Note on a Marine Labyrinthula.

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With 6 Figures in the Text.

PLASMODIA of Labyrinthula almost invariably appear in the diatom cultures and other small marine aquaria which I have kept during the last several years for a variety of purposes in Glasgow. These aquaria are stocked with material from Millport, I. of Cumbrae, and I think it quite certain that the Labyrinthula is imported thence.

This amazing creature has attracted interest ever since it was first described by Cienkowski in 1867, and good figures of it have been published by Cienkowski (1867), Duboscq (1921), and Valkanov (1929). The following note is to be regarded as a commentary on previous work and a record of my own observations rather than as an exhaustive account of the organism.

Labyrinthula exists, as is well known, in the form of a plasmodium in which small (about 10μ long) more or less spindle-shaped units glide about in a communal ectoplasm. Each spindle has a nucleus at about its centre, and is filled peripherally with oil droplets* which may be colourless or, in some of the specimens I have studied, yellow,† imparting a yellow tinge to the whole plasmodium as seen by the naked eye (cf. Cienkowski's Taf. XV, *loc. cit.*). The number and size of the oil droplets vary considerably—and sometimes spindles are seen in which there are none at all, the cytoplasm appearing quite homogeneous. I have never observed solid food bodies in the spindles, nor contractile vacuoles. The ectoplasm surrounds each spindle with a hyaline layer which is only clearly seen when it is heaped up at some point. Here and there will be a collection of spindles visible to the naked eye as an opaque patch which may be half

* Orange after 10–15 mins. in an alcoholic solution of Sudan III, brown in 2% osmic acid. It is possibly due to the oil droplets that fixation of the spindles is so often not successful. They appear to run together, causing distortion of the cytoplasm. The best results have been obtained with neutral formalin, followed by alcohol; sometimes Bouin's fluid has given good results. Pretty preparations of spindles with the oil drops in situ are obtained by fixing in osmic acid or Flemming (with no acetic acid), staining with picro-carmine, and mounting in glycerine jelly.

† Spindles containing yellow oil may occur in the same colonies as spindles containing colourless oil.

a millimetre or more across. From these there stream out spindles, singly or in small groups, in all directions, along ectoplasmic tracks which branch and anastomose very freely. These tracks in a well established active plasmodium form a widely extended network in which the spindles circulate slowly and intermittently. It is rather rare actually to see a spindle move, but with patience and some luck it is quite possible. On one

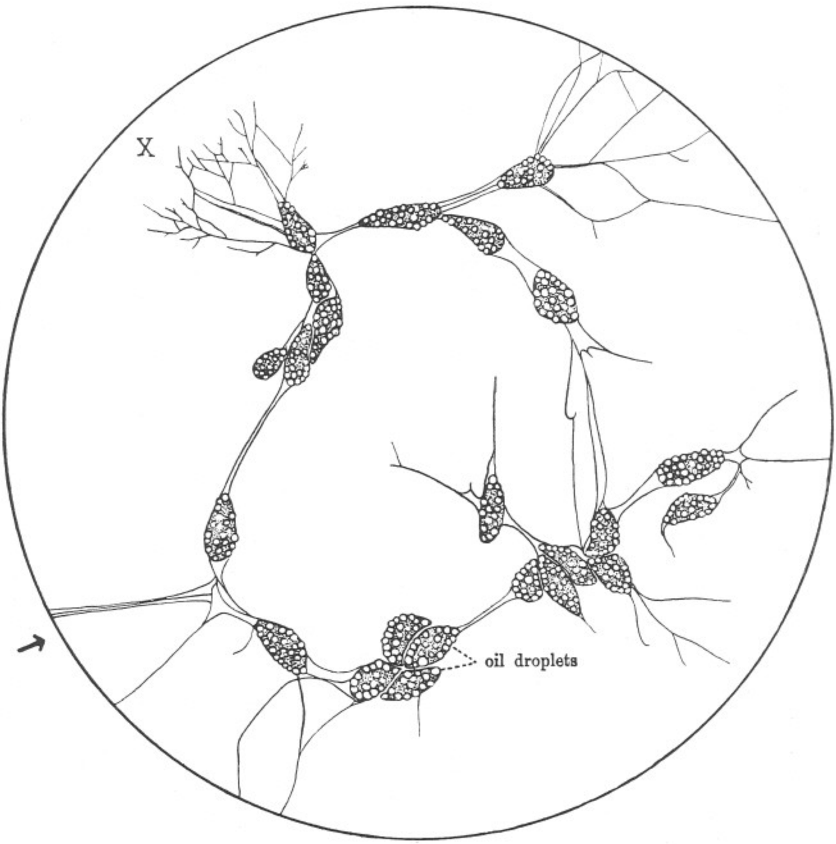

FIG. 1.—Labyrinthula spreading over coverslip in direction of arrow. At X more finely branched pseudopodia (from another specimen): these may extend all round the advancing plasmodium like an edging of fine lace. (From life.)

occasion I watched four spindles pass in succession over a length of 17μ. The times were respectively 1·5, 1·0, 2·25, and 1·25 minutes. The rate of movement is extremely variable however.

If a small portion of a deposit containing living plasmodia of Labyrinthula be removed from an aquarium on to a slide, preferably with a drop of fresh Nitzschia culture, and covered with a coverslip, the plasmodia will creep out on to the coverslip or on to the slide, and the mode of progression can easily be studied (Fig. 1). The advancing spindles are always preceded by ectoplasmic pseudopodia, and glide along these, looking under the microscope like diminutive trams moving along their rails. There has been some discussion as to the nature of the network in which the spindles circulate (see Valkanov, 1929). Its pseudopodial nature is obvious at the edge of a spreading plasmodium ;* is there any reason for considering the more centrally lying parts as essentially different ?

FIG. 2.—Degenerating pseudopodium.

The exact relation between the ectoplasm and the spindles is obscure. The whole ectoplasm seems to be absolutely common to all the spindles, which are seen to pass one another along the tracks.

Labyrinthula feeds on diatoms and other vegetable cells. An infection

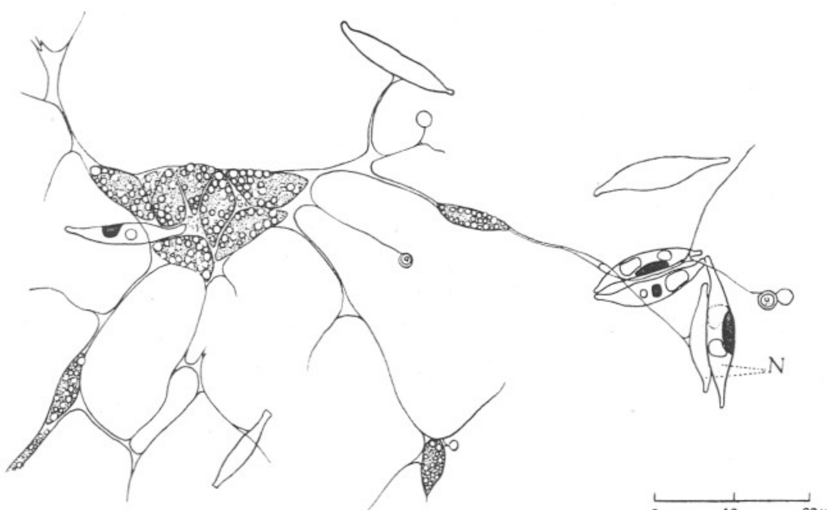

FIG. 3.—Labyrinthula feeding on Nitzschia, N. (From a living specimen.)

is in the end fatal to diatom cultures. One gets the impression that the tips of the pseudopodia gain entrance (? by natural apertures†) to the

* When degeneration sets in, as for example when the organism is observed for a long time, slowly suffocating in a preparation under a coverslip, in the light and warmth of a lamp, the peripheral parts of the reticulum may be seen to behave like other hyaline ectoplasmic structures, running into small droplets as shown in Fig. 2.

† It is well known that shelled organisms may not form their normal tests when grown in artificial culture, and it is possible that in such circumstances diatoms may offer less than the normal resistance to invasion.

cell, which is then completely used up, and the products of digestion passed back into the endoplasm of the spindles. Only very occasionally are isolated granules or droplets to be seen in the ectoplasm. When feeding

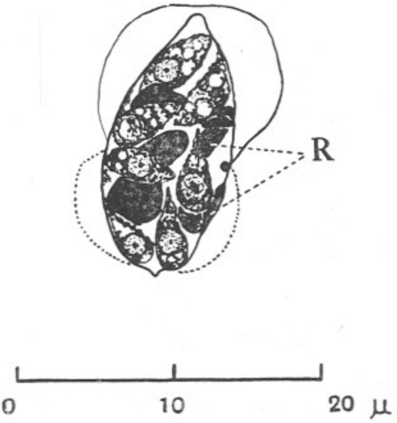

FIG. 4.—Labyrinthula in Amphiprora. From a stained specimen. R, remains of diatom contents.

on Nitzschia the spindles do not enter the diatom (see Fig. 3); but I have observed them inside a larger diatom, a species of *Amphiprora* (Ehr.) Cleve. (Peragallo, 1897–1908) as is shown in Figure 4. I was led by the

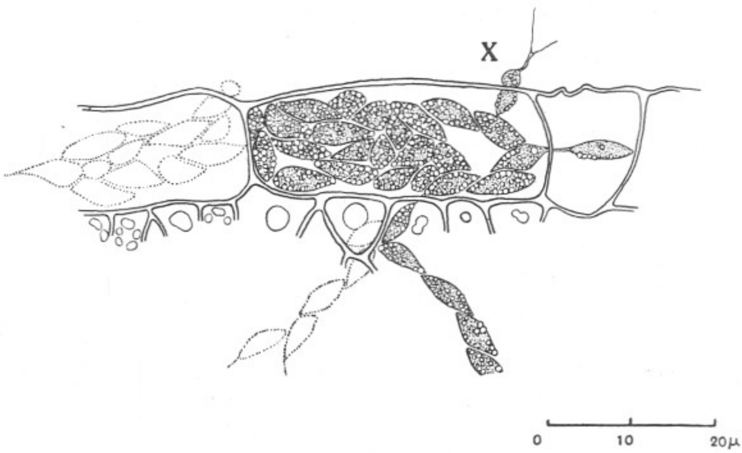

FIG. 5.—Living Labyrinthula in cells of *Laminaria saccharina*. Notice constricted spindle at X. Ectoplasm for the most part not shown.

papers of Professor O. Duboscq (1921) to infect some pieces of Laminaria with Labyrinthula. Pieces of the oarweed were placed in aquaria containing Labyrinthula, and I observed later the living plasmodia moving through the cells of the alga (see Fig. 5) and presumably feeding on it. In my experiments the Labyrinthula seemed to obtain entrance by a damaged part of the thallus surface. It is not clear that it would otherwise have succeeded in getting in; especially as it was closely followed by ordinarily free-living amœbæ and by ciliates. The constricted spindle at X in Figure 5 suggests, however, an ability to bore a hole in the cell

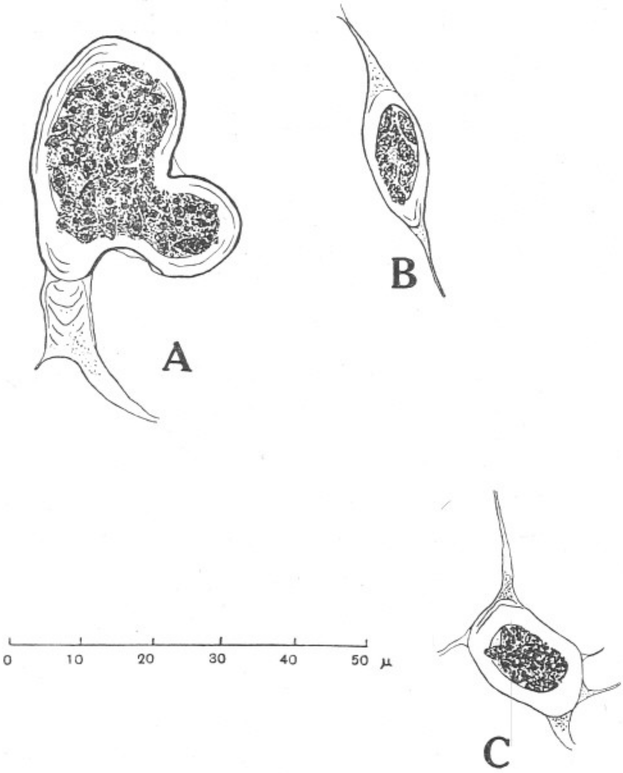

FIG. 6.—Cysts of Labyrinthula on a coverslip, from a stained preparation. Figs. B and C show two cysts evidently formed in the same plasmodium, in their original relative positions.

wall—cf. Duboscq's Figure 10. I may mention here that, though I have seen in my aquaria forms resembling other stages in the life-history of *Labyrinthomyxa* as described by Duboscq, I have not succeeded in connecting them with the Labyrinthula plasmodium. Nevertheless the two organisms appear so closely similar in their plasmodial stage that I venture to suggest that they belong to the same genus, i.e. Cienkowski's *Labyrinthula*.

The spindles multiply by binary fission, first of the nucleus and then of the cytoplasm. The nuclear division is mitotic, with the formation of a typical division spindle.

Rounded up plasmodia are encountered, each enclosed in a thick hyaline covering of which the exact limits are difficult to see ; nor will it colour with the usual stains.* The separate spindles can be squeezed out by pressure, as indeed they can from an active plasmodium, and they have no special individual protective coats (cf. Cienkowski, 1867). Figure 6, A–C, shows in a permanent preparation what I take to be plasmodia in a similar condition, possibly some little time after their formation. Here the outer covering is brown (in Heidenhain's iron hæmatoxylin) and appears laminated. These structures are very like the cysts described by Valkanov (1929).

It is impossible to decide on a specific name for this organism. Three marine "species" of *Labyrinthula* have been made (Cienkowski, 1867 ; Valkanov, 1929), but not fully described, and it seems that all the forms may in fact belong to the same somewhat variable species. In my cultures the size of the spindles has varied considerably for example. Of the three "species" my organism fits best the description of *L. zopfi* (Valkanov, 1929), but I do not feel convinced that this is its correct name. I do not place it with *L. vitellina* Cienk. as I gather that the colour is not the same ; nor with *L. macrocystis* Cienk. as I have not observed the spore coats described by the author.

It is my pleasure once more to acknowledge my indebtedness to the late Mr. P. Jameson for cutting sections of my Labyrinthula material ; and to Mr. R. Elmhirst for help in supplying me with material both at Millport and at Glasgow.

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* No cellulose reaction was obtained in this covering with iodine and sulphuric acid ; an observation of some interest on account of the similar organisms which have been described as Mycetozoa (Zopf, 1887). It resembles the ordinary ectoplasm in its small staining capacity.