourless, although bright yellow examples are sometimes seen, such as Pouchet himself observed occasionally. The yellow examples are always blunter at the apex than the type which is pronouncedly acuminate. My specimens, including the yellow forms, measure generally 0·04 mm. to 0·06 mm., whereas Pouchet (1883–85) gives 0·10 mm. as the typical size. The longitudinal striations are characteristic,

and green remains of food are sometimes to be found inside the body, also small roundish masses of fat.

The variety *acutum* Schütt (Plate XXI, Fig. 66) is also found, which seems to be close to the typical form and more nearly the size of Bergh's (1882) and Pouchet's specimens. Length of this variety 0·14 mm. One specimen which occurred in August, 1915, was coloured a beautiful carmine, the colour running along

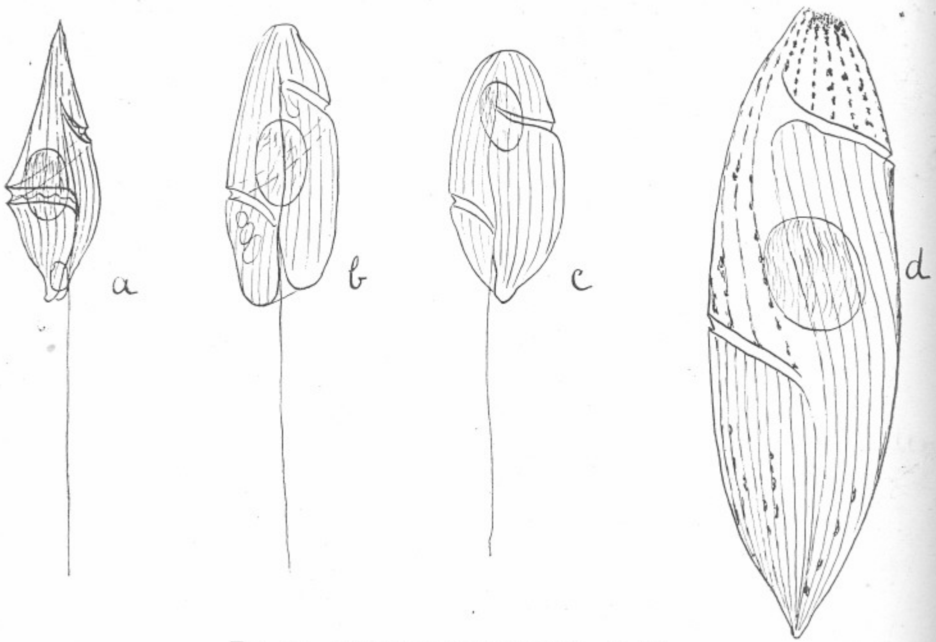

FIG. 10.—*Spirodinium spirale* (Bergh). × 466.
a typical form, *b* and *c* v. *obtusum* Schütt, *d* v. *acutum* Schütt.

the lines of the striæ in droplets. Other specimens are quite colourless.

The variety *obtusum* Schütt is also common but of small size. Length 0·06 mm. usually. Characterised by its blunt apex.

(50) *Spirodinium concentricum* n. sp. (Fig. 11). This species is characterised by the sculpture of concentric striæ on the body, the longitudinal striæ being arranged concentrically round a certain point at the side or on the dorsal surface. Body colourless. Grooves and shape of the body very much like the variety *obtusum* of the preceding species. A large and a small form exist, the larger form being several times the size of the smaller. Both rare, only in the summer of 1915.

(51) N.R. *Spirodinium crassum* (Pouchet) (Fig. 12). I have referred to this species a somewhat rare form which is definitely smaller than the type, length 0·075 mm. (type 0·12–0·2 mm.

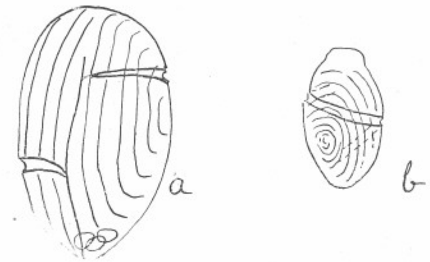

FIG. 11.—*Spirodinium concentricum* n. sp. × 466.
a large form, *b* small form.

Pouchet). In shape and contour of the furrows it corresponds and has a diffuse colouring of brownish red beginning at the apex and following the transverse furrow. Faint longitudinal striæ

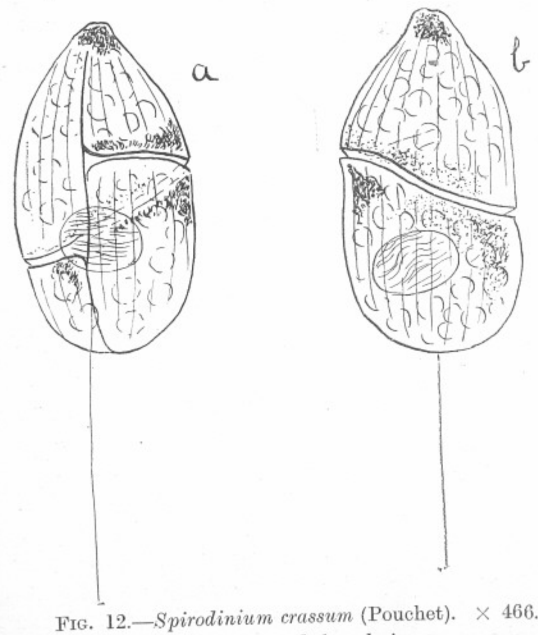

FIG. 12.—*Spirodinium crassum* (Pouchet). × 466.
a ventral view, *b* dorsal view.

are present; transverse furrow with its ends widely separated, longitudinal furrow weakly developed. Nucleus posterior. Interior of body full of large granules. Occurs occasionally in June.

(52) *Spirodinium glaucum* n. sp. (Fig. 13). This is a very common species, perhaps the commonest Spirodinium in this area. It begins in May, having its maximum in May and June and persists till October. A large yellow body posteriorly is characteristic, although this may be absent in young forms and

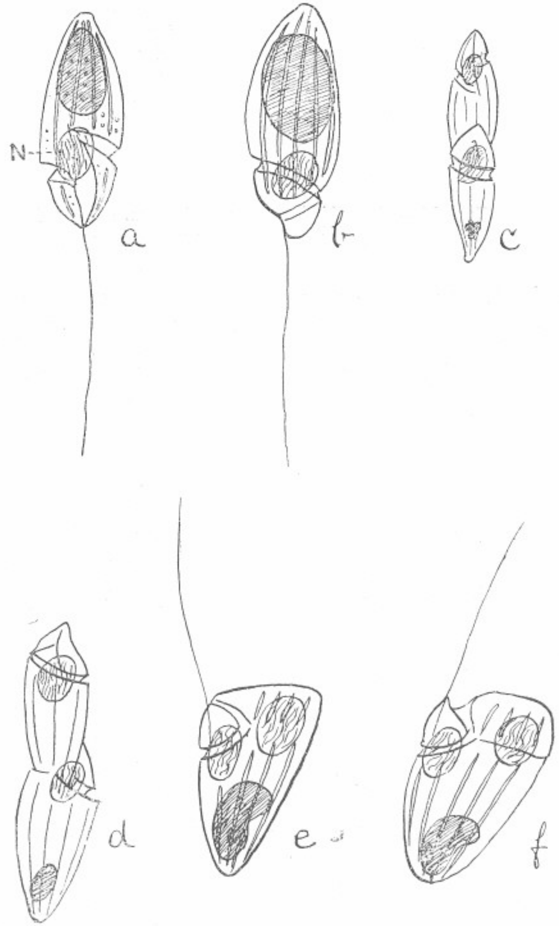

FIG. 13.—*Spirodinium glaucum* n. sp. × 466.
a ventral view, *b* dorsal view, *c–f* division stages. N=nucleus.

possibly is only food remains, although it is always the same colour and in the same place. These yellow bodies are also sometimes absent in divisional stages. The body is elongated with a long anterior and short posterior portion, with a few wide apart longitudinal striæ. Transverse furrow with the ends wide apart; longitudinal furrow short and with the appearance of a

three-cornered bite having been taken out of the posterior end. This species is rather like *G. teredo*, with the exception of the chromatophores which are numerous in the latter species. Cell colourless except for the yellow mass. Nucleus in the region of the transverse furrow. Divisional stages are often seen in the free state, one individual pushing part of its body backward so that a chain of two is formed very much like the figure given by Pouchet of the division of *S. spirale* (loc. cit.). Earlier stages in division show that the longitudinal flagellum persists as is described by Dogiel in his *Gymnodinium spirale* v. *obtusum*. A growth then takes place at the side of the whole body, so that the cell is very much swollen transversely; then division takes place, beginning at the posterior end as a groove and half the cell is pushed backwards so that the chain of two individuals is formed, one attached to the side of the posterior end of its fellow by its extreme anterior end. After division the individuals are small and may

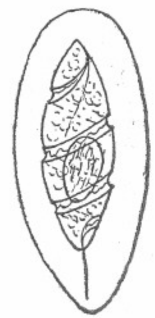

FIG. 14.—*Cochlodinium pulchellum* n. sp. × 466.

or may not contain yellow bodies. In one case the yellow body appeared to be dividing at the same time as the cell, which perhaps shows it to be a chromatophore.

Genus COCHLODINIUM Schütt.

(53) N.R. *Cochlodinium helix* (Pouchet). Occurs occasionally in the water samples in August, sometimes free, sometimes enclosed in a spacious perfectly transparent covering.

(54) N.R. *Cochlodinium pellucidum* Lohmann. Rare. In the water samples in July and August.

(55) *Cochlodinium pulchellum* n. sp. (Fig. 14). This species was found once only in the water samples from 7 fathoms, August, 1915. It is perfectly colourless and contained in a roomy trans-

parent case in which it rotates freely on its longitudinal axis. It is fusiform in shape, and pointed in much the same way at both ends. The transverse furrow makes three complete turns and is deeply grooved. The longitudinal furrow is inconspicuous, making over one turn round the body. Nucleus nearly central. Length of body 0·05 mm., length of case 0·65 mm. This species is very similar to *Pouchetia fusus* Schütt, but without the conspicuous lens and stigma of that form.

Genus POUCHETIA Schütt.

(56) N.R. *Pouchetia armata* Dogiel (1906). This species, with its characteristic stinging capsules, is common in the water samples, especially in May and June. It is sometimes contained in a case, sometimes, and more usually, free. Division into two within the case was seen. So far this species has only been recorded for the Mediterranean.

(57) N.R. *Pouchetia parva* Lohmann. This is fairly frequent in summer, especially in June. The case fits very close to the body, much closer than in *P. armata*. Division in the case is often seen. This species is very like Pouchet's figure (1885) of *P. polyphemus* v. *nigra*, the pigment, however, in his species is red and this is always black.

(58) N.R. *Pouchetia fusus* Schütt (1895). Occurs rarely in September. Conspicuous from its elongated body and large lens with dark red pigment. In one case the pigment mass was breaking up into small red spots. The specimens seen were always free.

Genus POLYKRIKOS Bütschli.

(59) N.R. *Polykrikos Schwarzii* Bütschli. Occurs occasionally in tow nettings and water samples from May throughout the summer.

PYROCYSTEÆ Apstein.

Genus PYROCYSTIS Murray.

(60) *Pyrocystis lunula* Schütt. Occurs occasionally in tow nettings in August and September in various stages of division in the semilunar cases.

Incertae sedis.

(61) N.R. *Oxyrrhis marina* (Duj.). The position of *Oxyrrhis* is still a vexed question, and although Senn (1910) regards it as a true peridinian, the view is not universally accepted (see Klebs, 1912). In my opinion it is more of a peridinian than a true flagellate, the division

stages of *Gymnodinium* and *Spirodinium* being closely related to those of *Oxyrrhis*. *Oxyrrhis marina* occurs sparingly in the water samples, but is to be found in great abundance in cultures in the laboratory in which it thrives with the greatest ease. In cultures of *Nitzschia closterium* especially it flourishes in enormous numbers, the body being full of this diatom on which it feeds.

LITERATURE.

1882. BERGH, R. S. "Der Organismus der Cilio-flagellaten." Morph. Jahrb., Bd. 7.

1906–8. BYGRAVE, W. "Report on the Plankton of the English Channel in 1906." M. B. A. International Fisheries Investigations, 1906–8, Cd. 4641.

1897. CLEVE, P. T. "Plankton Researches in 1887." Kongl. Svensk. Vetensk. Akademiens Handlingar, Bd. 32, No. 7.

1900. —— "The Plankton of the North Sea, English Channel and the Skagerak in 1899." *Ibid.*, Bd. 32, No. 2.

1906. DOGIEL, V. "Beitrage zur Kenntnis der Peridineen." Mitt. aus der Zool., Station Neapel, 18 Bd.

1903*a*. GOUGH, L. "Plankton, English Channel, February, May, August, and November, 1903 and 1904." Bull. d. Rés. acq. pend. l. c. périod pub. p. l. Conseil International pour l'Exploration de la Mer.

1903*b*. —— "Report on the Plankton of the English Channel in 1903." M.B.A. International Fisheries Investigations, Cd. 2670.

1905. —— Cd. 3837.

1912. GRAN, H. H. "The Plankton Production of the North European Waters in the Spring of 1912." Bull. Planktonique, 1912.

1907–14. HERDMAN, W. A. and SCOTT, A. "An Intensive Study of the Marine Plankton around the South End of the Isle of Man." Parts I–VIII. Reports for 1907–14 of the Lancashire Sea Fisheries Laboratory.

1912. KLEBS, G. "Ueber Flagellaten und Algen—ähnliche Perideen." Verhandlungen der Naturhistorisch-medizinischen Vereines zu Heidelberg, N.F. Bd. 11, July, 1912.

1908. LOHMANN, H. "Untersuchungen zur Feststellung des Vollständigen Gehaltes des Meeres an Plankton." Wissenschaftliche Meeresunterserchungen h.v.d. komm. z. wiss. unters. d. deutschen Meere in Kiel, 1908.

1913. MANGIN, L. "Sur la Flore planctonique de la rade de Saint-Vaast-la-Hougue 1908–12." Nouvelles Archives der Muséum d'Histoire naturelle, 5 Sér., 1913.

1910. MEUNIER, A. "Duc d'Orléans, Campagne Arctique de 1907." Microplankton des Mers de Barents et de Kara.

1908. PAULSEN, O. "Nordisches Plankton," Vol. VIII. "Peridiniales."

1883. POUCHET, G. "Contribution à l'Histoire des Cilio-flagellés." J. de l'Anat. et de la Phys., 1883.

1885. —— "Nouvelle contribution à l'histoire des Péridiniens marins."

1910. SENN, G. "Oxyrrhis, Nephroselmis und einige Euflagellaten." Zeitsch. Wissens. Zool., Bd. 97.

1895. SCHÜTT, F. "Die Peridinien des Plankton Expedition." I Thiel.

Some Parasites of *Sagitta bipunctata.*

By

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With text Figures 1–6.

Sagitta has been several times noticed as a host for various parasitic worms, notably a larval nematode and several trematodes. Larval cestodes have also been seen in it. It is exceeding voracious and apparently eats almost any animal food, especially its own species and small crustacea, so that it is not to be wondered at if it forms a convenient intermediate host for many worms, and as *Sagitta* itself is an important fish food it naturally follows that the adults of these parasitic worms are usually found in fish as their final hosts. So far, however, the life histories of the larval forms hitherto found have not been determined, so we are pleased to be able to identify two trematodes belonging to well-known species which inhabit *Sagitta* as intermediate host and fish as the final host.

Busch (1851) and Leuckart and Pagenstecher (1858) have described several larval trematodes and a nematode from *Sagitta*, Ulianin (1871) a nematode, and Pierantoni (1913) a nematode. The latter nematode is probably the same worm found in *Sagitta* in Plymouth Sound. Busch's description of a nematode in *Sagitta* is too vague to recognise it, and unfortunately Ulianin's paper has not been available for reference. Leuckart and Pagenstecher mention two larval trematodes from *Sagitta germanica* (=*Sagitta bipunctata* Q. and G.), one a monostome and the other a distome. Although these are figured, they are neither described nor named. The distome (Plate XXI, Fig. 9) is probably the larval *Derogenes varicus* which occurs in *Sagitta bipunctata* in Plymouth Sound. Busch's trematode larvæ found in *Sagitta cephaloptera* (=*Spadella cephaloptera*) were identified by him as *Distomum papillosum* Diesing (=*Distomum beroë* Will (1844)) and two new species, one of which he names *Distomum fimbriatum* and the other *Distomum crassicaudatum*. *Distomum papillorum* appears to be a larval *Hemiurus*, *D. fimbriatum* is not described sufficiently to recognise, and *D. crassicaudatum* seems also to be a species of *Hemiurus*. As *Derogenes* is a genus closely related to *Hemiurus* it is interesting to find that both inhabit *Sagitta* as an intermediate host.

In Plymouth Sound the only species of *Sagitta* is *S. bipunctata* Q. and G. In 1916 Mr. Smith called my attention to the number of parasitic nematodes in it from old plankton samples. Afterwards it was found to be very common in the fresh samples and quite the commonest parasite of *Sagitta*. It is a larval *Ascaris*, and in all probability is the same species as that described by Pierantoni (1913) from *Sagitta* in the Bay of Naples, and he has also found them from Villafranca, Wimereux and Trieste. In his brief note on the worm he suggests that it may be identical with an *Agamonema* described by Stossich from a *Ranzana*, one of the *Molidæ*. The final host of the nematode from the Plymouth *Sagitta* is quite unknown, but one would expect it to be something common judging from the frequency of its occurrence.

This larval *Ascaris* occupies the body cavity of *Sagitta*, lying lengthwise, and sometimes is three-quarters the length of its host. The figure here given (Fig. 1, Plate I) is from a small specimen. The body is colourless and measures 3 to 17 mm. in length and is very narrow. The anterior end is provided with a large larval hook for boring; the œsophagus is long and prolonged behind by the side of the intestine into a blind œsophageal sac: the intestine which occupies nearly the whole of the body, since the reproductive organs are not yet present, gives off forwards a second blind sac, the blind intestine, which runs along by the side of the œsophagus. The anus is near the tail, the latter ending in a small sharp spike. The brain is plainly seen as a broad band anteriorly running round the œsophagus, and just behind it is the excretory pore from which can be traced the thin excretory duct. A large proportion of the Sagittæ brought in by the tow nets is infected with this nematode.

Two trematode larvæ are also common in the local *Sagitta*, the larva of *Derogenes varicus* (O. F. Müller) and the larva of *Pharyngora bacillaris* (Molin). Both of these inhabit common fish in their adult state.

Derogenes varicus is one of the commonest trematodes with a wide distribution, and occurs in a number of different fish. Odhner (1906) states that about a dozen and a half northern fish are recorded as its hosts. Nicoll (1914) quotes twenty-eight different fish as its hosts from the Channel, *Cottus*, various *Gadidæ* and a few Plemonectids are the common hosts. It occupies the stomach of these fish.

Levinsen (1881) records the larval form of this trematode from *Harmothoë imbricata*, and finds the remains of this annelid in the stomach of *Cottus*. It is very interesting to find the larva in the Sound inhabiting

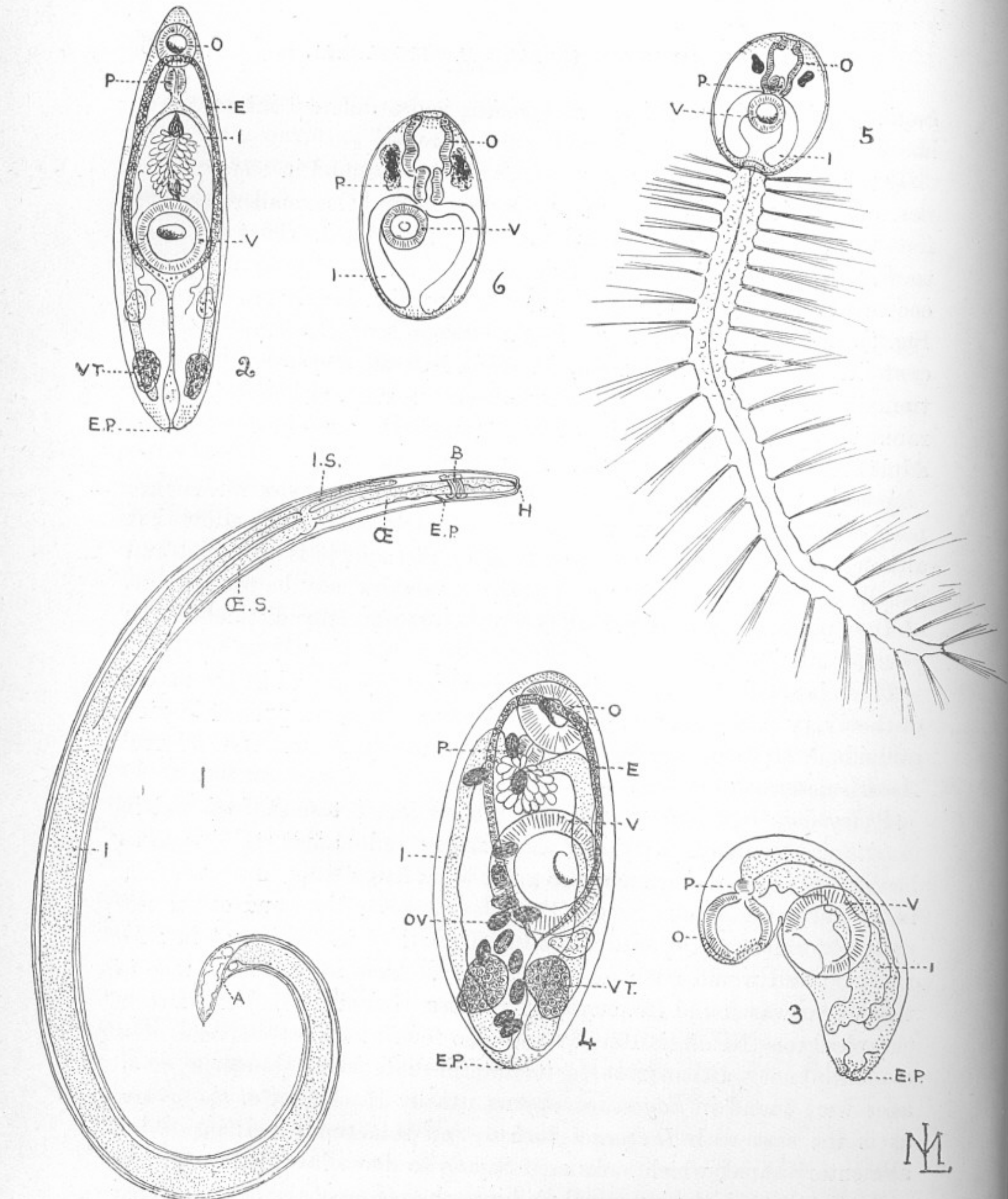
Sagitta, which looks as if *Derogenes varicus* had a different intermediate host in the open sea than it does near the shore.

The larger larvæ of *Derogenes varicus* which are found in *Sagitta* have nearly all the adult characters (Plate I, Fig. 2), and the smaller ones are found in intermediate stages and are easily recognised. That we have to do with the true *Derogenes varicus* is placed beyond a doubt by the occurrence of a mature specimen in *Sagitta* which bears eggs (Plate I, Fig. 4). A parallel case is found in *Echiurus pallasii* (Greef, 1879) which contained a mature *Distomum*, *D. echiuri* Greef, and other cases of trematode larvæ producing eggs have been recorded, although they are rare. The present specimen has only a few eggs, whereas in the ordinary adult stage in a fish they are very numerous.

A curious fact noticed is that all these larval *Derogenes varicus* are beset with small spines, whereas it is a characteristic of the adult that although it has sometimes a wrinkling of the skin it is unarmed and usually smooth. It is possible that these wrinkles may be the remains of the spines fused together. The spines are specially distinct in the younger specimens.

These larval *Derogenes varicus* are nearly always found in the region of the ovary of *Sagitta*, and there is rarely more than one present in each individual, although one may be present at the same time as the larval *Ascaris* described above.

Pharyngora bacillaris (Molin), the second larval trematode found in *Sagitta*, is a common parasite of the mackerel in its adult state, and has been found in the whiting and also a few other fish, except in the whiting, in an immature state. Nicoll (1914) found many thousand of the immature form in *Cyclopterus lumpus*. These had probably got in with the food and would not come to maturity. The late cercaria stage of this worm was found frequently in medusæ (Lebour, 1916) and free in the plankton (Nicoll, 1910). It was also found in ctenophores, so it is evidently not particular as to its intermediate host. Cercariæ of all ages were found in *Sagitta* occupying usually the region of the ovary, as is the case with *Derogenes varicus*, but sometimes it is inside the alimentary canal, which looks as if *Sagitta* swallows it and afterwards it migrates through the intestinal wall into the region of the ovary. What I have no doubt is the free-swimming cercaria of this trematode was found once in tow nettings on January 28th, 1916. *Sagitta* from the same samples contained these cercariæ without their tails, and it could be traced up to the ordinary *Pharyngora* late cercaria stage, such as was found in the medusæ and free in the plankton. The free-swimming cercaria is extremely interesting (Fig. 6). It is provided with a large tail several times the length of the body and armed with bunches of



EXPLANATION OF FIGURES.

FIG. 1.—Larval *Ascaris* from *Sagitta* $\times 60$. A anus, Œ œsophagus, Œ.S blind sac from œsophagus, B brain, I intestine, I.S blind sac from intestine, H boring hook.

FIGS. 2–3.—*Derogenes varicus* from *Sagitta* $\times 60$.

FIG. 4.—Ditto containing eggs $\times 60$.

FIG. 5.—Free-swimming cercaria of *Pharyngora bacillaris* $\times 60$.

FIG. 6.—Cercaria of *Pharyngora bacillaris* from *Sagitta* $\times 60$. O oral sucker, V ventral sucker, E excretory duct, E.P excretory pore, I intestine, P pharynx, VT vitellaria, OV ova.

long bristles placed at regular intervals and giving it the appearance of an annelid. The tail is an efficient swimming organ, and the bristles no doubt serve for keeping the whole animal floating. Two large kidney-shaped black eyes are conspicuous, the oral sucker has the typical *Pharyngora* form which is more like a pharynx in shape, the true pharynx leading from it to a short œsophagus and intestinal cœca reaching to the end of the body. The whole body is covered with small spines. In the specimens inside *Sagitta* the eyes have begun to show diffuse pigment as in the older specimens instead of its being in a thick black mass as in the free-swimming form.

Neither *Derogenes varicus* nor *Pharyngora bacillaris* have been found encysted, and it is presumed that the encysted stage is omitted as the cercariæ develop in *Sagitta* and the other hosts into a late form which is ready to enter its final host. The first host which presumably is a mollusk is yet to be discovered for both of these trematodes.

Two larval cestodes were also found in *Sagitta* from the Sound, one with four suckers and one with none. These were not identified. It is evident that we have in *Sagitta* an exceptionally good host for many parasites, and probably further investigation would be amply repaid.

LITERATURE.

1851. BUSCH, W. "Beobacht, über Anat. und Entwickl. Wirbelloser Seethiere," Berlin, p. 98.

1879. GREEF, R. "Die Echiuren." Nova Acta der Ksl. Leop. Carl. Deutschen Akad. d. Naturf. XLI., Pt. II, No. 1.

1916. LEBOUR, M. V. "Medusæ as Hosts for Trematodes." J. M. B. A., Vol. XI, No. 1.

1858. LEUCKART, R. UND PAGENSTECHER, A. "Untersuchungen über niedere Seethiere." Müller's Archiv., p. 559.

1881. LEVINSEN, G. M. R. "Bidrag til Kundskab om Grönlands Trematodfauna." Over. K. D. Videns. Selsk. Forh., p. 80.

1910. NICOLL, W. "On the Entozoa of Fishes from the Firth of Clyde." Parasitology, Vol. III, No. 3.

1914. NICOLL, W. "The Trematode Parasites of Fishes from the English Channel." J. M. B. A., Vol. X, No. 3.

1906. ODHNER, T. "Die Trematoden des Arktischen Gebietes." Fauna Arctica.

1913. PIERANTONI, U. "Sopra un Nematode Parassita della 'Sagitta' e sul suo probabile ciclo evolutivo." Trans. from IX. Congrès International de Zool. tenu a Monaco, p. 663.

1871.* ULIANIN. "Ueber die pelagische Fauna des schwarzen Meeres." Verhandl. d. Moskauer Freunde d. Natur.

1844. WILL, F. "Ueber Distoma beroës." Archiv. f. Naturgesch., Vol. X, p. 343.

* Not seen by the present writer.

Post-Larval Teleosteans collected near Plymouth during the summer of 1914.

By

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With 8 Figures in the Text.

IN Volume X, No. 2, of this Journal issued in June, 1914, Mr. R. S. Clark published an account of the post-larval fishes collected during the years 1906 to 1913 with the Petersen Young-fish Trawl in the neighbourhood of Plymouth. Similar collections were continued regularly under Mr. Clark's supervision, with the assistance of Mr. E. Ford and Mr. F. M. Gossen, from April to July, 1914, and two or three hauls were made in August and September of that year. At the beginning of August Mr. Clark joined Sir Ernest Shackleton's expedition to the Antarctic and left Plymouth in the "Endurance." The young fishes had for the most part been picked out from the general material collected by the young-fish trawl by Messrs. Ford and Gossen, and it is this collection of young fishes which forms the subject of the present report.

In drawing up the report I have followed closely the arrangement adopted by Mr. Clark for the earlier material, and it should be regarded throughout as being supplementary to his paper (**1914**). For most of the important fishes I have given a monthly summary of the number of specimens captured during the whole period 1906 to 1914, which includes both the figures given by Clark and those now added. The average number of specimens taken per haul of the trawl has also been given for each month. For many reasons, however, these averages cannot claim any great degree of accuracy, but they are, I think, useful as giving a general idea of the relative frequency in the different months. The following sources of error must be borne in mind when drawing conclusions from the averages. The duration of the hauls has been in most cases twenty minutes, but there are a few instances where the time was fifteen minutes and a few where it was thirty minutes. The error introduced by regarding all the hauls as of equal duration will be so small that it will hardly show in the average figures given.

A more important error will be caused by the fact that the hauls are not distributed with any uniformity over the whole area. The great majority were, however, made outside the 20-fathom line where the conditions are moderately uniform, but in calculating the averages these have not been separated from the hauls made nearer the shore and in the bays.

Some of the hauls were made at the surface, some at midwater, and some near the bottom, whilst some few are night hauls, which seem to yield larger numbers, especially at the surface, than those made during the day. These circumstances will all tend to diminish the accuracy of the averages, but they do not, I think, destroy their more general significance.

The number of hauls made in each month varies considerably, but from May to September the totals are fairly large (Table II). The number of hauls made in the different years for any given month, as will be seen from the same table, varies so very much that it is not possible to make reliable comparisons of the frequency of any species from year to year.

Another source of error is introduced by the fact that the material of which the young-fish trawl is constructed is not altogether satisfactory, and the size of the mesh often differs considerably in different samples, so that even two new trawls may have different catching powers. With use also the material shrinks badly, the meshes become smaller and the amount of water filtered through the net (and hence the catching power) is greatly diminished. All these circumstances make the numerical results approximate only.

Table I gives the list of stations at which hauls were made in 1914. The Chart Area, to which each haul is assigned, is that shown on the chart published in Clark's Report (**1914**).

TABLE I. LIST OF STATIONS.

Explanation of abbreviations. S.=surface. M.=midwater. B.=bottom. M.H.=midnight haul (between 10 p.m. & 2 a.m.).

No. of haul.	Date.	Depth of capture.	Duration of haul in minutes.	Locality.	Total depth in fathoms.	Chart area.
V.	29.iv.14	B.	20	Eddystone S. by W. 4 miles	28	S.
VI.	,,	M.	20	Rame N.E. by E. $4\frac{1}{2}$ miles	28	S.
VII.	,,	S.	20	Rame N.E. $3\frac{1}{2}$ miles	28	T.
VIII.(1)	8.v.14	M.	25	Cawsand	$\angle 10$	T.U.
VIII.(2)	,,	M.	20	Cawsand	$\angle 10$	T.U.
IX.(1)	15.v.14	M.	20	Bigbury Bay (west part)	ca. 10	W.Y.
IX.(3)	,,	S.	20	Bigbury Bay (central)	ca. 14	Y.
IX.(5)	,,	B.	20	Bigbury Bay (east of B. Island)	ca.12–14	Y.
X.	19.v.14	M.	20	Eddystone N. by E. 5 miles	37	O.
XI.	,,	S.	20	Eddystone N. $5\frac{1}{2}$ miles. M.H.	38	R.
XII.	,,	S.	20	Eddystone N. 6 miles. M.H.	39	R.
XIII.	,,	M.	20	Eddystone N. $6\frac{1}{2}$ miles. M.H.	39	Q.
XIII.a	22.v.14	—	20	Eddystone S.W. 3 miles	28	S.
XIV.	25.v.14	M.	20	Eddystone N. 4 miles. M.H.	35–36	R.
XV.	,,	S.	20	Eddystone N. $4\frac{1}{2}$ miles. M.H.	36	R.
XVI.	,,	S.	20	Eddystone N. 5 miles. M.H.	37	R.
XVII.	3.vi.14	B.	20	Rame E. 4 miles	26	T.
XVIII.	,,	B.	20	Rame E. $4\frac{1}{2}$ miles	27	M.
XIX.	,,	M.	20	Rame E. $4\frac{1}{2}$ miles	27	M.
XX.	10.vi.14	S.–M.	20	Rame E. 7 miles. M.H.	27	M.
XXI.	11.vi.14	M.	20	Rame E. 7 miles. M.H.	27	M.
XXII.	,,	M.–B.	20	Rame E. 7 miles. M.H.	27	M.

TABLE I. LIST OF STATIONS.

Explanation of abbreviations. S.=surface. M.=midwater. B.=bottom. M.H.=midnight haul (between 10 p.m. & 2 a.m.).

No. of haul.	Date.	Depth of capture.	Duration of haul in minutes.	Locality.	Total depth in fathoms.	Chart area.
XXIII.	11.vi.14	B.	20	Rame E. 7 miles. M.H.	27	M.
XXIV.	16.vi.14	B.	20	Between Penlee and Rame Head	ca. 15	T.
XXV.	,,	B.	20	Rame E. 1½ miles	22	T.
XXVI.	,,	B.	20	Rame E. 3 miles	23	T.
XXVII.	,,	M.	20	Rame E. 5 miles	27	M.
XXVIII.	,,	B.	15	Eddystone S.S.W. 3 miles (Mosquito net YFT.)	29	S.
XXIX.	17.vi.14	B.	20	Off Rame Head 2 miles	15	T.
XXX.	,,	M.	20	Off Rame Head 2 miles	11	T.
XXXI.	,,	M.	20	Rame Head N. by E. 4½ miles	28	S.
XXXII.	,,	S.	20	Eddystone S.W. 2 miles	29	S.
XXXIII.	19.vi.14	M.	20	Looe Island N.N.E. 5 miles	28	M.
XXXIV.	,,	M.	20	Looe Island N. by E. 5 miles	29	M.
XXXV.	,,	M.	20	Eddystone S.S.E. 4½ miles	28	N.
XXXVI.	24.vi.14	B.	20	Eddystone W. by N. ½ mile	23	S.
XXXVII.	,,	B.	20	Eddystone N.N.W. 1 mile	32	S.
XXXVIII.	,,	M.	20	Eddystone N. 2½ miles	35	R.
XXXIX.	,,	S.	20	Eddystone N. by E. 3½ miles	37	R.
XLI.	26.vi.14	B.	20	Eddystone N.E. by E. 3½ miles	36	R.
XLII.	29.vi.14	B.	20	Stoke Point N.E. 4 miles	24	X.
XLIII.	,,	B.	20	Stoke Point N.E. by N. 5 miles	27	X.
XLIV.	,,	M.	20	Bolt Tail E. by N. 5 miles	25	Z.
XLV.	,,	S.	20	Bolt Tail E.N.E. 6 miles	31	Z.

TABLE I. LIST OF STATIONS.

Explanation of abbreviations. S.=surface. M.=midwater. B.=bottom. M.H.=midnight haul (between 10 p.m. & 2 a.m.).

No. of haul.	Date.	Depth of capture.	Duration of haul in minutes.	Locality.	Total depth in fathoms.	Chart area.
XLVI.	2.vii.14	S.	20	Prawle Point N.E. 2 miles. M.H.	31	—
XLVII.	,,	S.	20	Prawle Point N.E. by N. 2 miles. M.H.	31	—
XLVIII.	,,	M.	20	Start Point N.E. 2 miles	27	—
XLIX.	,,	M.–B.	20	Start Point N.N.E. 2 miles. M.H.	32	—
L.	6.vii.14	B.	20	Rame N.N.W. 1 mile	20	T.
LI.	,,	B.	20	Rame N.N.W. 1½ miles	25	T.
LII.	,,	M.	20	Rame N.W. by N. 2½ miles	24	T.
LIII.	,,	B.	20	Cawsand Bay	∠10	T.U.
LIV.	9.vii.14	S.	20	Looe Is. W.N.W. ¼ mile	5	L.
LV.	,,	M.	20	Looe Is. N.W. 1 mile	10	M.
LVI.	,,	B.	20	Looe Is. N.N.W. 2 miles	23	M.
LVII.	,,	B.	20	Looe Is. N. 2 miles	23	M.
LVIII.	,,	M.	20	Rame Hd. E. by S. 2 miles	21	T.
LIX.	15.vii.14	M.	20	Rame E. 4 miles. M.H.	26	T.
LX.	,,	M.	20	Rame E. 4 miles. M.H.	26	T.
LXI.	16.vii.14	B.	20	Rame E. 6 miles	26	M.
LXII.	,,	B.	20	Rame E. 7 miles	27	M.
LXIII.	22.vii.14	B.	20	Cawsand Bay	∠10	T.U.
LXIV.	,,	B.	20	Between Penlee and Rame Bottom	10–12	T.
LXV.	,,	B.	20	Whitsands E.	∠10	T.U.
LXVI.	,,	M.	20	Whitsands W.	∠10	L.
LXVII.	,,	M.	20	Eddystone E. 1½ miles	32	S.

TABLE I. LIST OF STATIONS.

Explanation of abbreviations. S.=surface. M=midwater. B.=bottom. M.H.=midnight haul (between 10 p.m. & 2 a.m.).

No. of haul.	Date.	Depth of capture.	Duration of haul in minutes.	Locality.	Total depth in fathoms.	Chart area.
LXVIII.	22.vii.14	B.	20	Eddystone N.E. 4 miles	37	R.
LXIX.	,,	S.	20	Eddystone N.E. by N. 6 miles	38	Q.
LXX.	,,	M	20	Eddystone N.E. by N. 6 miles	38	Q.
LXXI.	,,	B.	20	Eddystone N. by E. 6 miles (Mosquito net)	38	Q.
LXXII.	,,	B.	20	Eddystone N. by E. 6 miles (Mosquito net)	38	Q.
LXXIII.	29.vii.14	M.	20	Eddystone S. $\frac{1}{4}$ mile	20	S.
LXXIV.	,,	M.	20	Eddystone S.E. by E. $\frac{1}{4}$ mile	20	S.
LXXV.	,,	B.	20	Eddystone N.E. by N. $\frac{1}{2}$ mile	25	S.
LXXVI.	,,	M.	20	Eddystone N. 2 miles	35	R.
LXXVII.	,,	B.	20	Eddystone N. by W. 2 miles	35	R.
LXXVIII.	,,	M.	20	Eddystone S.W. $4\frac{1}{2}$ miles	28	S.
LXXX.	,,	M.	20	Whitsand Bay E.	∠10	T.U.
LXXXI.	,,	M.	20	Whitsand Bay E.	∠10	T.U.
LXXXII.	,,	M.	20	Whitsand Bay W.	∠10	L.
LXXXIII.	,,	B.	20	Rame E. by S. $3\frac{1}{2}$ miles	23	T.
LXXXIV.	,,	B.	20	Rame E. by S. 4 miles (Mosquito net)	23	T.
LXXXV.	12.viii.14	M.	20	Rame E. by N. 5 miles	27	M.
LXXXVI.	,,	B.–M.	20	Rame E. by N. 4 miles	26	T.
LXXXVII.	4.ix.14	M.	30	Off Penlee	ca. 12	T.

Table II, showing the Number of Hauls made with the Young-fish Trawl in each month for each of the years from 1906 to 1914 in which investigations were carried on.

MONTHLY NUMBER OF HAULS.

	1906.	1907.	1908.	1909.	1913.	1914.	Total.
March	—	2	—	—	—	—	2
April	—	2	—	2	—	3	7
May	8	—	4	5	—	13	30
June	10	2	31	12	23	28	106
July	4	4	10	9	29	38	94
August	—	—	9	10	54	2	75
September	7	—	—	—	77	1	85
October	1	—	—	—	13	—	14
November	—	—	—	—	9	—	9

CLUPEIDÆ.

As in the previous years the Clupeidæ show a very marked maximum frequency in May and the first half of June. A considerable number of specimens have been stained and the vertebræ counted. In all cases these have proved to be sprats, and there seems no doubt that the sprat constitutes by far the greater proportion of the specimens taken during the months in which the 1914 material was collected. This is rendered more probable by the fact that the abundance of black pigment in the neighbourhood of the anus, which Ehrenbaum considers to be one of the distinguishing characters of post-larval sprats, was observed in nearly all the specimens examined. Unfortunately in the present state of our knowledge of the early stages of the different species of Clupea, the detection of a few specimens of *C. harengus* or *C. pilchardus* amongst the large quantities of *C. sprattus* which are caught in the young-fish trawl is from a practical point of view impossible, the labour involved in staining and counting the vertebræ of so many specimens being altogether out of proportion to the value of the information which would be gained.

TABLE III.

Record of Clupea sp.

No. of haul.	Date.	Depth.	No.	Size in mm.
V.	29.iv.14	B.	74	7–16·5
VI.	,,	M.	13	5·6–11·5
VII.	,,	S.	62	6–22
VIII. (1)	8.v.14	M.	Very many	9·5–25
VIII. (2)	,,	M.	220	9·5–24
IX. (1)	15.v.14	M.	54	9–22·5
IX. (3)	,,	S.	5	12–16·5
IX. (5)	,,	B.	80	6–24
XI.	19.v.14	S.	1	16
XII.	,,	S.	460	6·2–20
XIII.	,,	M.	406	5·5–20
XIV.	25.v.14	M.	Very many	8–25
XV.	,,	S.	Many thousands	
XVI.	,,	S.	,, ,,	9–25
XVII.	3.vi.14	B.	218	6·7–18·5
XVIII.	,,	B.	415	6·1–18·5
XIX.	,,	M.	195	6–19·5
XX.	10.vi.14	S.–M.	Very many	10·5–28
XXII.	11.vi.14	M.–B.	,, ,,	
XXIII.	,,	B.	80	14–27
XXIV.	16.vi.14	B.	7	14·5–19·5
XXV.	,,	B.	9	12·3–18 ca.
XXVI.	,,	B.	7	9–17
XXVII.	,,	M.	34	11·6–20
XXIX.	17.vi.14	B.	5	14–24
XXXI.	,,	M.	5	11·5–23·5
XXXII.	,,	S.	65	11·5–25
XXXIV.	19.vi.14	M.	3	8·2–13
XXXV.	,,	M.	10	7·2–20·5
XXXVI.	24.vi.14	B.	10	7·7–14·5
XXXVII.	,,	B.	11	7·5–19
XXXVIII.	,,	M.	26	7–16
XXXIX.	,,	S.	10	7·5–20
XLII.	29.vi.14	B.	2	10–13
XLIII.	,,	B.	6	9–13
XLIV.	,,	M.	4	9·5–11·5
XLV.	,,	S.	1	9·5
XLIX.	2.vii.14	M.–B.	71	11·5–35·5

TABLE III. (*continued*).

No. of haul.	Date.	Depth.	No.	Size in mm.
L.	6.vii.14	B.	6	13–28 ca.
LI.	,,	B.	9	11·5–19
LII.	,,	M.	3	12–21
LIII.	,,	B.	1	19
LIV.	9.vii.14	S.	7	13·5–24
LV.	,,	M.	3	15–16·5
LVI.	,,	B.	2	17–19
LVII.	,,	B.	1	20
LVIII.	,,	M.	2	19·5–22
LIX.	15.vii.14	M.	30	13–26
LX.	,,	M.	35	13–29
LXI.	16.vii.14	B.	89	11–26
LXII.	,,	B.	4	12·5–17
LXVII.	22.vii.14	M.	7	5·7–15·5
LXVIII.	,,	B.	30	10–17
LXIX.	,,	S.	7	13–21
LXX.	,,	M.	2	9·5–14
LXXIII.	29.vii.14	M.	1	17
LXXV.	,,	B.	11	9·5–17
LXXVII.	,,	B.	2	10–10·5
LXXVIII.	,,	M.	1	21
LXXXIII.	,,	B.	1	19
LXXXIV.	,,	B.	2	21–23
LXXXVII.	4.ix.14	M.	2	20·5–22·3

SYNGNATHIDÆ.

Only six specimens belonging to this family are present in the material, the small number being due to the fact that most of the hauls were made at considerable distances from the shore. The four hauls in which they occurred were made between Penlee and Rame Head and in Whitsand Bay, the total depth of water being in all cases not greater than 15 fathoms.

TABLE IV.

Record of Syngnathus rostellatus.

No. of haul.	Date.	Depth.	No.	Size in mm.
XXIX.	17.vi.14	B.	1	26·5
LXIV.	22.vii.14	B.	1	17·5
LXXX.	29.vii.14	M.	2	23–30·5
LXXXI.	,,	M.	2	35–52

AMMODYTIDÆ.

All the specimens of Ammodytes appear to belong to the same species, which is probably *A. lanceolatus*, though as Clark (**1914**) points out, it is difficult to distinguish between the young stages of *A. lanceolatus* and *A. tobianus*. Table V. gives the records for 1914, whilst Table VI. gives the monthly totals and averages per haul for all the years 1906–1914 for which records exist. The average shows a gradual rise to a maximum in August and then a sudden drop (cf. Clark (**1914**), p. 340).

TABLE V.

RECORD OF AMMODYTES SP.

No. of haul.	Date.	Depth.	No.	Size in mm.
V.	29.iv.14	B.	5	10·5–29
VI.	,,	M.	1	20
VII.	,,	S.	1	22·6
IX.	15.v.14	B.	2	7, 17
XII.	19.v.14	S.	2	12·6, 19
XIII.	,,	M.	1	7
XIII. a	22.v.14		1	14
XIV.	25.v.14	M.	2	7·5, 8
XVI.	,,	S.	3	6–11·5
XVII.	3.vi.14	B.	10	9–18
XVIII.	,,	B.	14	5·6, 12·3–18
XXI.	11.vi.14	M.	1	10·6
XXII.	11.vi.14	M.–B.	1	7·5
XXVI.	16.vi.14	B.	4	8·5–10·5
XXVII.	,,	M.	1	8 ca.
XXX.	17.vi.14	M.	3	9–23
XXXI.	,,	M.	1	8 ca.
XXXII.	,,	S.	1	12·5
XXXIII.	19.vi.14	M.	1	20·5
XXXIV.	,,	M.	1	13
XXXV.	,,	M.	7	7·6–12·6
XXXVII.	24.vi.14	B.	4	6–15·5
XXXVIII.	,,	M.	5	5·5–15
XXXIX.	,,	S.	1	10
XLVI.	2.vii.14	S.	1	12·5
XLVIII.	,,	M.	2	9–13
L.	6.vii.14	B.	9	11–24

No. of haul.	Date.	Depth.	No.	Size in mm.
LI.	6.vii.14	B.	3	12·5–18·5
LII.	,,	M.	3	23 ca.
LIV.	9.vii.14	S.	1	18·5
LVI.	,,	B.	2	12–17·5
LVII.	,,	B.	1	12 ca.
LIX.	15.vii.14	M.	7	10–16
LX.	,,	M.	8	12–23·5
LXI.	16.vii.14	B.	5	13·7–30
LXII.	,,	B.	5	15–19·5
LXVI.	22.vii.14	M.	1	12
LXVII.	,,	M.	8	8–12·5
LXVIII.	,,	B.	16	7–14·8
LXIX.	,,	S.	3	9–13
LXXIII.	29.vii.14	M.	2	13–15
LXXIV.	,,	M.	1	12
LXXV.	,,	B.	13	6·5–15·8

TABLE VI.

AMMODYTES SP.

Month.	Total number of hauls 1906–1914.	Number of hauls in which the species occurs.	Number of specimens.	Size in mm.	Average number per haul.
March	2	1	1	8·5	0·5
April	7	6	14	6·5–29	2
May	30	11	32	6–29	1·07
June	106	49	247	5·5–104	2·3
July	94	52	420	5–30	4·5
August	75	46	506	4·5–25	6·7
September	85	12	14	5·5–24	0·16
October	14	0	0		
November	9	0	0		

GADIDÆ.

Gadus pollachius L. *G. merlangus* L. *G. minutus* O. F. Müller. *G. luscus* L.

Table VII. gives the records of the above species for 1914, whilst Tables VIII. to XI. show the monthly totals and averages of all the records from 1906–1914. The few specimens of *G. pollachius* taken in 1914 were nearly all taken in April and the first half of May. The maximum frequency for the whole period is in March and April. For the whiting

(*G. merlangus*) the maximum is in May, whilst in June specimens of the sizes captured by the young-fish trawl are still fairly numerous. May also shows a distinct maximum for *G. luscus* and *G. minutus*. Specimens of all these gadoids are very infrequent in hauls taken after June.

TABLE VII.

Record of Gadus sp.

No. of haul.	Date.	Depth.	G. pollachius. No.	G. pollachius. Size in mm.	G. merlangus. No.	G. merlangus. Size in mm.	G. luscus. No.	G. luscus. Size in mm.	G. minutus. No.	G. minutus. Size in mm.
V.	29.iv.14	B.	2	6–16·5	2	6–6·5	—	—	6	7–14
VI.	,,	M.	—	—	—	—	—	—	2	7·5–10·5
VII.	,,	S.	7	5·5–13	—	—	—	—	—	—
VIII.(2)	8. v.14	M.	—	—	1	7	—	—	1	8·5
IX.(1)	15.v.14	M.	4	8–10	103	5·5–11·5	—	—	—	—
IX.(3)	,,	S.	6	7·5–9·5	5	8·5–10·2	—	—	—	—
IX.(5)	,,	B.	—	—	211	6·5–15	4	6–8	1	7·5
X.	19.v.14	M.	—	—	10	6–16	—	—	—	—
XI.	,,	S.	3	5·5–9	1	6·5	—	—	2	7–9
XII.	,,	S.	3	9·6–13	4	7–12	5	6–9·8	16	5·4–12·3
XIII.	,,	M.	—	—	8	5·5–8·3	7	5·6–6·2	158	5·5–15
XIV.	25.v.14	M.	—	—	21	7·2–14	11	6·5–16	34	6·5–16
XV.	,,	S	—	—	4	8–13	2	8–8·5	23	6·7–14
XVI.	,,	S.	—	—	14	5·5–18	6	7·8–12·7	89	6–17
XVII.	3.vi.14	B.	—	—	31	6·3–9·5	—	—	4	5·3–8·5
XVIII.	,,	B.	—	—	24	6·5–11	—	—	—	—
XIX.	,,	M.	—	—	6	7–13	—	—	—	—
XX.	10.vi.14	S.–M.	—	—	—	—	1	9·3	—	—
XXI.	11.vi.14	M.	—	—	3	8·5–9·5	1	9·5	—	—
XXII.	,,	M.–B.	—	—	1	8·5	—	—	3	6·5–17·7
XXIII.	,,	B.	—	—	—	—	1	7	8	7·6–10
XXV.	16.vi.14	B.	—	—	1	6	—	—	—	—
XXVI.	,,	B.	—	—	4	6·2–16	—	—	—	—
XXVIII.	,,	B.	—	—	1	11	—	—	—	—
XXX.	17.vi.14	M.	1	5·6	2	8–13·5	—	—	—	—
XXXII.	,,	S.	—	—	4	9–18	—	—	—	—
XXXVI.	24.vi.14	B.	—	—	1	14	—	—	—	—
XXXVII.	,,	B.	—	—	—	—	—	—	1	18
XXXVIII.	,,	M.	—	—	2	11–11·5	2	5·3–5·5	—	—
XLI.	26.vi.14	B.	—	—	—	—	—	—	25	11–28
XLIV.	29.vi.14	M.	—	—	1	19	—	—	—	—
XLVI.	2.vii.14	S.	—	—	2	25–31	1	10·2	—	—
LV.	9.vii.14	M.	—	—	1	7·5	—	—	—	—
LXVII.	22.vii.14	M.	1	7.2	—	—	—	—	—	—
LXVIII.	,,	B.	—	—	—	—	—	—	1	8·6
LXXVII.	29.vii.14	B.	—	—	—	—	—	—	1	12·4

TABLE VIII.

Gadus pollachius.

Month.	Total number of hauls 1906–1914.	Number of hauls in which the species occurs.	Number of specimens.	Size in mm.	Average number per haul.
March	2	2	23	3–5	11·5
April	7	4	46	3·5–16·5	6·6
May	30	8	21	5–22	0·7
June	106	5	20	5·6–42	0·2
July	94	2	2	6–7·2	0·01

TABLE IX.

Gadus merlangus.

Month.	Total number of hauls 1906–1914.	Number of hauls in which the species occurs.	Number of specimens.	Size in mm.	Average number per haul.
March	2	1	2	3–4	1
April	7	5	51	3·5–10	7·3
May	30	24	1009	4–18	33·6
June	106	66	584	3–40	5·5
July	94	10	22	6–52·5	0·2
August	75	1	1	62	0·01

TABLE X.

Gadus luscus.

Month.	Total number of hauls 1906–1914.	Number of hauls in which the species occurs.	Number of specimens.	Size in mm.	Average number per haul.
March	2	0	—	—	—
April	7	3	3	5·5–7·5	0·4
May	30	8	44	5–16	1·5
June	106	13	15	4–9·5	0·14
July	94	1	1	10·2	0·01
August	75	—	—	—	—
September	85	5	5	4–8	0·06
October	14	4	5	3·4–4·9	0·36
November	9	1	1	3·4	0·1

TABLE XI.

Gadus minutus.

Month.	Total number of hauls 1906–1914.	Number of hauls in which the species occurs.	Number of specimens.	Size in mm.	Average number per haul.
March	2	2	14	4·5–7	7
April	7	3	11	7–18	1·6
May	30	16	405	4–17	13·5
June	106	16	116	5–48	1·1
July	94	5	5	8·6–54	0·05

GADIDÆ.

Molva molva L.

During the period 1906–13, eight post-larval specimens of *Molva molva* were taken in May and twenty-two in June.

TABLE XII.

Record of Molva molva L.

No. of haul.	Date.	Depth.	No.	Size in mm.
XII.	19.v.14	S.	1	10·3
XVI.	25.v.14	S.	2	8·6–11
XVII.	3.vi.14	B.	1	8
XXII.	11.vi.14	M.	2	8·5–10·5
XXVIII.	16.vi.14	B.	1	8·6
XXXVIII.	24.vi.14	M.	1	12·5
XLIV.	29.vi.14	M.	1	10 ca.
L.	6.vii.14	B.	1	20 ca.

GADIDÆ.

Raniceps raninus L.

The single specimen of the lesser forkbeard taken in 1914 was obtained at the end of July. Previous records of post-larvæ of the species at Plymouth are all due to Clark who obtained eight specimens in August and September, 1913.

TABLE XIII.

Record of Raniceps raninus L.

No. of haul.	Date.	Depth.	No.	Size in mm.
LXXIII.	29.vii.14	M.	1	8

GADIDÆ.

Onos mustelus L.

All the post-larval rocklings have been identified as *O. mustelus*. The differences between the species are not, however, very well defined, and it is possible that a few of the specimens may belong to *O. tricirratus* Bl. or to *O. cimbrius* L.

TABLE XIV.

Record of Onos mustelus L.

No. of haul.	Date.	Depth.	No.	Size in mm.
V.	29.iv.14	B.	2	4·8–8·5
VII.	,,	S.	6	4·5–6·5
IX. (1)	15.v.14	M.	3	6·6–7·3
IX. (3)	,,	S.	1	6·5
IX. (5)	,,	B.	1	6
X.	19.v.14	M.	5	5·4–10
XII.	,,	S.	3	6·1–11
XIII.	,,	M.	5	5–8·5
XIV.	25.v.14	M.	7	5–16
XV.	,,	S.	5	6–15·6
XVI.	,,	S.	14	6·5–15·5
XVIII.	3.vi.14	B.	2	7–7·5
XIX.	,,	M.	1	6·8
XXI.	11.vi.14	M.	1	31
XXII.	,,	M.–B.	1	28·5
XXIV.	16.vi.14	B.	3	7–25
XXXI.	17.vi.14	M.	2	5·2
XXXII.	,,	S.	2	5·5
XXXVIII.	24.vi.14	M.	3	5·3–6·5
XXXIX.	,,	S.	1	6·5
XLVI.	2.vii.14	S.	2	6·3–8·5
XLVIII.	,,	M.	1	7
XLIX.	,,	M.–B.	1	9·8
LIX.	15.vii.14	M.	2	8·8–31
LX.	,,	M.	4	12–32
LXXIII.	29.vii.14	M.	1	7·5

TABLE XV.

ONOS MUSTELUS.

Month.	Total number of hauls 1906–1914.	Number of hauls in which the species occurs.	Number of specimens.	Size in mm.	Average number per haul.
April	7	3	9	4·5–8·5	1·3
May	30	10	45	5–16	1·5
June	106	29	46	2·7–31	0·4
July	94	14	19	4·2–32	0·2
August	75	1	1	4·9	0·01
September	85	1	1	8	0·01

SERRANIDÆ.

Roccus labrax L. (=*Labrax lupus* Cuv.)

One specimen of a larval bass 6 mm. long was obtained in Haul IX. (1), a midwater haul made in the west part of Bigbury Bay on May 15th, 1914. It is well represented by Raffaele's figure (**1888** Tav. IV. Fig. 2), which is reproduced by Ehrenbaum in Nordisches Plankton (**1905**) as Fig. 7.d.

LABRIDÆ.

Labrus bergylta Asc. *Labrus mixtus* L. *Ctenolabrus rupestris* L.

Young stages of wrasse belonging to three different species occur in the material, but there is some slight doubt as to their correct specific determination. The most numerous of the forms is the one in which the body and the greater part of the tail is covered with many black stellate chromatophores, which, however, cease more or less abruptly behind the anal fin, leaving the hinder end of the tail unpigmented. This form has been figured by Danois (**1913**, p. 155) and there seems no reason to doubt that he has identified it correctly as *L. bergylta*. Holt's figure (**1899**, Pl. V. Fig. 49) is probably the same species, Ehrenbaum (**1905**, p. 7) having already pointed out that it certainly is not *Ctenolabrus rupestris* as Holt has named it. The just hatched larva of *L. bergylta* was described by Matthews (**1887**), and it is not improbable that the larva described by Hefford (**1910**, Pl. I. Figs. 8 and 8a) as *L. mixtus* also belongs here. In the present records, as well as in those by Clark (**1914**), all the specimens in which the body is deeply pigmented, but the hinder portion of the tail is quite free from pigment, have been regarded as *Labrus bergylta*.

A second form is *Ctenolabrus rupestris*. This is well figured by Ehrenbaum (**1905**, p. 8). The body is free from pigment excepting for a large post-anal black chromatophore on the body at the hinder end of the anal fin, and one or two chromatophores at the root of the caudal fin. I see no reason to question Ehrenbaum's identification, which is also accepted by Clark.

The third form, of which I give an illustration in Fig. 1, kindly made for me by Mr. E. Ford, has occurred not infrequently in the 1914 material. The distribution of the chromatophores is very constant and characteristic. On the dorsal edge of the body, at the base of the dorsal fin, there are on each side five large black chromatophores which remain in specimens preserved in formalin. One of these, the smallest, lies beneath the anterior end of the dorsal fin, followed by two large ones near the middle of the fin, and finally a pair close together near its hinder end. On the post-anal, ventral edge of the body there is a large chromatophore a little way behind the anus, and two more near the posterior end of the anal fin. A single black chromatophore can generally be seen at the base of the caudal fin. In the anterior part of the fish there are two or three large chromatophores on the top of the head, a row of small ones on the mandible, two or three on the ventral edge of the abdomen, and one fairly large one immediately in front of the anus. A line of pigment extends along the dorsal side of the abdominal cavity, extending nearly to the anus. The number of vertebræ is 38 or 39, rays of dorsal fin 30 or 31, of anal fin 14 or 15. These numerical characters agree completely with those given by Day for *Labrus mixtus*, and amongst the British Labridæ the only other species in which the number of vertebræ is so high is *Labrus bergylta*, the young stage of which seems to be satisfactorily known. I have little hesitation therefore in regarding *Labrus mixtus* as the proper name to give to the form we are considering. If that be so the larva described by Hefford (**1910**) is probably *L. bergylta* and not *L. mixtus* as he was inclined to think.

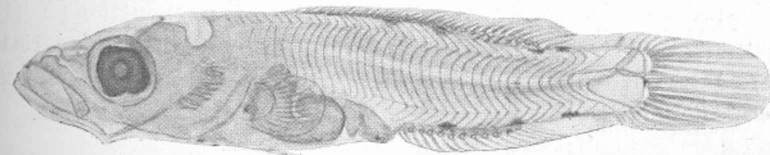


FIG. 1.—*Labrus mixtus* L. Length 10 mm. July 2nd, 1914.

Post-larval stages of *Labrus bergylta* are most numerous in June and July, a few were taken in May and August, whilst in September they practically disappear from the young-fish trawl material. *Ctenolabrus rupestris* was most abundant in July. In 1914, the only year for which the species is recorded, *Labrus mixtus* was distinctly earlier in appearance than *C. rupestris* and was most abundant in June.

TABLE XVI.

Record of Labrus sp.

No. of haul.	Date.	Depth.	Labrus bergylta. No.	Labrus bergylta. Size in mm.	Labrus mixtus. No.	Labrus mixtus. Size in mm	Ctenolabrus rupestris. No.	Ctenolabrus rupestris. Size in mm.
IX.(1)	15.v.14	M.	4	5·8–7·3	—	—	—	—
X.	19.v.14	M.	1	6·5	—	—	—	—
XII.	,,	S.	—	—	1	6·6	—	—
XIII.	,,	M.	1	6	—	—	—	—
XIV.	25.v.14	M.	3	5·6–6·3	2	7, 7·2	—	—
XV.	,,	S.	4	5·2–6·5	—	—	—	—
XVI.	,,	S.	—	—	1	8·3	—	—
XVII.	3.vi.14	B.	13	5·3–7·5	1	6·5	—	—
XVIII.	,,	B.	6	6–7	—	—	—	—
XIX.	,,	M.	1	6·5	—	—	—	—
XX.	10.vi.14	S.–M.	—	—	2	8–8·5	—	—
XXII.	11.vi.14	M.–B.	—	—	1	9·2	—	—
XXIII.	,,	B.	—	—	1	8·5	—	—
XXIV.	16.vi.14	B.	1	5·5	—	—	—	—
XXV.	,,	B.	1	5.5	1	6	—	—
XXVI.	,,	B.	1	6	2	6·7–8	—	—
XXVII.	,,	M.	2	6–7·5	—	—	—	—
XXIX.	17.vi.14	B.	3	6·3–7	—	—	—	—
XXX.	,,	M.	1	6·5	1	6·5	—	—
XXXIV.	19.vi.14	M.	1	7·4	—	—	—	—
XXXVI.	24.vi.14	B.	—	—	1	7	—	—
XXXVII.	,,	B.	—	—	—	—	1	6
XXXVIII.	,,	M.	—	—	—	—	2	7·3–8
XLIII.	29.vi.14	B.	—	—	—	—	1	8·5
XLVI.	2.vii.14	S.	1	8·3	2	9–10	1	9
XLVII.	,,	S.	—	—	2	6·2–10	—	—
XLVIII.	,,	M.	1	5·7	—	—	—	—
XLIX.	,,	M.–B.	2	4·5–5·7	1	8·5	—	—
L.	6.vii.14	B.	2	5·5–6·5	—	—	—	—
LI.	,,	B.	11	4·2–5·6	—	—	—	—
LII.	,,	M.	1	5·3	—	—	—	—
LIV.	9.vii.14	S.	10	5·7–6·5	—	—	—	—
LV.	,,	M.	12	4–5·7	—	—	—	—
LVI.	,,	B.	1	5 ca.	—	—	—	—
LIX.	15.vii.14	M.	2	7–8	—	—	—	—
LXI.	16.vii.14	B.	1	7	—	—	—	—
LXII.	,,	B.	1	7	—	—	—	—
LXIII.	22.vii.14	B.	1	6·6	—	—	—	—
LXIV.	,,	B.	1	8	—	—	—	—
LXVIII.	,,	B.	—	—	2	7–7·7	—	—
LXIX.	,,	S.	—	—	—	—	1	8
LXXIII.	29.vii.14	M.	1	6	—	—	1	8·6
LXXIV.	,,	M.	—	—	—	—	1	9·5
LXXV.	,,	B.	—	—	—	—	1	9·6
LXXX.	,,	M.	1	8	—	—	1	8·5
LXXXV.	12.viii.14	M.	1	7·5	—	—	—	—
LXXXVI.	,,	B.–M.	3	9·5–10	—	—	1	9

TABLE XVII.

Labrus bergylta.

Month.	Total number of hauls 1906–1914.	Number of hauls in which the species occurs.	Number of specimens.	Size in mm.	Average number per haul.
May	30	8	26	4·5–7·5	0·87
June . . .	106	42	240	3·25–24	2·2
July	94	49	348	3–20	3·7
August . . .	75	19	29	3–10	0·38
September . . .	85	1	1	4·5	0·01

TABLE XVIII.

Labrus mixtus.

(1914 only.)

Month.	Total number of hauls 1914 only.	Number of hauls in which the species occurs.	Number of specimens.	Size in mm.	Average number per haul.
May	13	3	4	6·6–8·3	0·31
June	28	8	10	6·5–9·2	0·36
July	38	3	7	7–10	0·18

TABLE XIX.

Ctenolabrus rupestris.

Month.	Total number of hauls 1906–1914.	Number of hauls in which the species occurs.	Number of specimens.	Size in mm.	Average number per haul.
June	106	14	39	3·8–9·8	0·37
July	94	30	131	4–10	1·4
August . . .	75	8	13	5·5–9	0·17

CARANGIDÆ.

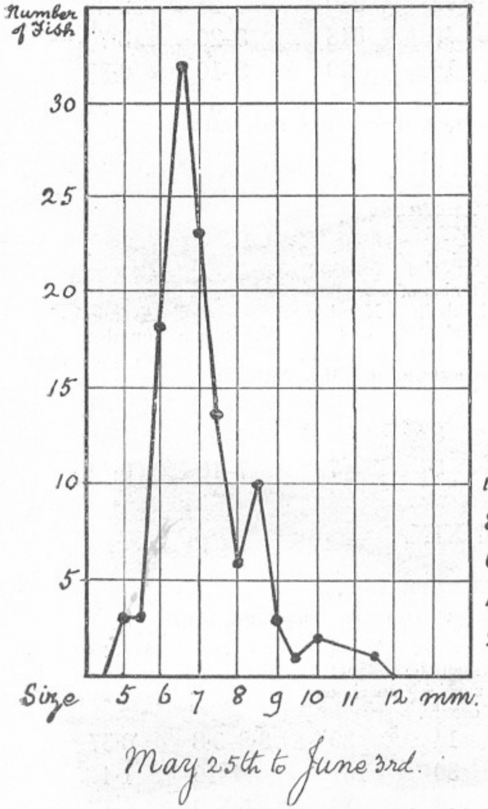
Caranx trachurus L.

Only one specimen of the scad or horse mackerel is recorded amongst the 1914 material. This was 23·5 mm. long, with most of the adult characters developed, and was taken in Haul LXXXVII. at midwater off Penlee Point on September 4th. The previous records given by Clark (**1914**, p. 348) are all for July, August and September.

SCOMBRIDÆ.

Scomber scomber L.

Perhaps the most interesting feature in the material collected with the young-fish trawl in 1914 is the abundance of young stages of the mackerel, which were far more numerous than in any of the previous years for which records are available, though a number of specimens were taken by Hefford (see Clark, **1914**, p. 349) in June, 1906, and June,



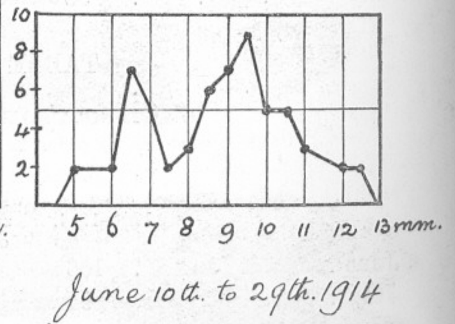


FIG. 2.—Frequency curve of young mackerel from Hauls XIV.–XIX., caught on May 25th and June 3rd, 1914.

FIG. 3.—Frequency curve of young mackerel from Hauls XX.–XLV., caught June 10th to 29th, 1914.

1908. These young stages were first taken on May 25th, when 22, 29 and 32 specimens were captured respectively in three successive hauls. The numbers were still considerable in the hauls on June 3rd. After that date they became less, but the young fish remained in the catches throughout June, whilst isolated specimens were captured in July.

The individual fishes were measured, and the results to the nearest

·5 mm. are recorded in Table XX. Figs. 2 and 3 show in graphic form the length frequencies at each successive half-millimetre for two groups of hauls, the first group comprising XIV.–XIX., taken on May 25th and June 3rd, the second group comprising 16 hauls in which specimens occurred from Haul XX. to Haul XLV., taken between June 10th and 29th. The first group (Fig. 2) shows a definite mode at 6·5 mm. and the

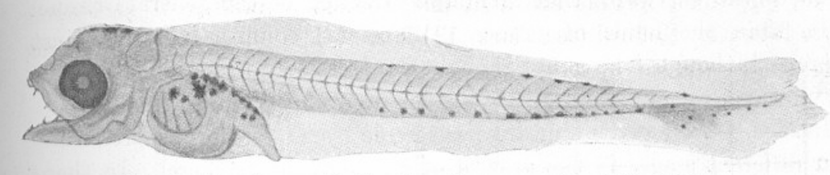


FIG. 4.—*Scomber scomber* L. Length 6 mm. May 25th, 1914.

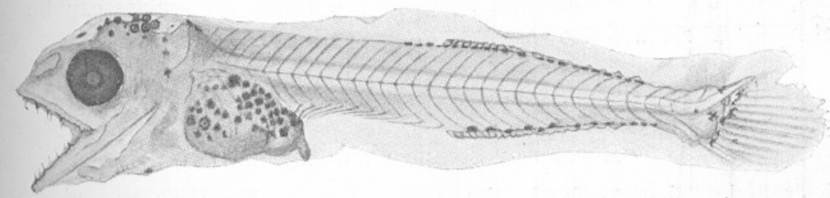


FIG. 5.—*Scomber scomber* L. Length 9 mm. May 25th, 1914.

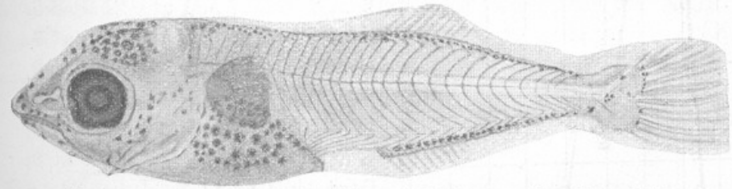


FIG. 6.—*Scomber scomber* L. Length 11·5 mm. May 25th, 1914.

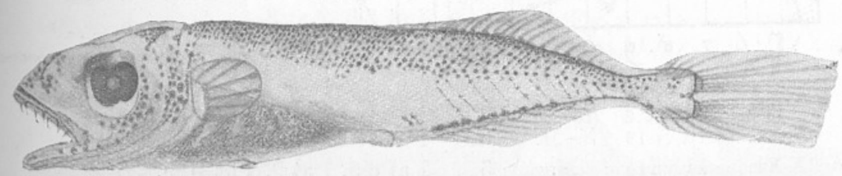


FIG. 7.—*Scomber scomber* L. Length 16 mm. ca. July 22nd, 1914.

arithmetic mean is 7·15 mm. The second group (Fig. 3) has two modes, one at 6·5 mm. and another at 9·5 mm., whilst the arithmetic mean is 8·8 mm. It is probable that the mode at 9·5 in the second group (Fig. 3) is due to the group of fish found in the earlier hauls and represented in Fig. 2, which then showed a mode at 6·5 mm. This would indicate a growth of 3 mm. in three weeks. If this interpretation be correct then the other mode in Fig. 3, that at 6·5 mm., would be most easily explained as being due to the offspring of a second shoal of spawning fish appearing some three weeks later than the one whose offspring are represented in Fig. 2. A more detailed analysis of the figures by taking five groups of hauls instead of two, namely, (1) XIV., XV., XVI., (2) XVII., XVIII., XIX., (3) XX., XXI., XXII., XXIII., (4) XXIV.–XXXVIII., (5) XLIII., XLIV., XLV., and noting that the fifth group comprises hauls taken more to the eastward, that is in the direction of the general Channel drift, than the hauls of groups (1) and (2) confirms the view just expressed, though I have not thought it necessary to reproduce the five curves here, the numbers of fish in each group being rather small.

In Figs. 4–7 are given four drawings made by Mr. E. Ford, representing four different stages in the growth of these young mackerel. In these drawings the characteristic distribution of the black pigment, the larval teeth, and the other characters by means of which the species can be distinguished are well shown.

TABLE XX.

Record of Scomber scomber.*

No. of haul.	Date.	Depth.	No.	Sizes in mm.
XIV.	25.v.14	M.	22	2 at 5, 1 at 5·5, 7 at 6, 6 at 6·5, 3 at 7, 1 at 7·5, 1 at 8, 1 at 8·5.
XV.	25.v.14	S.	29	1 at 5·5, 2 at 6, 8 at 6·5, 5 at 7, 4 at 7·5, 2 at 8, 4 at 8·5, 2 at 9, 1 at 10.
XVI.	25.v.14	S.	32	1 at 5, 7 at 6, 8 at 6·5, 5 at 7, 3 at 7·5, 1 at 8, 4 at 8·5, 1 at 9, 1 at 10, 1 at 11·5.
XVII.	3.vi.14	B.	21	1 at 5·5, 1 at 6, 8 at 6·5, 6 at 7, 3 at 7·5, 2 at 8.
XVIII.	3.vi.14	B.	10	1 at 6, 3 at 6·5, 3 at 7, 2 at 7·5, 1 at 9·5.
XIX.	3.vi.14	M.	3	1 at 7, 1 at 7·5, 1 at 8·5.
XX.	10.vi.14	S.–M.	3	1 at 7, 1 at 8, 1 at 12·5.
XXI.	11.vi.14	M.	3	1 at 8·5, 1 at 9, 1 at 10·5.
XXII.	11.vi.14	M.–B.	4	1 at 7·5, 2 at 11, 1 at 12.
XXIII.	11.vi.14	B.	4	1 at 9, 2 at 10·5, 1 at 11.
XXIV.	16.vi.14	B.	1	1 at 6·5.
XXVI.	16.vi.14	B.	2	1 at 8·5, 1 at 9·5.
XXVII.	16.vi.14	M.	7	1 at 5, 1 at 6, 2 at 9, 2 at 9·5, 1 at 10.
XXXI.	17.vi.14	M.	2	1 at 5, 1 at 8·5.
XXXII.	17.vi.14	S.	2	1 at 8, 1 at 9.

* Measurements to the nearest ·5 mm.

TABLE XX. (*continued*).

No. of haul.	Date.	Depth.	No.	Sizes in mm.
XXXIII.	19.vi.14	M.	1	1 at 12·5.
XXXIV.	19.vi.14	M.	1	1 at 6·5.
XXXVI.	24.vi.14	B.	1	1 at 7.
XXXVII.	24.vi.14	B.	1	1 at 7.
XXXVIII.	24.vi.14	M.	11	1 at 6, 4 at 6·5, 2 at 7, 1 at 7·5, 1 at 8, 1 at 8·5, 1 at 9·5.
XLIII.	29.vi.14	B.	2	1 at 8.5, 1 at 9·5.
XLIV.	29.vi.14	M.	3	1 at 6·5, 2 at 9·5.
XLV.	29.vi.14	S.	12	1 at 8·5, 2 at 9, 2 at 9.5, 4 at 10, 2 at 10·5, 1 at 12.
LX.	15.vii.14	M.	1	1 at 9·5.
LXVIII.	22.vii.14	B.	1	1 at 16.
LXIX.	22.vii.14	S.	1	1 at 8·5.

ZEIDÆ.

Zeus faber L.

One specimen only, 12 mm. long, was taken, this being found in Haul LXXXIV., a bottom haul made on July 29th, 1914. For 1913 Clark (**1914**) has recorded a number of specimens in August and September.

PLEURONECTIDÆ.

Pleuronectes limanda L.

Post-larval dates are exceptionally well represented in the 1914 material. Already at the end of April when the collection began 29 and 37 specimens were obtained in one haul. The maximum abundance was reached in May, and in three hauls taken off the Eddystone on May 25th, 290, 276, and 508 individuals were captured. It is worth noting that these three hauls were taken during the dark hours of the night, between 10.25 p.m. and midnight. During June the numbers obtained fell off rapidly and after the 2nd July no more specimens were obtained. During June also the most prolific hauls were made at night. The details of the captures for 1914 are shown in Table XXI., whilst Table XXII. gives monthly summaries of the hauls made during the period 1906–14.

Pleuronectes microcephalus Donov.

Although no young merry-soles were taken until May 15th the captures reached a maximum before the end of that month, falling off during

June and July, when chiefly the larger sizes were taken. The figures for 1914 are given in Table XXI., and the monthly summaries for 1906–14 in Table XXIII.

The species is more abundant in hauls taken beyond the 20-fathom line. In Table XXIII. this is shown by the figures given for the month of May. The average number of individuals per haul for all the hauls is 6·6, whilst the average for the hauls at and beyond the 20-fathom line is 12·2.

TABLE XXI.

RECORD OF PLEURONECTES SP.

No. of Haul.	Date.	Depth.	P. limanda. No.	P. limanda. Size in mm.	P. microcephalus. No.	P. microcephalus. Size in mm.
V.	29.iv.14	B.	36	5·5–11·5	—	—
VI.	,,	M.	29	4·5–9·2	—	—
VII.	,,	S.	6	5·5–10·5	—	—
VIII.(2)	,,	M.	3	6·2–8·5	—	—
IX.(5)	15.v.14	B.	23	5–12·6	3	9·5–11·2
X.	19.v.14	M.	5	8·5–14·3	37	5–11
XI.	,,	S.	8	9–13·8	22	6·5–10·5
XII.	,,	S.	35	4–14·8	21	6·8–10·6
XIII.	,,	M.	70	4·7–12·0	55	6–15
XIII.a	22.v.14		46	6·5–13	—	—
XIV.	25.v.14	M.	290	5·7–15	25	7–14·7
XV.	,,	S.	276	5·5–12·5	7	9·6–13·5
XVI.	,,	S.	508	5–12·6	12	7·5–14·5
XVII.	3.vi.14	B.	45	6·5–11·5	5	7–9
XVIII.	,,	B.	9	6–8	8	5·2–7·5
XIX.	,,	M.	4	6·7–8	1	6
XX.	10.vi.14	S.–M.	22	8·2–14·5	3	9·5–16
XXI.	11.vi.14	M.	14	8–14·2	3	10·6–14
XXII.	,,	M.–B.	31	8·5–17	11	10–15·6
XXIII.	,,	B.	32	9–15·6	22	9–14
XXVI.	16.vi.14	B.	3	10·5–11·6	—	—
XXVII.	,,	M.	1	10·5	—	—
XXVIII.	,,	B.	1	12·5	—	—
XXXI.	17.vi.14	M.	2	8·7–11	—	—
XXXII.	,,	S.	—	—	1	7
XXXVII.	24.vi.14	B.	1	10·2	3	8–12
XLIII.	29.vi.14	B.	1	10·5	—	—
XLVI.	2.vii.14	S.	8	6·5–17·3	2	12·4–12·7
XLVII.	,,	S.	1	8·5	3	11·5–15·2

TABLE XXI. (*continued*).

No of Haul.	Date.	Depth.	P. limanda. No.	P. limanda. Size in mm.	P. microcephalus. No.	P. microcephalus. Size in mm.
XLVIII.	2.vii.14	M.	3	15·5–16	3	9–18·5
XLIX.	,,	M.–B.	2	15·5–16·6	—	—
LVI.	9.vii.14	B.	—	—	2	9·2–11·5
LVII.	,,	B.	—	—	2	9–9·5
LXVIII.	22.vii.14	B.	—	—	1	8
LXXVIII.	29.vii.14	M.	—	—	1	8

Pleuronectes flesus L. occurred in the following hauls:—V. 1 spec. 7 mm., VII. 3 specs. 6·5–8·5 mm., VIII. (1) 2 specs. 8–8·5 mm., VIII. (2) 2 specs. 8–8·5 mm., IX. (1) 1 spec. 9 mm., IX. (2) 33 specs. 5·5–10·5 mm.

TABLE XXII.

PLEURONECTES LIMANDA.

Month.	Total number of hauls 1906–1914.	Number of hauls in which the species occurs.	Number of specimens.	Size in mm.	Average number per haul.
April	7	5	86	4·5–11·5	12·3
May	30	20	1371	4–15	45·7
June	106	28	199	1·59–17	1·9
July	94	5	17	6·5–42	0·18

TABLE XXIII.

PLEURONECTES MICROCEPHALUS.

Month.	Total number of hauls 1906–1914.	Number of hauls in which the species occurs.	Number of specimens.	Size in mm.	Average number per haul.
March	2	1	1	6	0·5
April	7	0	0	—	—
May	30	10	199	5–15	6·6
*May**	*16*	*9*	*196*	*5–15*	*12·2*
June	106	30	129	5–16	1·2
July	94	10	18	7–18·5	0·19

* Hauls where total depth of water is 20 fathoms and over.

PLEURONECTIDÆ.

Sub.-fam. BOTHINÆ.

Arnoglossus sp.

The records for 1914 are given in Table XXIV. By far the greater number of specimens taken belong certainly to the species *Arnoglossus laterna*. There were a certain number of doubtful cases, but in no instance was I able to feel sure that the specimen should be attributed to *A. Thori* or *A. imperialis*.

The monthly summaries for the whole period 1906–14 given in Table XXV. show a maximum frequency in September with an average of 8·3 per haul. The average for August 6·8 is also high. It may be noted, however, that the post-larval Arnoglossus seems to have been more abundant in June, 1914, than it was in that month of previous years, the average for the month being 8·4 in 1914, whilst for the whole period it is only 2·3.

TABLE XXIV.

RECORD OF ARNOGLOSSUS SP.

No. of haul.	Date.	Depth.	No.	Size in mm.
XI.	19.v.14	S.	1	5·5 ca.
XIII.	,,	M.	1	5·6
XIV.	25.v.14	M.	5	5–8·3
XV.	,,	S.	7	6·5–8·3
XVI.	,,	S.	12	5·6–7·6
XVII.	3.vi.14	B.	11	5·5–7·5
XVIII.	,,	B.	18	4–8
XIX.	,,	M.	1	5·2
XX.	10.vi.14	S.–M.	17	9·5–11·7
XXI.	11.vi.14	M.	28	6·5–11·2
XXII.	,,	M.–B.	27	7–11
XXIII.	,,	B.	47	7·5–12·3
XXV.	16.vi.14	B.	1	7
XXVI.	,,	B.	10	3·5–7·3
XXVII.	,,	M.	3	6·3–9
XXX.	17.vi.14	M.	2	6·5
XXXI.	,,	M.	18	5·5–10
XXXII.	,,	S.	3	6–10 ca.
XXXIV.	19.vi.14	M.	5	6·4–10·8

TABLE XXIV. (*continued*).

No. of haul.	Date.	Depth.	No.	Size in mm.
XXXV.	19.vi.14	M.	3	6·5–12·3
XXXVI.	24.vi.14	B.	6	6·5–14
XXXVII.	,,	B.	1	10·5
XXXVIII.	,,	M.	10	—
XLII.	29.vi.14	B.	2	9–14·5
XLIII.	,,	B.	14	8·5–18·5
XLIV.	,,	M.	5	5–17·5
XLV.	,,	S.	3	6·5–9
XLVI.	2.vii.14	S.	4	8·2–13
XLVII.	,,	S.	1	15·5
XLVIII.	,,	M.	4	11–18
XLIX.	,,	M.–B.	3	6·5–15
L.	6.vii.14	B.	1	18·3
LI.	,,	B.	4	4·5–18·5
LII.	,,	M.	1	17
LV.	9.vii.14	M.	2	12·5–16·5
LVI.	,,	B.	6	11–17·5
LVII.	,,	B.	1	13
LVIII.	,,	M.	1	19·5
LIX.	15.vii.14	M.	29	13·5–22
LX.	,,	M.	11	13·4–20·3
LXI.	16.vii.14	B.	2	13–16
LXII.	,,	B.	6	15–21 ca.
LXIII.	22.vii.14	B.	1	7·2
LXVII.	,,	M.	7	7·2–19·5
LXVIII.	,,	B.	5	7–20·5
LXX.	,,	M.	2	18·7–21·2
LXXIII.	29.vii.14	M.	10	6·3–20·5
LXXV.	,,	B.	4	8·2–20·5
LXXVI.	,,	M.	5	17–20·5
LXXVII.	,,	B.	1	20
LXXVIII.	,,	M.	14	10–23·5
LXXXIII.	,,	B.	3	9·5–20·5
LXXXV.	12.viii.14	M.	2	24·5–25·6

TABLE XXV.

ARNOGLOSSUS SP.

Month.	Total number of hauls 1906–1914.	Number of hauls in which the species occurs.	Number of specimens.	Size in mm.	Average number per haul.
May	30	5	26	5–8·3	0·87
June	106	30	249	3·5–18·5	2·3
[*June, 1914* . .	*28*	*22*	*235*	*3·5–18·5*	*8·4*]
July	94	41	232	3·5–23·5	2·5
August . . .	75	47	507	3–28·5	6·8
September . . .	85	62	708	4–31	8·3
October . . .	14	2	2	7	0·14

Sub-fam. RHOMBINÆ.

Rhombus maximus Will. *R. laevis* Rond.

Seven specimens of *R. laevis* were taken in 1914 between May and August, and one specimen of *R. maximus* in July. These records support the conclusion reached by Clark that the spawning season of the brill is earlier than that of the turbot.

TABLE XXVI.

RECORD OF RHOMBUS SP.

No. of haul.	Date.	Depth.	R. maximus. No.	R. maximus. Size in mm.	R. laevis. No.	R. laevis. Size in mm.
XIV.	25.v.14	M.	—	—	2	9·8–11·5
XV.	25.v.14	S.	—	—	2	6·8,6·8
LXX.	22.vii.14	M.	—	—	1	6·2
LXXVI.	29.vii.14	M.	2	7·7–8·5	—	—
LXXVIII.	29.vii.14	M.	—	—	1	7
LXXXV.	12.viii.14	M.	—	—	1	13

Scophthalmus norvegicus Gthr.

The records for 1914 (Table XXVII.) give a distinct maximum of the post-larval stages in May. The numbers remain fairly large until June 11th, after which only a few specimens were taken. This would indicate that the maximum spawning season is a little earlier than Clark (1914) suggests, being probably in April. The hauls containing the largest number of individuals were made south of the Eddystone, where the depths were from 37–39 fathoms. The monthly summary for the period 1906–14 shows an average number of 14·6 individuals per haul for May, and of 5·4 for June (Table XXVIII.).

TABLE XXVII.

RECORD OF SCOPHTHALMUS NORVEGICUS.

No. of haul.	Date.	Depth.	No.	Size in mm.
X.	19.v.14	M.	69	4·2–11
XI.	,,	S.	44	4–12
XII.	,,	S.	68	4·5–12
XIII.	,,	M.	84	4–11·7
XIII.a	22.v.14	—	2	6–6·6
XIV.	25.v.14	M.	5	5·5–10
XV.	,,	S.	1	9·5
XVI.	,,	S.	6	6·5–10·5
XVII.	3.vi.14	B.	45	4·0–8·0
XVIII.	,,	B.	31	4·5–8
XIX.	,,	M.	1	7
XX.	10.vi.14	S.–M.	5	6–8
XXI.	11.vi.14	M.	11	5·5–8·5
XXII.	,,	M.–B.	16	6–8·7
XXIII.	,,	B.	27	6–8·7
XXVI.	16.vi.14	B.	1	5·5
XXX.	17.vi.14	M.	1	6
XLVI.	2.vii.14	S.	1	9·7
LVI.	9.vii.14	B.	1	7·3
LIX.	15.vii.14	M.	1	6
LXVIII.	22.vii.14	B.	1	7·2

TABLE XXVIII.

SCOPHTHALMUS NORVEGICUS.

Month.	Total number of hauls 1906–1914.	Number of hauls in which the species occurs.	Number of specimens.	Size in mm.	Average number per haul.
May	30	14	438	4–12	14·6
June	106	39	576	3·5–12·2	5·4
July	94	16	33	4–11	0·35

Zeugopterus unimaculatus Bnp.

Fourteen specimens of post-larvæ one-spotted topknots were taken in 1914. The only previous records are those of Clark, who found three specimens in June and July, 1913. The 1914 records are of specimens taken in May and the early part of June. The species is easily distinguished from the other topknots.

TABLE XXIX.

RECORD OF ZEUGOPTERUS UNIMACULATUS Gthr.

No. of haul.	Date.	Depth.	No.	Size in mm.
XI.	19.v.14	S.	1	8
XIII.	19.v.14	M.	1	5·5
XIV.	25.v.14	M.	1	6·5
XV.	25.v.14	S.	1	8·7
XVI.	25.v.14	S.	1	8
XVII.	3.vi.14	B.	3	6–6·5
XVIII.	3.vi.14	B.	2	6–6·2
XXI.	11.vi.14	M.	1	8·6
XXII.	11.vi.14	M.	1	9·3
XXIII.	11.vi.14	B.	2	8–9·4

Zeugopterus punctatus Blainv.

In 1914 the post-larvæ were much more frequent in May than in June, indeed they practically disappeared after the beginning of the latter month. The maximum frequency for the whole period 1906–14 occurred in April, though the figure is based on too few hauls to be very reliable. It is clear, however, that the species must have its maximum spawning period in the early months of the year.

TABLE XXX.

RECORD OF ZEUGOPTERUS PUNCTATUS Bl.

No. of haul.	Date.	Depth.	No.	Size in mm.
IX.(5)	15.v.14	B.	1	7
X.	19.v.14	M.	7	5–8
XI.	19.v.14	S.	1	6·5
XII.	19.v.14	S.	2	8·5, 8.5
XIII.	19.v.14	M.	4	6.5–8.5
XIII.a	22.v.14	—	10	5·5–7
XIV.	25.v.14	M.	1	7·5
XV.	25.v.14	S.	1	8
XVI.	25.v.14	S.	7	8·5–10·2
XVII.	3.vi.14	B.	2	6·5–6·7
XVIII.	3.vi.14	B.	1	7·3
XIX.	3.vi.14	M.	1	6
XXII.	11.vi.14	M.	1	7·6

TABLE XXXI.

ZEUGOPTERUS PUNCTATUS.

Month.	Total number of hauls 1906–1914.	Number of hauls in which the species occurs.	Number of specimens.	Size in mm.	Average number per haul.
April	7	3	16	3–6	2·3
May	30	13	44	5–10·2	1·5
June	106	14	27	5·5–11·69	0·25

Sub-fam. SOLEINÆ.

Solea vulgaris Quens.

The majority of the specimens of post-larvæ of the common sole were taken in May. The number captured was, however, not large and was below that of the thickback sole (*S. variegata*).

Solea variegata Don.

These were taken in considerable numbers during May and a few were also present in June. The maximum number taken in one haul was 48, in marked contrast to *S. vulgaris*, of which only one specimen occurred in a haul, except in two cases where there were 2 and 4 specimens.

Solea lascaris Risso.

Only two specimens were found in the 1914 material, taken on the 22nd July. Previous records made by Clark in 1913 are in July, August, and September.

Solea lutea Risso.

Not a single specimen of *S. lutea* was recognised in the 1914 material, although in 1913 Clark found a fair number in June, a month which is well represented in the 1914 hauls.

TABLE XXXII.

Record of Solea.

No. of haul.	Date.	Depth.	S. vulgaris. No.	S. vulgaris. Size in mm.	S. variegata. No.	S. variegata. Size in mm.	S. lascaris. No.	S. lascaris. Size in mm.
V.	29.iv.14	B.	1	5·7	—	—	—	—
VI.	,,	M.	1	7·5	—	—	—	—
IX.(5)	15.v.14	B.	1	7	—	—	—	—
X.	19.v.14	M.	1	6·9	33	4–8·2	—	—
XI.	,,	S.	—	—	41	4–9·5	—	—
XII.	,,	S.	—	—	21	5·5–9·2	—	—
XIII.	,,	M.	—	—	48	4·5–10·2	—	—
XIII.(a)	22.v.14	—	1	6·4	11	4·5–8·5	—	—
XIV.	25.v.14	M.	1	6·6	43	4·2–12·3	—	—
XV.	,,	S.	2	6·6, 7·7	3	9·2–9·8	—	—
XVI.	,,	S.	4	6·2–8·7	9	5–9·8	—	—
XVII.	3.vi.14	B.	—	—	5	5·3–7·5	—	—
XVIII.	,,	B.	1	5	—	—	—	—
XXII.	11.vi.14	M.	—	—	2	6·4–7	—	—
XXIII.	,,	B.	—	—	6	6·5–8·5	—	—
XXXVII.	24.vi.14	B.	—	—	2	3·6–5·6	—	—
LXIV.	22.vii.14	B.	—	—	—	—	1	10·3
LXV.	,,	B.	—	—	—	—	1	9·6

TABLE XXXIII.

Solea vulgaris.

Month.	Total number of hauls 1906–1914.	Number of hauls in which the species occurs.	Number of specimens.	Size in mm.	Average number per haul.
April	7	2	2	5·7–7·5	0·3
May	30	11	19	4–10·5	0·63
June	106	5	5	5–8·7	0·05

TABLE XXXIV.

Solea variegata.

Month.	Total number of hauls 1906–1914.	Number of hauls in which it occurs.	Number of specimens.	Size in mm.	Average number per haul.
May	30	11	288	4–12·3	9·6
June	106	26	170	3–11	1·6
July	94	3	4	4·5–10	0·04
August	75	4	7	4–8·5	0·09

GOBIIDÆ.

Gobius sp. *Crystallogobius nilssoni* Düb. and Kör.
Aphya pellucida Nardo.

Table XXXV. gives the record of all the gobies which have not been specifically determined, and the list probably includes many young stages of both *Crystallogobius nilssoni* and *Aphya pellucida*. The larger specimens, probably chiefly belong to *Gobius minutus* Pall., though other species may be included.

Tables XXXVI. and XXXVII. give the records of those specimens, chiefly the larger ones, of Crystallogobius and Aphya which could be determined with some certainty. The separation of the different species has been too incomplete to make it advisable to draw conclusions as to seasonal distribution.

TABLE XXXV.

Record of Gobius sp.

No. of haul.	Date.	Depth.	No.	Size in mm.
XI.	19.v.14	S.	1	13
XII.	,,	S.	2	9·5–12·5
XIII.	,,	M.	5	10–12·5
XIII. a	22.v.14	—	63	8–14, 24
XIV.	25.v.14	M.	13	9·6–13·3
XV.	,,	S.	3	7–11·5
XVI.	,,	S.	18	6·5–15
XX.	10.vi.14	S.–M.	1	14·5
XXII.	11.vi.14	M.–B.	6	12·6–14
XXIII.	,,	B.	5	12·5–15
XXV.	16.vi.14	B.	1	7
XXVIII.	,,	B.	1	7
XLIV.	29.vi.14	M.	3	10–14
XLVI.	2.vii.14	S.	73	7–22·6
XLVII.	,,	S.	87	6–19·5
XLVIII.	,,	M.	59	7–18
XLIX.	,,	M.–B.	17	10–16
LI.	6.vii.14	B.	3	6–7·5
LIII.	6.vii.14	B.	1	10·2
LIV.	9.vii.14	S.	3	5–7
LV.	,,	M.	1	5
LVI.	,,	B.	1	5

TABLE XXXV. (*continued.*).

No. of haul.	Date.	Depth.	No.	Size in mm.
LVII.	9.vii.14	B.	5	4·5–11
LIX.	15.vii.14	M.	83	6–19
LX.	,,	M.	52	7–19
LXI.	16.vii.14	B.	82	6·7–18·6
LXII.	,,	B.	11	5·7–27
LXV.	22.vii.14	B.	3	10–11·5
LXVII.	,,	M.	1	6·6
LXVIII.	,,	B.	7	3·2–8·5
LXXI.	,,	B.	6	7·5–12
LXXIII.	29.vii.14	M.	1	10
LXXVII.	,,	B.	6	7–10
LXXVIII.	,,	M.	1	6
LXXXI.	,,	M.	3	10–11·6
LXXXIII.	,,	B.	1	12
LXXXVII.	4.ix.14	M.	1	14

TABLE XXXVI.

RECORD OF CRYSTALLOGOBIUS NILSSONI.

No. of haul.	Date.	Depth.	No.	Size in mm.
IX.(5)	15.v.14	B.	2	9–11·5
XII.	19.v.14	S.	6	24–27
XIII.	,,	M.	150	17–36
XIV.	25.v.14	M.	40	18–31 ca.
XV.	,,	S.	11	10–27
XVI.	,,	S.	3	11·5–28
XXII.	11.vi.14	M.–B.	4	26·5–37
XXXII.	17.vi.14	S.	1	Fragment of large one.
XLIII.	29.vi.14	B.	3	25 ca.–30
LVI.	9.vii.14	B.	1	27
LVII.	,,	B.	2	22–28
LIX.	15.vii.14	M.	12	27–37·5
LX.	15.vii.14	M.	20	8–29·5
LXI.	16.vii.14	B.	18	26–29
LXXI.	22.vii.14	B.	8	22–38
LXXIII.	29.vii.14	M.	1	12

TABLE XXXVII.

RECORD OF APHYA PELLUCIDA.

No. of haul.	Date.	Depth.	No.	Size in mm.
XIV.	25.v.14	M.	2	8, 13
XV.	,,	S.	3	6·6–13
XVI.	,,	S.	1	11·5
XVIII.	3.vi.14	B.	2	6–6·2
XX.	10.vi.14	S.–M.	3	13·5–15
XXI.	11.vi.14	M.	3	11·5–16·5
XXII.	11.vi.14	M.–B.	3	13·2–15·3
XXIII.	11.vi.14	B.	4	7·6–16
XXXVII.	24.vi.14	B.	3	6·5–8·5
XLIII.	29.vi.14	B.	2	10 ca.–12
LXIII.	22.vii.14	B.	50	7·5–11
LXIV.	22.vii.14	B.	1	10
LXV.	,,	B.	6	10·5–12·5
LXVI.	,,	M.	1	10
LXXV.	29.vii.14	B.	1	11
LXXXII.	,,	M.	1	11 ca.
LXXXVI.	12.viii.14	B.–M.	1	11

CYCLOPTERIDÆ.

Cyclopterus lumpus L.

One specimen of the lump sucker was obtained in the young-fish trawl in 1914. It was found in Haul XLI., 3½ miles S.W. by W. of the Eddystone, a bottom haul made on June 26th, 1914. The length of the specimen was 16·5 mm. Clark records one specimen 18 mm. long in 1913.

TRIGLIDÆ.

Trigla gurnardus L. *T. hirundo* Bl.

The characters by means of which post-larval stages of *T. gurnardus* and *T. hirundo* may be distinguished have been pointed out by Clark (**1914**) in his report on the post-larval teleosteans of Plymouth. The specimens which were most numerous in the 1914 material belong to the *T. gurnardus* type, with long pectoral fins which are pigmented chiefly on the posterior half of the fin. From specimens of this type young *T. hirundo* with short, broad pectorals pigmented over the whole surface, are easily and definitely distinguishable.

Clark refers to specimens appearing in August and September which he thinks are quite distinct from *T. gurnardus* and *T. hirundo*, and have very little pigment. These he regards as probably belonging to the species *T. lineata*. A few specimens amongst the 1914 material, which I have included under the *gurnardus* type, very closely approach the forms which Clark thus regards as *T. lineata*, the amount of pigment on the pectoral fins being small, although the fins are long. The variation in the amount of pigment seen in preserved material, especially when the preservation is not very good, is considerable, and seems to me to make it impossible to assign every specimen to a particular species with any degree of certainty until some more definite character can be used for purposes of investigation.

It must be borne in mind too that the species which as an adult is perhaps the most numerous on the grounds in the neighbourhood where most of the hauls have been made is *T. cuculus*, and so far as I am aware the young stages of that form have never been recognised. It is possible, therefore, that this species may be included amongst the forms with long pectorals pigmented on the posterior half, which are here included under *Trigla sp.*, and amongst those which Clark recorded as *T. gurnardus*. A fourth species, *T. lyra*, is occasionally found in the western part of the English Channel, concerning the young stages of which nothing is known.

Unfortunately the numerical characters, such as number of fin rays and vertebræ, of these gurnards are all so similar that they cannot be used for discriminating the species in these young stages.

TABLE XXXVIII.

RECORD OF TRIGLA SP.

No. of haul.	Date.	Depth.	Trigla sp. No.	Trigla sp. Size in mm.	T. hirundo. No.	T. hirundo. Size in mm.
IX.(5)	15.v.14	B.	3	7·5–9·5	—	—
X.	19.v.14	M.	53	4·5–11·7	—	—
XI.	,,	S.	39	6–9·5	—	—
XII.	,,	S.	8	5·1–10	—	—
XIII.	,,	M.	13	6–8·2	—	—
XIII. a	22.v.14	—	9	7·5–10	—	—
XIV.	25.v.14	M.	45	5·5–13	—	—
XV.	25.v.14	S.	33	7·2–12·5	—	—
XVI.	,,	S.	41	5·5–12·7	—	—
XVII.	3.vi.14	B.	77	5–11·5	—	—
XVIII.	,,	B.	63	5·5–18	1	18
XIX.	,,	M.	15	6–11·5	—	—

TABLE XXXVIII. (*continued*.).

No. of haul.	Date.	Depth.	Trigla sp. No.	Trigla sp. Size in mm.	T. hirundo. No.	T. hirundo. Size in mm.
XX.	10.vi.14	S.–M.	4	9–10·8	—	—
XXI.	11.vi.14	M.	9	8·7–10·5	—	—
XXII.	,,	M.–B.	12	8·2–15	—	—
XXIII.	,,	B.	24	7–11·5	—	—
XXIV.	16.vi.14	B.	2	8, 8·5	—	—
XXV.	,,	B.	1	10 ca.	—	—
XXVI.	,,	B.	19	5·6–16·5	—	—
XXVII.	,,	M.	5	7–9	—	—
XXX.	17.vi.14	M.	2	7·7–8·5	—	—
XXXI.	,,	M.	2	7·5–8·4	—	—
XXXV.	19.vi.14	M.	2	12–13	—	—
XXXVI.	24.vi.14	B.	1	7·7	1	10·5
XXXVII.	,,	B.	3	6·8–7·7	—	—
XXXVIII.	,,	M.	1	11	1	7
XLII.	29.vi.14	B.	1	10·5	—	—
XLIII.	,,	B.	7	6·5–12	—	—
XLIV.	,,	M.	2	9–13·5	—	—
XLV.	,,	—	—	—	1	12 ca.
XLVI.	2.vii.14	S.	5	9·5–10·5	—	—
XLVII.	2.vii.14	S.	1	10·8	—	—
LVIII.	9.vii.14	M.	2	13–16	—	—
LX.	15.vii.14	M.	1	12	—	—
LXVIII.	22.vii.14	B.	—	—	2	8–10
LXIX.	,,	S.	—	—	1	9·5
LXXIII.	29.vii.14	M.	1	11	—	—
LXXIV.	,,	M.	—	—	1	11 ca
LXXV.	,,	B.	1	10	—	—
LXXVI.	,,	M.	1	11·7	—	—
LXXVIII.	,,	M.	2	9–19	—	—
LXXXV.	12.viii.14	M.	5	13·5–19	—	—

TRACHINIDÆ.

Trachinus vipera Cuv.

The 1914 records are given in Table XXXIX. and monthly summaries for the period 1906–14 in Table XL. In 1914 no specimens were observed during May and the first half of June, the first record being on June 16th. Over the whole period the average number per haul is highest in July and August, being slightly though perhaps not significantly higher in August than in July. In September there is a rapid disappearance of specimens in the hauls.

No specimens of *Trachinus draco* were recognised in the 1914 material. Clark obtained four specimens of this species in August and September, 1913.

TABLE XXXIX.

RECORD OF TRACHINUS VIPERA.

No. of haul.	Date.	Depth.	No.	Size in mm.
XXV.	16.vi.14	B.	3	5·2–7
XXVI.	,,	B.	2	5·6–8·2
XXXIV.	19.vi.14	M.	3	6·6–8·5
XXXV.	,,	M.	3	6·5–7·5
XXXVI.	24.vi.14	B.	1	7
XXXVII.	,,	B.	1	7·5
XXXVIII.	,,	M.	2	5·6–6·5
XXXIX.	,,	S.	1	9
L.	6.vii.14	B.	4	all 5 mm.
LI.	,,	B.	9	4·5–7·5
LII.	,,	M.	7	5–6
LV.	9.vii.14	M.	2	6–7
LIX.	15.vii.14	M.	8	5·5–7·8
LXI.	16.vii.14	B.	1	5·5
LXII.	,,	B.	2	5–7
LXVII.	22.vii.14	M.	5	6·5–8
LXVIII.	,,	B.	6	5·2–9·3
LXIX.	,,	S.	7	4·3–8·3
LXX.	,,	M.	1	5·5
LXXIII.	29.vii.14	M.	1	11·6
LXXIV.	,,	M.	3	6·5–7·5
LXXV.	,,	B.	1	8·5
LXXVI.	,,	M.	1	11·5
LXXVIII.	,,	M.	4	6·2–10·7
LXXXIII.	,,	B.	2	5·5–8·7
LXXXVI.	12.viii.14	B.–M.	1	7

TABLE XL.

TRACHINUS VIPERA.

Month.	Total number of hauls 1906–1914.	Number of hauls in which it occurs.	Number of specimens.	Size in mm.	Average number per haul.
April	7	1	1	3·5	0·1
May	30	1	1	3·5	0·03
June	106	22	80	2·5–9	0·75
July	94	45	335	3–11·6	3·6
August . . .	75	52	292	2·7–18	3·9
September . . .	85	26	42	3·5–18	0·5

CALLIONYMIDÆ.

Callionymus lyra L.

Post-larval dragonets are more constantly met with in the hauls and occur in greater numbers than any other species of teleostean, being specially abundant in May and June. The 1914 records are given in Table XLI., and the monthly summaries in Table XLII.

TABLE XLI.

RECORD OF CALLIONYMUS LYRA.

No. of haul.	Date.	Depth.	No.	Size in mm.
V.	29.iv.14	B.	5	4–7
VI.	,,	M.	4	5–7
VII.	,,	S.	5	3–6
VIII. (1)	8.v.14	M.	1	6·3
IX. (1)	15.v.14	M.	67	5–7·5
IX. (5)	,,	B.	108	4–7
XII.	19.v.14	S.	5	5–10·5
XIII.	,,	M.	20	4·5–11
XIII.a	22.v.14	—	34	5–9
XIV.	25.v.14	M.	4	5·5–7
XV.	,,	S.	4	8–10·5
XVI.	,,	S.	3	5·5–6
XVII.	3.vi.14	B.	105	4–7
XVIII.	,,	B.	59	3·5–7
XIX.	,,	M.	15	4·5–8
XX.	10.vi.14	S.–M.	2	5·5–6·3
XXI.	11.vi.14	M.	9	5·2–11
XXII.	,,	M.–B.	16	6–12

TABLE XLI. (*continued*).

No. of haul.	Date.	Depth.	No.	Size in mm.
XXIII.	11.vi.14	B.	41	5–13·5
XXIV.	16.vi.14	B.	2	6·7–10·2
XXV.	,,	B.	27	3·8–8
XXVII.	,,	M.	1	7
XXIX.	17.vi.14	B.	1	7·3
XXX.	,,	M.	14	3·7–8·3
XXXI.	,,	M.	30	3–9
XXXII.	,,	S.	17	4–6
XXXIII.	19.vi.14	M.	1	7·7
XXXIV.	,,	M.	1	7
XXXV.	,,	M.	10	5·5–8·7
XXXVI.	24.vi.14	B.	2	3·2–6·6
XXXVII.	,,	B.	54	4·5–8
XLII.	29.vi.14	B.	11	7–8·5
XLIII.	,,	B.	37	5·5–8·7
XLIV.	,,	M.	13	5·5–8
XLV.	,,	S.	1	6
XLVI.	2.vii.14	S.	165	6–12
XLVII.	,,	S.	98	5·5–12·2
XLVIII.	,,	M.	94	4–12·2
XLIX.	,,	M.–B.	47	5·5–11·5
L.	6.vii.14	B.	2	10–13·5
LI.	,,	B.	2	7·5–9
LIV.	9.vii.14	S.	2	6–6·5
LV.	,,	M.	1	5·3
LVI.	,,	B.	1	6
LVII.	,,	B.	3	6·7–7·1
LIX.	15.vii.14	M.	6	6·5–8·5
LXI.	16.vii.14	B.	4	7·5–11
LXII.	,,	B.	2	5–6
LXVII.	22.vii.14	M.	1	6·5
LXVIII.	,,	B.	10	4·5–7·3
LXIX.	,,	S.	1	6·5
LXX.	,,	M.	1	6
LXXIII.	29.vii.14	M.	8	6·5–8
LXXIV.	,,	M.	3	6·5–7·5
LXXVI.	,,	M.	2	9·2
LXXVII.	,,	B.	4	6·5–8·5
LXXXIV.	,,	B.	1	8

TABLE XLII.

CALLIONYMUS LYRA.

Month.	Total number of hauls 1906–1914.	Number of hauls in which it occurs.	Number of specimens.	Size in mm.	Average number per haul.
March . . .	2	2	36	2·5–6	18
April . . .	7	6	46	2·5–12	6·6
May . . .	30	21	654*	2·5–11	21·8
June . . .	106	77	1890*	2–14	17·8
July . . .	94	57	933	2·5–13·5	10
August . . .	75	43	279	2·75–13	3·7
September . . .	85	20	56	4–10	0·7
October . . .	14	1	1	5	0·07

GOBIESOCIDÆ.

Lepadogaster.

Eighteen post-larval specimens were obtained in 1914, thirteen of which occurred in July. According to Clark's records (**1914**) specimens may occur from June to September.

TABLE XLIII.

RECORD OF LEPADOGASTER SP.

No. of haul.	Date.	Depth.	No.	Size in mm.
XXIII.	11.vi.14	B.	1	10·5
XLVI.	2.vii.14	S.	5	10–12
XLVII.	,,	S.	1	11·2
XLVIII.	,,	M.	3	8·6–11·7
LV.	9.vii.14	M.	1	6·5
LVII.	,,	B.	2	7·5
LIX.	15.vii.14	M.	1	10
LXXXVI.	12.viii.14	B.–M.	4	10–11·2

BLENNIIDÆ.

Probably two species at least are represented in the material, *Blennius pholis* L. and *Blennius ocellaris* L., but I have not succeeded in separating them with certainty. The records are shown in Table XLIV.

* m. (=many) has been counted as 50, and v.m. (=very many) as 100. The figures for May and June are therefore approximations only

TABLE XLIV.

Record of Blennius sp.

No. of haul.	Date.	Depth.	No.	Size in mm.
XXV.	16.vi.14	B.	1	6·5
XXVII.	,,	M.	1	7
XXXVII.	24.vi.14	B.	1	5·5
XXXIX.	,,	S.	1	9
XLVI.	2.vii.14	S.	2	8–9
XLVII.	,,	S.	2	8·5–9·5
XLVIII.	,,	M.	1	12·5
L.	6.vii.14	B.	1	6·4
LI.	,,	B.	1	7·5
LIV.	9.vii.14	S.	1	17
,,	,,	,,	6	6–8·5
LV.	,,	M.	1	6
LVIII.	,,	M.	2	12–13·5
LXIV.	22.vii.14	B.	2	17·5
LXV.	,,	B.	1	17
LXVIII.	,,	B.	3	7–9·8
LXXIII.	29.vii.14	M.	1	12
LXXV.	,,	B.	1	7
LXXV.	,,	B.	1	8·5
LXXXIII.	,,	B.	1	8
LXXXVII.	4.ix.14	M.	4	8·3–11·5

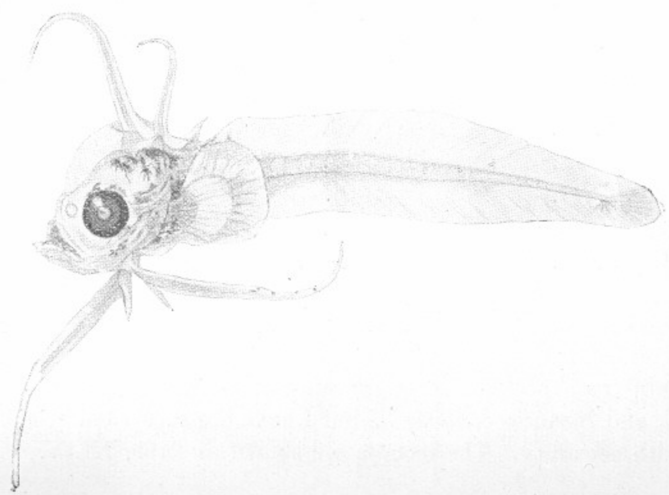


Fig. 8.—*Lophius piscatorius* L. Length 6·2 mm. July 16th, 1914.

PEDICULATI.

Lophius piscatorius L.

One specimen of an early stage, 6·2 mm. long was found in Haul LXII., taken near the bottom 7 miles west of Rame Head on July 16th, 1914. A figure of this specimen drawn by Mrs. Sexton is reproduced as Fig. 8. The great resemblance of this figure with Emery's figure, which is reproduced by Ehrenbaum in *Nordisches Plankton*, p. 303, Fig. 108, b, and ascribed by both authors to *Macrurus*, may be pointed out. It seems to me very probable that that figure should really be assigned to *Lophius*.

The larva of *Lophius piscatorius* is figured by Danois (**1913**, p. 164, Fig. 319). Ehrenbaum (**1905–9**) reproduces Agassiz and Whitman's figures of American specimens.

SUMMARY.

Table XLV. is perhaps of interest, as showing the composition of the catch obtained with the young-fish trawl at different times of the year. It has been obtained by combining certain groups of hauls made in 1914 in the offshore waters outside Plymouth, all of them being beyond the 20-fathom line. As far as the conditions are concerned therefore the different groups are fairly comparable. The figure given for each species is the average number of specimens per haul for the group. It will be seen that after June the number of species present as well as the average number per haul are both very much reduced.

TABLE XLV.

Averages per Haul in Different Groups of Hauls.

	X.–XIII. S. of Eddystone May 19,'14. 27–39 fms.	XIV.–XVI. S. of Eddystone May 25,'14. 35–37 fms.	XVII.–XXIII. W. of Rame June 3-11, 1914. 26–27 fms.	XXXV. to XLI. Eddystone June 19–26, 1914. 23–39 fms.	LXVII. to LXX. Eddystone July 22,'14 32–38 fms.	LXXIII. to LXXVIII. Eddystone July 29,'14. 20–35 fms.	LXXXV. and LXXXVI. W. of Rame Aug. 12,'14 26–27 fms.
Clupea . . .	217	v.m.	v.m.	11	11	2	—
Ammodytes . .	0·7	1	4	3	7	3	—
Gadus pollachius . .	2	—	—	—	0·2	—	—
,, merlangus . .	6	13	9	0·5	—	—	—
,, minutus . .	44	47	2	4	0·2	0·2	—
,, luscus . .	3	6	0·4	0·3	—	—	—
Molva molva . .	0·2	0·7	0·4	0·2	—	—	—
Raniceps raninus . .		—	—	—	—	0·2	—
Onos mustelus . .	3	9	0·7	0·7	—	0·2	—
Labrus bergylta . .	0·5	2	3	—	—	0·2	2
Labrus mixtus . .	0·2	1	0·7	0·2	0·5	—	—

v.m.=very many.

TABLE XLV. (*continued*).

	X.–XIII. S. of Eddystone May 19, '14. 27–39 fms.	XIV.–XVI. S. of Eddystone May 25, '14. 35–37 fms.	XVII.–XXIII. W. of Rame June 3-11, 1914. 26–27 fms.	XXXV. to XLI. Eddystone June 19–26, 1914. 23–39 fms.	LXVII. to LXX. Eddystone July 22, '14. 32–38 fms.	LXXIII. to LXXVIII. Eddystone July 29, '14. 20–35 fms.	LXXXV. and LXXXVI. W. of Rame Aug. 12, '14 26–27 fms.
Ctenolabrus rupestris	—	—	—	0·5	0·2	0·5	0·5
Scomber scomber	—	28	7	2	0·5	—	—
Pleuronectes limanda	29	358	22	0·2	—	—	—
,, microcephalus	34	15	8	0·5	0·2	0·2	—
Arnoglossus laterna	0·5	8	21	3	3	6	1
Rhombus maximus	—	—	—	—	—	0·3	—
,, laevis	—	1	0·3	—	0·2	0·2	0·5
Scophthalmus norvegicus	66	4	19	—	0·2	—	—
Zeugopterus punctatus	4	3	0·7	—	—	—	—
,, unimaculatus	0·5	1	1	—	—	—	—
Solea vulgaris	0·2	2	0·1	—	—	—	—
,, variegata	36	18	2	0·3	—	—	—
Gobius sp.	2	11	2	—	2	1	—
Crystallogobius nilssoni	39	18	0·6	—	—	0·2	—
Aphya pellucida	—	2	2	0·5	—	0·2	0·5
Cyclopterus lumpus	—	—	—	0·2	—	—	—
Trigla gurnardus	28	40	29	1	—	1	2
,, hirundo	—	—	0·1	0·3	1	0·2	—
Trachinus vipera	—	—	—	1	5	2	0·5
Callionymus lyra	6	4	35	11	3	3	—
Lepadogaster	—	—	0·1	—	—	—	2
Blennius	—	—	—	0·3	1	0·5	—

LITERATURE.

1887. MATTHEWS, J. DUNCAN.—Note on the Ova, Fry and Nest of the Ballan Wrasse. 5th Ann. Rep. Fish. Bd. Scotland.

1888. RAFFAELE, F.—Mitteil. Zool. Sta. Neapel. VIII.

1899. HOLT, E. W. L.—Recherches sur la reproduction des poissons osseux. Ann. Mus. d'Hist. Nat. Marseille. Zoologie. T. V.

1905–9. EHRENBAUM, E.—Eier und Larven von Fischen. *Nordisches Plankton*. IV. and X.

1910. HEFFORD, A. E.—Notes on Teleostean Ova and Larvæ observed at Plymouth in Spring and Summer, 1909. Journ. Mar. Biol. Assoc. IX. p. 1.

1913. DANOIS, E.—Contribution à l'étude systématique et biologique des poissons de la manche occidentale. Paris. Masson et Cie.

1914. CLARK, R. S.—General Report on the Larval and Post-Larval Teleosteans in Plymouth Waters. Journ. Mar. Biol. Assoc. X. p. 327.

On the Amount of Phosphoric Acid in the Sea-Water off Plymouth Sound. II.

By

Donald J. Matthews.

With one Figure in the Text.

IN a previous paper* the writer gave the results of the determination of the phosphates in sea-water, by means of Pouget and Chouchak's reagent, on a number of samples collected between September 13, 1915, and February 5, 1916, at the Knap Buoy, half a mile outside the breakwater at Plymouth.

The analyses have been continued so as to cover a period of sixteen months and show a large seasonal variation.

The method is described in detail in the previous paper, and consists in throwing down the phosphoric acid with iron and an alkali, treating with nitric acid, and determining the amount colorimetrically in the Dubosq apparatus after adding nitromolybdate of strychnine. A few modifications have been made and are described below.

In the first place, as the pressure of other work made it impossible to examine all samples immediately after collection, they were sterilised as soon as taken with toluol or chloroform. Toluol was perfectly satisfactory, but the chloroform in some cases threw down a precipitate on standing, and the absence of figures for July, August, November and December, 1916, is due to the loss of samples from this cause. If the sample is allowed to stand without previous sterilisation the phosphates decrease and may be entirely removed in a few weeks.

The standard phosphate solution contained 0·003 mg. of P_2O_5 in one cubic centimetre, and was made up in approximately decinormal nitric acid to prevent the growth of moulds.

For the precipitation of the iron, sodium carbonate was used instead of ammonia and ammonium chloride ; 1 ccm. of 2 N solution for 1 ccm. of iron solution was sufficient to more than neutralise the excess acid of the latter.

In some instances the iron precipitate was greasy and was difficult

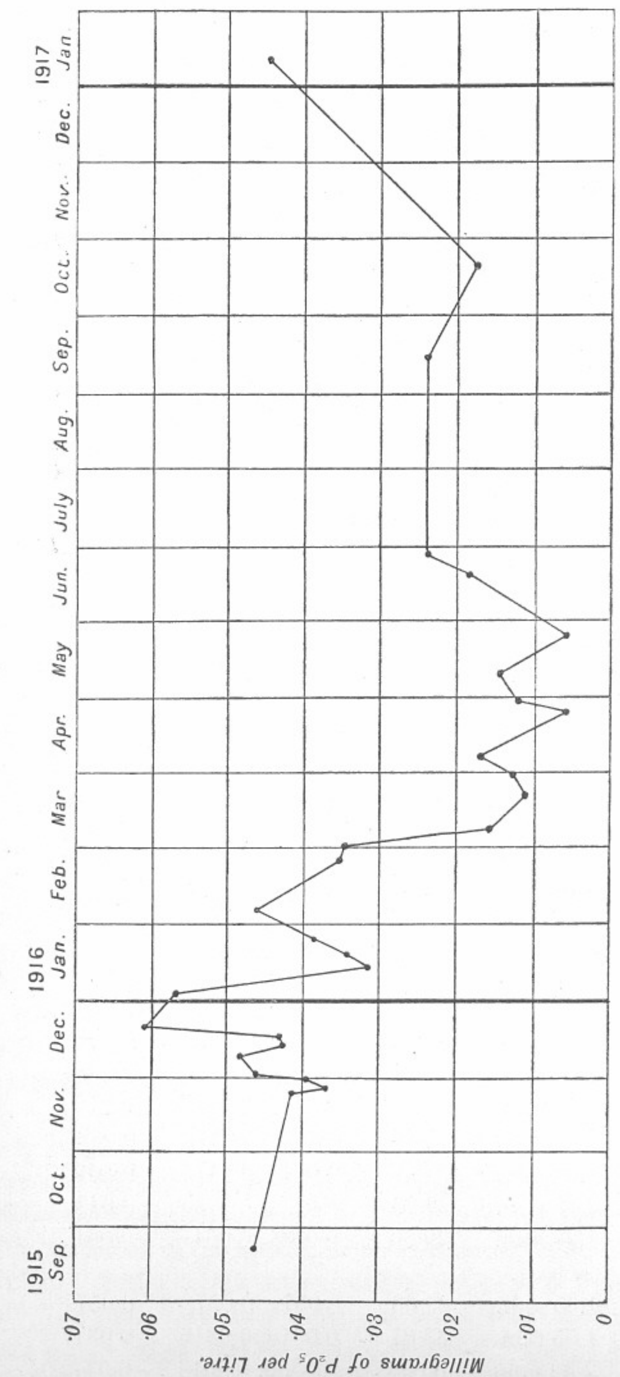
* Matthews, D. J., "On the Amount of Phosphoric Acid in the Sea-Water off Plymouth Sound." This Journal, xi., No. 1, p. 122, March, 1916.

to dissolve off the paper completely, so the following method was adopted. Five cubic centimetres of strong hydrochloric acid were poured into the beaker in which precipitation had taken place and distributed over the walls to dissolve any iron; then 10 ccm. of water were added, the beaker was warmed for a few minutes, and the hot dilute acid was allowed to drop on to the filter paper by means of a small pipette provided with a rubber-teat head. The beaker and paper were well washed and the latter incinerated in a platinum crucible; the ash was dissolved in a little strong hydrochloric acid and added to the rest of the solution, which was then evaporated to dryness on the water-bath; the chlorides were converted to nitrates by evaporation to dryness with 10 ccm. of the dilute nitric acid, taken up in more nitric acid, using 7 ccm. of 25% by volume if the final bulk was to be 50 ccm. The analysis was then carried out as described in the previous paper. In an extreme case the dirty residue on the paper was found to contain 0·0024 mg. of P_2O_5. The origin of the greasy matter is unknown; it may be due to the drainage from the port, or, on the other hand, it may be the volatile oily substance which so often renders the distillate turbid when sea-water is boiled with an alkali for the determination of ammonia.

It was mentioned in the earlier paper that the amount of phosphates found was increased if the water was previously oxidised with a permanganate. Attempts to find a suitable method for determining this excess phosphorus have been only partly successful. It is necessary to use strong oxidising substances which do not interfere with subsequent operations and are easily purified. In the end the following process was adopted. From 200 ccm. to 400 ccm. of the water were evaporated in a porcelain basin holding nearly 200 ccm. until the bulk of the salts had separated; then 10 ccm. or 20 ccm. of strong nitric acid were added, according to the amount of sample taken, the dish was covered, and heating continued until the evolution of brown fumes had ceased. The cover was removed and the evaporation was continued to dryness; the dish was then heated over an argand burner until the salts were in gentle fusion and the nitrates of the earths were decomposed with evolution of brown fumes.

The dish was allowed to cool and the salts were dissolved by warming for an hour with 150 ccm. of water and 1 ccm. of strong hydrochloric acid. Iron was added and 5 ccm. of 2 N sodium carbonate solution and the analysis completed as before. There is danger of the porcelain being attacked unless it is very carefully heated, and unless it is certain that it gives up no phosphates under this treatment it would probably be better to use fused silica basins.

The blank on the reagents used in the analyses reported in the previous



Phosphates in Water at Knap Buoy, Plymouth Sound.

paper was 0·0036 mg. of P_2O_5. A repurification of the iron, acids, alkali and water reduced it to 0·0026 mg., and a second purification to 0·0021 mg. The blank on the amounts required for the estimation of total phosphorus was at first 0·0066 mg. and afterwards 0·0061 mg. The blanks were determined both by carrying out analyses on distilled water, to which 0·0300 mg. of P_2O_5 had been added, and also with small amounts of water, the final solution being made up to 10 ccm. and compared in a special small colorimeter tube holding only 10 ccm. The results agreed excellently.

The determination of the small amounts of phosphoric acid found during the summer presented considerable difficulty. Making the final volume 10 ccm. gave rather discordant results, and it was subsequently found that the closest agreement was obtained between duplicates if enough of the standard solution was added to the sample to bring the content up to about 0·035 mg. of P_2O_5 per litre, the final volume being 50 ccm. This gives a strong colour in a depth of 40 mm. and at the same time avoids the errors which arise when very small volumes of liquid are to be manipulated.

The whole of the results obtained by the colorimetric method are given in the following table, and those for phosphoric acid are plotted in the curve; the figures for February 17th, 1915, have not been used in this case as the sample was by an oversight allowed to stand unsterilised for six days.

SURFACE SAMPLES TAKEN AT THE KNAP BUOY.

Date.	G.M.T.	S.‰.	Phosphates. P_2O_5 mg. per litre. Found in duplicates.	Mean.	Total P calculated to P_2O_5 mg. per litre.
1915					
Sept. 21	10.30 a.m.	34·96	—	0·046	—
Nov. 24	11.35 a.m.	34·78	0·042, 0·041	0·0415	—
,, 26	11.45 a.m.	34·43	0·040, 0·034	0·037	—
,, 29	11.10 a.m.	34·14	0·040, 0·037	0·0385	—
Dec. 2	12.20 p.m.	—	0·0484, 0·0435	0·0460	—
,, 9	10.30 a.m.	31·46	0·049, 0·047	0·048	—
,, 13	11.30 a.m.	—	0·044, 0·041	0·0425	—
,, 16	12.10 p.m.	26·20	—	0·043	—
,, 20	11.25 a.m.	29·69	0·058, 0·064	0·061	—
1916					
Jan. 3	11.35 a.m.	25·66	0·057, 0·057	0·057	—
,, 14	1.55 p.m.	33·87	0·0318, 0·0316	0·0317	—
,, 18	2.30 p.m.	33·93	0·0336, 0·0348	0·0342	—

Date.	G.M.T.	S.‰.	Phosphates. P_2O_5 mg. per litre. Found in duplicates.	Mean.	Total P calculated to P_2O_5 mg. per litre.
Jan. 24	11.20 a.m.	33·42	0·0378, 0·0391	0·0384	—
Feb. 5	12.30 p.m.	31·58	0·0507, 0·0414	0·0460	—
,, 17	10.45 a.m.	—	0·0190, 0·0190	(0·0190)	0·0323
,, 25	11.0 a.m.	33·30	0·0371, 0·0343	0·0357	—
Mar. 1	11.40 a.m.	33·82	—	0·0350	0·039
,, 8	11.15 a.m.	34·54	0·0201, 0·0115	0·0158	—
,, 21	11.50 a.m.	34·54	0·0101, 0·0122	0·0111	0·050
,, 29	11.45 a.m.	32·18	0·0104, 0·0148	0·0126	0·045
April 6	11.55 a.m.	34·40	0·0160, 0·0180	0·0170	0·016
,, 24	11.10 a.m.	34·40	—	0·0056	—
,, 28	—	34·40	0·0117, 0·0124	0·0120	0·035
May 9	10·50 a.m.	34·16	0·0158, 0·0130	0·0144	0·046
,, 24	11.45 a.m.	34·60	0·0053, 0·0064	0·0058	—
June 19	10.45 a.m.	34·90	0·0185, 0·0184	0·0184	0·036
,, 27	11.45 a.m.	—	0·0230, 0·0248	0·0239	0·038
Sept. 13	noon	—	0·0277, 0·0198	0·0238	0·024
Oct. 19	10.45 a.m.	33·93	0·0194, 0·0155	0·0174	0·029
1917					
Jan. 10	12.30 p.m.	33·62	0·0435, 0·0448	0·0442	0·049

In the first place it is clear that the results given in the previous paper which were obtained by precipitating the phosphorus with iron and then weighing as phosphomolybdic anhydride are seriously in error, and it was found that molybdic acid was thrown down at the same time.

The data of the present table show that there is a large seasonal variation, the maximum being more than ten times as large as the minimum. At first it was expected that the curve would agree with that for the phytoplankton inverted, but this is not the case. Miss Lebour* has made counts of the diatoms at the surface, 5 fthms. and 7 fthms. on 330 samples taken on 110 days at the Knap Buoy from September 21, 1915, to September 18, 1916. The average number in 1 ccm. for October, 1915, was 17, and in November 9, while in December and in January, February and March, 1916, there were only one or two. The maximum number for the year, 38, occurred in April, 1916, the high value being due to the last week of the month, 45 being counted on the 25th and 137 on the 27th. Then a decline set in, with 30 per cubic centimetre in May and only 9 in June. In July there was a rise to 21 and a secondary

* Lebour, Marie V., M.Sc., "The Microplankton of Plymouth Sound from the Region beyond the Breakwater." This Journal and Volume, p. 133.

maximum of 31 in August, followed by a fall to 17 in September. The curve shows that the maximum value for phosphates, 0·061 mg. of P_2O_5 per litre, coincided with the smallest number of diatoms, and also with the shortest days of the year. The phosphates then commenced to fall at once, irregularly at first it is true, to a minimum, of less than one-tenth of the maximum, at the end of April, which coincides with the diatom maximum for the year. The number of diatoms fell off at the beginning of May, while the phosphate minimum continued to the last week of the month. At this period, however, the alga *Phæocystis* appeared in enormous quantities. It was first abundant on April 25, reached its maximum on May 9th and 12th, then declined, and was absent after June 12th. If the decrease in phosphates is to be attributed to their removal by algæ, as the writer considers to be the case, some other factor must be sought in addition to the phytoplankton. This is probably to be found in the larger algæ, such as *Fucus*, *Laminaria* and others. Well grown young plants of these are to be found in February, and must by that time have already abstracted considerable quantities of phosphorus from the water. The march of events would then be somewhat as follows. As soon as the young plants of the fixed algæ begin to increase the amount of phosphates in the water falls off, and this decline is further hastened by the sudden increase of diatoms at the end of April. In May the diatoms decrease, but the phosphates are kept at a minimum value by the appearance of *Phæocystis*, and increase at once when this disappears in June. The want of data for phosphates in July and August prevents a further comparison with the figures for diatoms, but another minimum might be expected in August. Phosphate values are also missing in November and December, 1916, but the records for 1915 show an agreement with what might be expected from the diatom figures, that is, a rise from November to December.

On January 10th, 1917, the amount of phosphates present was very nearly the mean of the first two figures for the month in the previous year.

The Admiralty regulations have made it impossible to obtain water at a distance from the shore. It is by no means improbable that in mid-Channel, beyond the influence of the fixed weeds, the decrease in the phosphates would not be large until much later in the year when the phytoplankton begins to increase.

The last column of the table contains some figures for the total dissolved phosphorus, calculated to P_2O_5. It is not claimed that they are accurate, but they certainly show that what may be called for the present " organic phosphorus " is often high even when the phosphates are at a minimum, though it varies from month to month. The figures for June 27th, 1916, and January 10th, 1917, are probably the most

accurate, and as the two samples were analysed side by side they are fairly comparable. They show that the total phosphorus may be as high in summer as in winter, but that in summer only a very small part of it may be present as phosphoric acid. The analyses as a whole, however, do not allow more to be stated with certainty than that there is a soluble phosphorus compound present other than phosphoric acid, that it is probably not a lower acid of phosphorus owing to the comparative difficulty with which it is oxidised, and that it is probably an organic compound.

The nature and origin of this " organic phosphorus " is, of course, quite unknown. At first it was thought that it might be due to minute organisms which pass through a filter paper, and an attempt was made to filter it out by means of candles such as are used for bacteriological work, but this proved impossible as both Doulton and Chamberland filters gave up a considerable amount of phosphates to distilled water passed through them. It is, however, unlikely that it is due to solid particles, as if iron and a relatively large amount of ammonia are added to sea-water so as to produce a bulky precipitate of hydrates of iron, lime, and magnesium, which would almost certainly entangle and stop any suspended matter, the filtrate from this still shows a considerable amount of phosphate after oxidising.

SUMMARY.

The amount of phosphoric acid in sea-water off Plymouth was at a maximum of 0·06 mg. per litre of P_2O_5 at the end of December, 1915, after which it fell irregularly to a minimum of less than 0·01 mg., which extended from the last week of April to the latter part of May; it then increased again and in January, 1917, reached the same value as the average for the first part of the month in the previous year.

This seasonal variation is probably to be attributed to the removal of the phosphates from solution, at first by the fixed algæ, and later in the spring by the diatoms and for a short time by *Phæocystis*. There is also present in sea-water taken near Plymouth another soluble compound of phosphorus which can be converted into phosphoric acid by oxidising agents.

Abstract of Memoir

RECORDING WORK DONE AT THE PLYMOUTH LABORATORY.

The Development of Alcyonium Digitatum, with some notes on the Early Colony Formation. By Annie Matthews, M.Sc.

Quart. Journ. Micr. Sci., Vol. 62, *Part* 1, *New Series*, 1916.

THE above paper is a record of the successful rearing of Alcyonium larvæ in tanks at the Plymouth Laboratory.

Ripe male and female specimens collected near the Eddystone during the breeding seasons of 1912–13 and 1913–14 spawned in the tank water, and fertilised eggs were collected from which eventually young colonies were obtained.

Segmentation gave rise in various ways to a morula, followed by the pre-planula and planula stages. The pear-shaped free-swimming planula eventually settled by the broad anterior end, and the mouth arose at the narrow posterior end subsequent to a general flattening of the settled planula along the long axis.

The characteristic eight mesenteries grew out into the cœlenteron on the second day of fixation, followed by the appearance of spicules and eight hollow circumoral tentacles which alternated in position with the mesenteries. Free entrance of food was permitted on the fourth day, after the degeneration of the base of the œsophageal invagination. On the fifth and sixth day of fixation respectively the ventral and dorsal mesenteric filaments were formed, the two being of homogeneous origin, i.e. consisting of endodermic and ectodermic portions developed in different degrees.

At the end of the third week the first bud grew as an outgrowth from the basal stolon formed by the solitary polyp.

Very young fixed stages were fed with fine plankton, but colonies of two or three individuals or more were successfully fed on larvæ and single adults from Leptoclinum and Botryllus colonies. The early buds are arranged in circles round the parent, but in colonies of thirty-two individuals budding took place irregularly.

A. M.

Marine Biological Association of the United Kingdom.

Report of the Council, 1915.

The Council and Officers.

FOUR ordinary meetings of the Council were held during the year, at which the average attendance was nine. During the Easter Vacation a Committee of the Council visited and inspected the Laboratory at Plymouth.

The Association has suffered a great loss during the year through the death of Mr. J. A. Travers, who was for eighteen years its Honorary Treasurer. During his term of office Mr. Travers worked hard in the interests of the Association, and his advocacy of the practical value of the scientific fishery work which was being undertaken did much to ensure the continued progress of our investigations.

The Council elected Mr. George Evans, lately Prime Warden of the Worshipful Company of Fishmongers, to succeed Mr. Travers as Honorary Treasurer.

The Council desires to express its thanks to the Royal Society for the use of the Rooms at Burlington House in which its meetings have been held.

The Plymouth Laboratory.

The buildings, fittings and machinery at Plymouth have been kept in a state of efficient repair, but owing to the war all expenditure has been kept at the lowest possible limit. It has been necessary, however, to effect some repairs to the Shone's ejector, which pumps water from the sea, and the small gas-engine used for circulating sea-water through the Aquarium and Laboratory tanks has been fitted with a new piston and cylinder liner.

The Boats.

The steamer *Oithona* has not been put in commission this year. All the collecting work which has been possible has been done with the small sailing boat built for the Association two years ago. The motor boat given to us by Colonel G. M. Giles was sold early in the year for the sum of £35, as there was little prospect of making use of her for some time to come.

The Staff.

Dr. J. H. Orton and Mr. L. R. Crawshay have joined His Majesty's Forces for the war, making with Mr. E. W. Nelson and Mr. E. Ford, who joined last year, and Mr. R. S. Clark, who accompanied Sir Ernest Shackleton's Antarctic Expedition, five members of the staff who have been absent this year. Of the old staff, in addition to the Director, Dr. E. J. Allen, only Mr. D. J. Matthews remains, he being employed by the Association for half his time.

Miss M. V. Lebour, M.Sc., lecturer in Zoology of the University of Leeds, has been appointed a temporary Naturalist for the period of the war and the Council is indebted to the Senate of the University for granting Miss Lebour the necessary leave of absence. Mrs. D. J. Matthews, M.Sc., has also been engaged for part of her time in carrying out fishery researches for the Association.

Mr. D. W. Cutler, B.A., now Lecturer in Zoology at Manchester University, was employed for some months last summer in assisting with fishery work.

Those members of the staff who have joined His Majesty's Forces are being paid by the Association the differences between their salaries and service pay.

Occupation of Tables.

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

W. De Morgan, Plymouth (Protozoa).
Dr. E. S. Goodrich, F.R.S., Oxford (Myxosporidia).
Mrs. Goodrich, B.SC., Oxford (Parasitic Protozoa).
Miss M. Irwin, B.A., Cambridge (Embryology of Elasmobranchs).
W. O. R. King, M.A., Leeds, Ray Lankester Investigator (Temperature coefficient of development of *Echinus miliaris*).
Mrs. W. O. R. King, Leeds (Enzymes of Echinoderm gonads).
D. G. Lillie, B.A., Cambridge (Antarctic Plankton).
J. H. Lloyd, Birmingham (Larvæ of Nematode of the Common Dogfish in *Carcinus mænas*).
Mrs. Matthews, M.SC., Plymouth (Development of Alcyonium).
Mrs. E. W. Sexton, Plymouth (Amphipoda and Polychæta).
Dr. C. Shearer, M.A., Cambridge (Dinophilus).

The usual Easter Vacation Course in Marine Biology for University students was not held this year.

General Work at the Plymouth Laboratory.

The number of the Journal issued during the year (Volume X, No. 4) contains a report by Mr. L. R. Crawshay upon his experiments in the keeping of Plankton animals under artificial conditions. Since this paper was written Mr. Crawshay has, after a careful study of the different factors involved, succeeded in rearing *Calanus finmarchicus*, one of the most typical of the Plankton Copepods, through all stages from the egg to the adult form, under critical experimental conditions.

In the same number of the Journal the Director has published a revised list of the Polychæta of the Plymouth District and of the South Devon Coast, with records of the localities in which these annelids have been found. The list contains many new records for the English Channel and several for the British area.

The Director has been engaged for a portion of the year in examining a large collection of larval and young stages of fishes made by Mr. Clark and Mr. Ford in the summer of 1914, by the use of Petersen's young-fish trawl. This work will form the subject of a report on similar lines to those followed by Mr. Clark in his account in the Journal of the young-fish collections of 1913.

In connection with a scheme drawn up by the Board of Agriculture and Fisheries for the study of the different races of herrings found around the British coasts, Dr. Orton, with the help of a number of other workers, has examined two large samples of the Plymouth winter herrings, each containing over 500 fishes. This investigation involved the measurement and enumeration of some eighteen characters on each fish. The figures have been sent to the Board of Agriculture and Fisheries for comparison with those obtained from other localities, and in order to make them generally available they are also being published in the Journal of the Association.

A series of experiments has been commenced by Mr. D. W. Cutler, with a view to studying the growth of the scales of fishes kept in the Laboratory tanks under different conditions, especially as regards temperature. It is hoped that these experiments may throw some light upon the causes which produce the differences in the lines or markings on the scales now generally used in determining the age of fishes. Mrs. Matthews has taken charge of an investigation on the nutrition and growth-rate of fishes living under Aquarium conditions.

Mr. Matthews has been making determinations of the phosphates in samples of sea-water collected at about intervals of one week outside Plymouth Breakwater, in order to study seasonal changes. A considerable number of analyses have been made, and the results will be published in the next number of the Journal. The hydrographic work he was previously doing for the Fisheries Branch of the Department of Agriculture, etc. (Ireland), is in abeyance for the present, and since the latter part of October last he has been assisting in the chemical side of the investigations into cerebro-spinal meningitis which are being carried out at the Military Hospital at Stonehouse. The chemical work has been done in the Laboratory of the Association.

Miss M. V. Lebour has taken up the study of Plankton, especially that of the most minute organisms which escape from the ordinary silk tow-nets, but can be obtained by centrifuging samples of sea-water. The samples examined have been taken at frequent and regular intervals during the year by means of a water-bottle, which has been worked at several different depths, generally near the surface, about mid-water and near the bottom, at the entrance to Plymouth Sound. A numerical estimate has been made of the number of organisms of each kind in the individual samples. Miss Lebour has also undertaken the examination of a series of samples obtained by means of tow-nets during the last few years, at fortnightly intervals, at the Seven Stones Light Vessel, midway between Land's End and the Scilly Islands.

Mr. W. O. R. King, assisted by Mrs. King, spent some time at the Laboratory as Ray Lankester Investigator, and continued his work on the temperature coefficient of development of *Echinus*.

Mrs. E. W. Sexton has completed a paper on the Mendelian inheritance of eye-colour in the Amphipod, *Gammarus chevreuxi*, which is being published in the next number of the Journal.

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 :—

Drury, A. N. *The Eosinophil Cell of Teleostean Fish.* Journ. Physiology, vol. 49, 1915, pp. 349–366.

Gray, J. *Note on the Relation of Spermatozoa to Electrolytes and its bearing on the Problem of Fertilization.* Quart. Journ. Micr. Sci., vol. 61, 1915, pp. 119–126.

Orton, J. H. *An American Enemy of the English Oyster Farmer.* Trans. Plymouth Inst., vol. 15, 1912–13 (1915), pp. 247–261.

Pixell-Goodrich, H. L. M. *On the Life-History of the Sporozoa of Spatangoids, with Observations on some Allied Forms.* Quart. Journ. Micr. Sci., vol. 61, 1915, pp. 81–104.

Pixell-Goodrich, H. L. M., *Minchinia: A Haplosporidian.* Proc. Zool. Soc., 1915, pp. 445–457.

Potts, F. A. *Polychæta from the North-East Pacific: The Chætopteridæ. With an Account of the Phenomenon of Asexual Reproduction in Phyllochætopterus and the Description of Two New Species of Chætopteridæ from the Atlantic.* Proc. Zool. Soc., 1914, pp. 955–994.

Svedelius, N. *Zytologisch-Entwicklungsgeschichtliche Studien über Scinaia furcellata. Ein Beitrag zur Frage der Reduktionsteilung der nicht Tetrasporenbildenden Florideen.* Nova Acta Reg. Soc. Sc. Ups., Ser. iv., vol. 4, no. 4, 1915.

The Library.

The thanks of the Association are due to numerous Government Departments, Universities and other institutions at home and abroad for copies of books and current numbers of periodicals presented to the Library. The list is similar to that published in the Reports of Council of former years. A number of authors have been good enough to send reprints of their papers for the Library and to these also thanks are due.

Donations and Receipts.

The receipts for the year include a grant from H.M. Treasury of £500, being on account of the war one-half of the sum granted in recent years, a grant from the Board of Agriculture and Fisheries, Development Fund (£500), and one from the Fishmongers' Company (£600). In addition to these grants there have been received Annual Subscriptions (£136), Composition Fee (£15), Rent of Tables in the Laboratory, including £25 from the University of London and £20 from the Trustees of the Ray Lankester Fund (£49) ; Sale of Specimens (£324) and Admission to Tank Room (£99).

Vice-Presidents, Officers, and Council.

The following is the list of gentlemen proposed by the Council for election for the year 1916–17 :—

President.

Sir E. Ray Lankester, K.C.B., LL.D., F.R.S.

Vice-Presidents.

The Duke of Bedford, K.G.
The Earl of Ducie, F.R.S.
The Earl of Stradbroke, C.V.O., C.B.
Lord Montagu of Beaulieu.
Lord Walsingham, F.R.S.
The Right Hon. A. J. Balfour, M.P., F.R.S.
The Right Hon. Austen Chamberlain, M.P.
W. Astor, Esq., M.P.
G. A. Boulenger, Esq., F.R.S.
A. R. Steel-Maitland, Esq., M.P.
Rev. Canon Norman, D.C.L., F.R.S.
Edwin Waterhouse, Esq.

Members of Council.

E. T. Browne, Esq.
L. W. Byrne, Esq.
Prof. H. J. Fleure, D.Sc.
E. S. Goodrich, Esq., D.Sc., F.R.S.
Sir Eustace Gurney.
Prof. J. P. Hill, D.Sc., F.R.S.
E. W. L. Holt, Esq.
H. G. Maurice, Esq., C.B.
Dr. P. Chalmers Mitchell, F.R.S.
C. C. Morley, Esq.
F. A. Potts, Esq.
C. Tate Regan, Esq.
Prof. D'Arcy W. Thompson, C.B.

Chairman of Council.

A. E. Shipley, Esq., D.Sc., F.R.S.

Hon. Treasurer.

George Evans, Esq., 1 Wood Street, London, E.C.

Hon. Secretary.

E. J. Allen, Esq., D.Sc., F.R.S., The Laboratory, Citadel Hill, Plymouth.

The following Governors are also members of the Council :—

G. P. Bidder, Esq., Sc.D.
W. P. Haskett Smith, Esq. (Prime Warden of the Fishmongers' Co.).
The Earl of Portsmouth (Fishmongers' Company).
Sir Richard Martin, Bart. (Fishmongers' Company).
The Hon. Nathaniel Charles Rothschild (Fishmongers' Company).
George Evans, Esq. (Fishmongers Company).
Prof. G. C. Bourne, D.Sc., F.R.S. (Oxford University).
A. E. Shipley, Esq., D.Sc., F.R.S. (Cambridge University).
Prof. W. A. Herdman, D.Sc. F.R.S. (British Association).

THE MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM.

Dr. *Statement of Receipts and Payments for the Year ending 31st December, 1915.* **Cr.**

	£ s. d.	£ s. d.
To Balance from Last Year :—		
Cash at Bankers	720 14 3	
Cash in hand	13 10 11	734 5 2
,, Current Receipts :—		
H.M. Treasury for the year ending 31st March, 1916	500 0 0	
The Worshipful Company of Fishmongers	600 0 0	
Annual Subscriptions	135 8 0	
Rent of Tables (including Ray Lankester's Trustees, £20; University of London, £25)	48 15 0	
Interest on Investments	14 11 0	1,298 14 0
,, Extraordinary Receipts :—		
Donation, G. H. Fox	0 10 6	
Composition Fee	15 15 0	
Board of Agriculture and Fisheries, Grant from Development Fund for year ending 31st March, 1916	500 0 0	516 5 6
,, Laboratory Boats and Sundry Receipts :—		
Sales of Apparatus	7 19 0	
,, ,, Specimens	323 14 1	
,, ,, Boats, Nets, Gear, etc.	55 7 2	
Rebate of Insurance, S.Y. "Oithona"	20 13 1	
Other Items	1 1 0	408 14 4
		£2,957 19 0

The Association's Bankers hold on its behalf £410 14s. 8d. New Zealand 4% Stock, 1943–63.

	£ s. d.	£ s. d.
By Salaries and Wages—		
Director	300 0 0	
Hydrographer	150 0 0	
Senior Naturalist	91 9 4	
Additional ,,	138 14 2	
Temporary ,,	97 11 9	
Assistant ,,	61 0 10	
,, ,, (temporary)	52 9 6	
Salaries and Wages	479 2 7	1,370 8 2
,, Travelling Expenses		14 0 3
,, Library	84 4 2	
Less Duplicates sold	0 19 0	83 5 2
,, Journal	107 6 9	
Less Sales	17 16 1	89 10 8
,, Buildings and Public Tank Room—		
Gas, Water, and Coal	147 16 4	
Stocking Tanks and Feeding	33 2 11	
Maintenance and Renewals	156 8 11	
Rent, Rates, Taxes, and Insurance	46 14 0	
	384 2 2	
Less Admission to Tank Room, etc.	107 13 1	276 9 1
,, Laboratory, Boats, and Sundry Expenses—		
Glass, Apparatus, and Chemicals	75 0 2	
Purchase of Specimens	31 16 10	
Maintenance and Renewals of Boats, Nets, etc.	41 5 8	
Boat Hire and Collecting Expeditions	10 16 5	
Insurance of S.Y. "Oithona"	5 19 11	
Coal and Water for Steamer	1 16 0	
Stationery, Office Expenses, Carriage, Printing, etc.	87 17 8	254 12 8
,, Balance :—		
Cash at Bankers	852 0 2	
Cash in hand	17 12 10	869 13 0
		£2,957 19 0

Examined and found correct,
28th January, 1916.

(Signed) N. E. Waterhouse.
Edward T. Browne.
J. O. Borley.

Marine Biological Association of the United Kingdom.

LIST
OF
Governors, Founders, and Members.

1st May, 1917.

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

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.

I.—Governors.

The British Association for the Advancement of Science, *Burlington House, W.*	£500
The University of Oxford	£500
The University of Cambridge	£500
The Worshipful Company of Clothworkers, 41, *Mincing Lane, E.C.*	£500
The Worshipful Company of Fishmongers, *London Bridge, E.C.*	£12,505
Bayly, Robert (the late)	£1000
Bayly, John (the late)	£600
Thomasson, J. P. (the late)	£970
G. P. Bidder, Esq., Sc.D., *Cavendish Corner, Cambridge*	£1500

II.—Founders.

1884	The Corporation of the City of London	£210
1884	The Worshipful Company of Mercers, *Mercers' Hall, Cheapside*	£341 5s.
1884	The Worshipful Company of Goldsmiths, *Goldsmiths' Hall, E.C.*	£100
1884	The Royal Microscopical Society, 20, *Hanover Square, W.*	£100
1884	The Royal Society, *Burlington House, Piccadilly, W.*	£350
1884	The Zoological Society, *Regent's Park, London, N.W.*	£100
1884	Bulteel, Thos. (the late)	£100
1884	Burdett-Coutts, W. L. A. Bartlett, 1, *Stratton Street, Piccadilly, W.*	£100
1884	Crisp, Sir Frank, Bart., Treas. Linn. Soc., 17, *Throgmorton Avenue, E.C.*	£100
1884	Daubeny, Captain Giles A.	£100
1884	Eddy, J. Ray, *The Grange, Carleton, Skipton*	£100
1884	Gassiott, John P. (the late)	£100
‡1884	Lankester, Sir E. Ray, K.C.B., F.R.S., 29, *Thurloe Place, South Kensington, S.W.*	£100

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. (the late)	£100
1884	Poulton, Prof. Edward B., M.A., F.R.S., *Wykeham House, Oxford*	£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., *Mayfield House, Farnham, Surrey*	£100
1888	The Worshipful Company of Drapers, *Drapers' Hall, E.C.*	£315
1889	The Worshipful Company of Grocers, *Poultry, E.C.*	£120
1889	Thompson, Sir Henry, Bart. (the late)	£110
1889	Revelstoke, The late Lord	£100
1890	Riches, T. H., B.A., *Kitwells, Shenley, Herts*	£230
1902	Gurney, Robert, *Ingham Old Hall, Stalham, Norfolk*	£105
1909	Harding, Colonel W., *The Hall, Madingley, Cambridge*	£100
1910	Murray, Sir John, K.C.B., F.R.S. (the late)	£100
1912	Swithinbank, H., F.R.S.E., F.R.G.S., *Denham Court, Denham, Bucks.*	£100
1913	Shearer, Dr. Cresswell, 30, *Thompson's Lane, Cambridge*	£100

III.—Members.

1913	Adams, Alfred, M.B., B.Ch., Oxon., *Looe, Cornwall*	Ann.
1897	Adams, W. R., 11, *Windsor Road, Denmark Hill, Camberwell, London, S.E.*	Ann.
1900	Aders, Dr. W. M., *Zanzibar, East Africa*	Ann.
*1895	Allen, E. J., D.Sc., F.R.S., *The Laboratory, Plymouth*	Ann.
1889	Alward, G. L., *Enfield Villa, Humberstone Avenue, Waltham, Grimsby*	Ann.
1910	Ashworth, J. H., D.Sc., *The University, Edinburgh*	Ann
†1911	Astor, W., M.P., 4, *St. James's Square, London, W.*	*C.*
1910	Atkinson, G. T., 43, *Parliament Street, London, S.W.*	Ann.
1902	Baker, R. J., 89, *Alexandra Road, Plymouth*	Ann.
1884	Balfour, Prof. Bayley, F.R.S., *Royal Botanic Gardens, Edinburgh*	*C.*
*1884	Bayliss, Prof. W. Maddock, D.Sc., F.R.S., *St. Cuthberts, West Heath Road, Hampstead*	Ann.
1884	Bayly, Miss Anna, *Seven Trees, Plymouth*	£50
1885	Beck, Conrad, 68, *Cornhill, E.C.*	*C.*
1884	Beddington, Alfred H., 8, *Cornwall Terrace, Regent's Park, N.W.*	*C.*
†1907	Bedford, His Grace the Duke of, K.G., *Endsleigh, Tavistock*	*C.*
1903	Bidder, Major H. F., *Ravensbury Manor, Mitcham*	Ann.
1910	Bidder, Mrs. M. G., *Cavendish Corner, Cambridge*	Ann.
1912	Bles, E. J., D.Sc., *Elterholm, Madingley Road, Cambridge*	Ann.
1910	Bloomer, H. H., 40, *Bennett's Hill, Birmingham*	Ann.
1910	Borley, J. O., M.A., 43, *Parliament Street, London, S.W.*	Ann.
*1884	Bourne, Prof. Gilbert C., M.A., F.R.S., *Savile House, Mansfield Road, Oxford*	Ann
1898	Bowles, Col. Henry, *Forty Hall, Enfield*	Ann
1910	Bradford, Sir J. Rose, K.C.M.G., M.D., D.Sc., F.R.S., 8, *Manchester Square, London, W.*	Ann.

1902 Brighton Public Library (Henry D. Roberts, Chief Librarian) .... Ann.
1886 Brooksbank, Mrs. M., *Leigh Place, Godstone, Surrey* .... C.
1884 Brown, Arthur W. W., 62, *Carlisle Mansions, Carlisle Place, London, S.W.* C.
*1893 Browne, Edward T., B.A., *Anglefield, Berkhamsted* .... Ann.
1892 Browne, Mrs. E. T., *Anglefield, Berkhamsted* .... Ann.
*1897 Byrne, L. W., B.A., 7, *New Square, Lincoln's Inn, London, W.C.* .... Ann.

1908 Calman, Dr. W. T., *British Museum (Natural History), Cromwell Road, S.W.* .... Ann.
1912 Cavers, Dr. F., *Goldsmiths' College, New Cross, London, S.E.* .... Ann.
1913 Childs, Christopher, M.D., *Boscarne, Looe* .... Ann.
1911 Chilton, Prof. C., *Canterbury College, Christchurch, New Zealand* .... Ann.
1884 Christy, Thomas Howard .... C.
1911 Clark, Dr. J., *Technical School, Kilmarnock, N.B.* .... Ann.
1910 Clarke, G. S. R. Kitson, *Meanwoodside, Leeds* .... Ann.
1887 Clarke, Rt. Hon. Sir E., K.C., 5, *Essex Court, Temple, E.C.* £25
1886 Coates and Co., *Southside Street, Plymouth* .... C.
1885 Collier Bros., *George Street, Plymouth* .... C.
1912 Cotton, A. D., *The Herbarium, Royal Gardens, Kew* .... Ann.
1909 Crawshay, L. R., M.A., *The Laboratory, Plymouth* .... Ann.

1916 Delphy, J., *Laboratoire Maritime de Tatihou, par St. Vaast-la-Hougue (Manche), France* .... Ann.
1885 Darwin, Sir Francis, F.R.S., 10, *Madingley Road, Cambridge* .... C.
*1906 De Morgan, W. C., c/o *National Provincial Bank, Plymouth* .... Ann.
1908 Dendy, Prof. A., F.R.S., *Vale Lodge, Hampstead Heath, N.W.* .... Ann.
1884 Dewick, Rev. E. S., M.A., F.G.S., 26, *Oxford Square, Hyde Park, W.* ... C.
1915 Dick, G. W., J.P., c/o P.O. Box 28, *The Point, Durban, Natal* .... C.
1915 Director of Agriculture and Fisheries, *Travancore, Quilon, S. India*... Ann.
1885 Dixey, F. A., M.A. Oxon., F.R.S., *Wadham College, Oxford* £26 5*s.* and Ann.
1910 Dobell, C. C., M.A., *Imperial College of Science and Technology, South Kensington, S.W.* .... 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 15*s.*
1910 Duncan, F. Martin, 71, *St. Leonard's Road, East Sheen, S.W.* .... Ann.
1884 Dunning, J. W., 4, *Talbot Square, London, W.* .... £26 5*s.*
1884 Dyer, Sir W. T. Thiselton, M.A., K.C.M.G., F.R.S., *The Ferns, Witcombe, Gloucester* .... C.

1908 Elwes, Maj. Ernest V., c/o Hon. Secretary, *Torquay Natural History Society, The Museum, Torquay* .... Ann.
1885 Ewart, Prof. J. Cossar, M.D., F.R.S., *University, Edinburgh* £25

1894 Ferrier, Sir David, M.A., M.D., F.R.S., 34, *Cavendish Square, W.* ...... Ann.
1884 Fison, Sir Frederick W., Bart., *Boarzell, Hurst Green, Sussex* .... C.
*1913 Fleure, Prof. H. J., D.Sc., *University College of Wales, Aberystwyth* ... Ann.
1897 Foster, Richard, *Windsworth, Looe, R.S.O.* .... Ann.
1885 Fowler, G. Herbert, B.A., Ph.D., *The Old House, Aspley Guise, Bedfordshire* .... Ann.
1884 Fry, George, F.L.S., *Carlin Brae, Berwick-on-Tweed* £21

1912 Fuchs, H. M. de F., *Zoological Department, Imperial College of Science and Technology, South Kensington, S.W.* .... Ann.

1907 Gamble, Prof. F. W., D.Sc., F.R.S., *The University, Edmund Street, Birmingham* .... Ann.
1906 Gardiner, Prof. J. Stanley, M.A., F.R.S., *Caius College, Cambridge* ...... Ann.
1907 Garstang, Prof. W., D.Sc., 2, *Ridge Mount, Cliff Road, Headingley, Leeds* Ann.
1910 Gooding, H. C., *Ipswich Street, Stowmarket* .... Ann.
*1910 Goodrich, E. S., F.R.S., *Merton College, Oxford* .... Ann.
1885 Gordon, Rev. J. M., 7, *Moreton Gardens, London, S.W.* .... Ann.
1912 Gray, J., *King's College, Cambridge* .... Ann.
1899 Guinness, Hon. Rupert, *Elveden, Thetford* .... £35 15*s.*
1916 Guitel, Prof. F., *Laboratoire de Zoologie, Rennes, France* .... Ann.
1900 Gurney, Sir Eustace, *Sprowston 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., *British Museum (Natural History), Cromwell Road, S.W.* .... C.
1888 Haselwood, J. E., 3, *Richmond Terrace, 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, F.R.S., 10, *King's Bench Walk, Temple, London, E.C.* C.
1910 Hefford, A. E., B.Sc., *Riggside, Sandend, Whitby, Yorks* .... Ann.
1908 Hepworth, Commander M. W. Campbell, C.B., R.N.R., *Meteorological Office, South Kensington, London, S.W.* .... Ann.
*1884 Herdman, Prof. W. A., F.R.S., *The Zoology Department, The University, Liverpool* .... Ann.
1913 Heron-Allen, E., F.L.S., F.R.M.S., F.G.S., 33, *Hamilton Terrace, London, N.W.* .... C.
1884 Herschel, Col. J., R.E., F.R.S., *Observatory House, Slough, Berks.* ...... C.
1910 Hicks, F., *Zoological Laboratory, King's College, London, W.C.* .... Ann.
1884 Hickson, Prof. Sydney J., M.A., D.Sc., F.R.S., *Ellesmere House, Wilenslow Road, Withington, Manchester* .... Ann.
1907 Hill, Prof. J. P., F.R.S., *The Zoological Laboratory, University College, London, W.C.* .... Ann.
1897 Hodgson, T. V., *Highfield, Plympton, S. Devon* .... Ann.
*1905 Holt, E. W. L., *Department of Agriculture and Technical Instruction for Ireland (Fisheries Branch), Dublin* .... Ann.
1909 Hoyle, W. E., M.A., D.Sc., *National Museum of Wales, City Hall, Cardiff* Ann.
1912 Huxley, Prof. J. S., *The Rice Institute, Houston, Texas, U.S.A.* .... Ann.

1885 Jackson, W. Hatchett, M.A., D.Sc., F.L.S., *Pen Wartha, Weston-super-Mare* .... Ann.
1914 James, Lewis H., 43, *Parliament Street, London, S.W.* .... Ann.
1914 Jarvis, P. W., *Colonial Bank, Trinidad, and* 27, *Crescent Lane, London, S.W.* .... Ann.

1911 Kirkpatrick, R., *British Museum (Natural History), Cromwell Road, S.W.* Ann.

1897 Lanchester, W. F., B.A., 19, *Fernshaw Road, Chelsea, London, S.W.* ... C.
1885 Langley, Prof. J. N., F.R.S., *Trinity College, Cambridge* ... C.
1915 Lillie, D. G., B.A., *St. John's College, Cambridge* ... Ann.
1895 Lister, J. J., M.A., F.R.S., *St. John's College, Cambridge* ... Ann.
1910 Liversidge, Prof. A., F.R.S., *Fieldhead, George Road, Coombe Warren, Kingston, Surrey* ... Ann.
1912 Lloyd, Miss D. Jordan, *The Mythe, Edgbaston, Birmingham* ... Ann.

1885 Macalister, Prof. A., F.R.S., *St. John's College, Cambridge* ... Ann.
*1910 MacBride, Prof. E. W., M.A., D.Sc., F.R.S., *Royal College of Science, South Kensington, S.W.* ... Ann.
1900 Macfie, J. W. Scott, *Rowton Hall, Chester* ... C.
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.
1906 Masterman, A. T., D.Sc., F.R.S., *Board of Agriculture and Fisheries (Fisheries Division)*, 43, *Parliament Street, London, S.W.* ... Ann.
1910 Matthews, D. J., *c/o T. C. Matthews, Esq., Pitt White, Uplyme, S. Devon* Ann.
1912 Matthews, Mrs. D. J., *c/o T. C. Matthews, Esq., Pitt White, Uplyme, S. Devon* ... Ann.
*1912 Maurice, H. G., C.B., *Board of Agriculture and Fisheries*, 43, *Parliament Street, S.W.* ... Ann.
1910 McClean, W. N., 1, *Onslow Gardens, London, S.W.* ... Ann.
1884 McIntosh, Prof. W. C., F.R.S., 2, *Abbotsford Crescent, St. Andrews* ... C.
1884 Michael, Albert D., *The Warren, Studland, nr. Wareham, Dorset* ... C.
1909 Midgley, J. H., B.Sc., *Birstwith, Torquay* ... Ann.
*1905 Mitchell, P. Chalmers, D.Sc., F.R.S., Secretary Zoological Society, *Regent's Park, London, N.W.* ... Ann.
†1914 Montagu of Beaulieu, The Rt. Hon. Lord, 62, *Pall Mall, London.* Ann., £2 2s.
1906 Morford, Rev. Augustin, *Syon Abbey, Chudleigh* ... Ann.
*1915 Morley, C. C., c/o Messrs. Morley, Sellick and Price, Steam Trawler Owners, *Milford Haven* ... Ann.

1912 Newman, C. A., *Bramston House, Oundle* ... Ann.
†1884 Norman, Rev. A. M., M.A., D.C.L., F.R.S., *The Red House, Berkhamsted, Herts* ... Ann.

1911 Oldham, Chas., *Kelvin, Boxwell Road, Berkhamsted, Herts.* ... Ann.
1910 Orton, J. H., D.Sc., *The Laboratory, Plymouth* ... Ann.

1915 Pascual, Enrique, P.O. Box 8, *Galicia, Vigo, Spain* ... Ann.
1906 Plymouth Corporation (Museum Committee) ... Ann.
1910 Plymouth Education Authority ... Ann.
1906 Port of Plymouth Incorporated Chamber of Commerce ... Ann.
1910 Porter, Horatio, 16, *Russell Square, London, W.C.* ... Ann.
*1913 Potts, F. A., M.A., *Trinity Hall, Cambridge* ... C.
1910 Preston, H. B., F.Z.S., 53, *West Cromwell Road, London, S.W.* ... Ann.

1893 Quintin, St. W. H., *Scampstone Hall, Rillington, Yorks* ... Ann.

1913 Raymond, Major G., *The Gymnasium, Western College Road, Plymouth* Ann.
*1916 Regan, C. Tate, F.R.S., British Museum (Natural History), *Cromwell Road, S.W.* ... Ann.

1914 Samuel, T. A. S., *North Hill House, Torpoint, Cornwall* ... Ann.
1911 Saunders, J. T., B.A., *Christ's College, Cambridge* ... Ann.
1914 Savage, R. E., *Board of Agriculture and Fisheries, Winchester House*, 21, *St. James's Square, London, S.W.* ... Ann.
1888 Scharff, Robert F., Ph.D., *Science and Art Museum, Dublin* ... Ann.
1901 Schiller, F. W., *Butterhill, Stafford* ... Ann.
1909 Schuster, Edgar, D.Sc., 110, *Banbury Road, Oxford* ... Ann.
1884 Sclater, W. L., 10, *Sloane Court, London, S.W.* ... Ann.
1885 Scott, D. H., M.A., Ph.D., F.R.S., *East Oakley House, Oakley, Hants.* ... C.
1888 Serpell, E. W., *Loughtonhurst, West Cliff Gardens, Bournemouth* ... £50
1900 Sexton, L. E., 3, *Queen Anne Terrace, Plymouth* ... Ann.
1904 Shaw, Joseph, K.C., *Bryanston Square, London, W.* ... £13
1885 Sheldon, Miss Lilian, *High Park, Bideford* ... Ann.
*1884 Shipley, Arthur E., D.Sc., F.R.S., *Christ's College, Cambridge*...C. and Ann., £3 3s.

1891 Sinclair, William F., 102, *Cheyne Walk, Chelsea, S.W.* ... C.
1884 Skinners, the Worshipful Company of, *Skinners' Hall, E.C.* ... £42
1889 Slade, Rear-Admiral Sir E. J. W., K.C.I.E., K.C.V.O., 128, *Church Street, Campden Hill, London, W.* ... C.
1888 Spencer, Sir W. Baldwin, K.C.M.G., M.A., F.R.S., *University of Victoria, Melbourne* ... Ann.
1907 Sprague, Thomas Bond, M.A., LL.D., *West Holme, Woldingham, Surrey* Ann.
1897 Straker, J., LL.M., F.Z.S., *Oxford and Cambridge Club, S.W.* ... C.

*1899 Thompson, Prof. D'Arcy W., C.B., F.R.S., *University College, Dundee*... Ann.
1890 Thompson, Sir H. F., Bart., 9, *Kensington Park Gardens, London, W.* Ann.
1884 Thornycroft, Sir John I., F.R.S., *Eyot Villa, Chiswick Mall* ... Ann.
1906 Tims, H. W. Marett, M.D., *Bedford College, Regent's Park, London, N.W.* Ann.
1903 Torquay Natural History Society, *Torquay* ... Ann.
1910 Travers, Miss R. C., *Tortington House, Arundel* ... C.

1891 Vaughan, Henry ... C.

1884 Walker, Alfred O., *Ulcombe Place, Maidstone* ... Ann.
1884 Walker, P. F., 36, *Prince's Gardens, S.W.* ... Ann.
1910 Wallace, W., D.Sc, 43, *Parliament Street, London, S.W.* ... Ann.
†1884 Walsingham, The Rt. Hon. Lord, F.R.S., *Merton Hall, Thetford* ... £20
1912 Ward, Dr. Francis, 20, *Park Road, Ipswich* ... Ann.
1906 Waterhouse, N. E., 3, *Fredericks Place, Old Jewry, London, E.C.* ... Ann.
1909 Waters, Arthur W., F.L.S., *Alderley, McKinley Road, Bournemouth* ... Ann.
1909 Watson, A. T., *Southwold, Tapton Crescent Road, Sheffield* ... Ann.
1906 Weldon, Mrs., *Merton Lea, Oxford* ... Ann.
1910 Willes, W. A., *Elmwood, Cranborne Road, Bournemouth* ... Ann.
1900 Willey, A., D.Sc., F.R.S., *McGill University, Montreal, Canada* ... Ann.
1908 Williamson, Lieut. H. A., R.N., *Air Department, Admiralty, S.W.* ... Ann.
1884 Wilson, Scott, B., *Heather Bank, Weybridge Heath* ... C.
1913 Wise, W. H., 34, *George Street, Plymouth* ... Ann.
1905 Woolf, M. Yeatman, *Wimpole House, Wimpole Street, London, W.* ... Ann.
1898 Worth, R. H., 42, *George Street, Plymouth* ... Ann.
1913 Warden of Fisheries, *Punjab, Upper Dharamsala, District Kangra, India* ... Ann.

IV.—Associate Members.

1914 Dunn, Howard, *Mevagissey, Cornwall.*
1914 Dunn, Matthias, J.P., *Newlyn, Cornwall.*
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., *Rockvall, Brixham.*
1889 Sinel, Joseph, 8, *Springfield Cottages, Springfield Road, Jersey, C.I.*
1890 Wells, W., *The Aquarium, Brighton.*

OBJECTS

OF THE

Marine Biological Association

OF THE UNITED KINGDOM.

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, the late Lord AVEBURY, the late Sir JOSEPH HOOKER, the late Dr. CARPENTER, the late Dr. GÜNTHER, the late Lord DALHOUSIE, the late Professor MOSELEY, the late Mr. ROMANES, and Sir E. RAY 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 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.

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.

CONTENTS OF NEW SERIES, Vol. XI., No. 2.

NOTICE.

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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.