in which was a piece of moist filter-paper with a *Peziza* cup, for it rapidly attacked the hymenium in the dark, and gnawed just such holes in it as I had noticed.

In a few hours also the animal had left little ellipsoidal pellets of dung on the glass, paper, &c., and the bright scarlet colour of these told plainly the nature of his food. Microscopic examination of the dung-pellets showed abundance of spores, apparently uninjured, and now it seemed as if the problem was at length to be solved: of course it had suggested itself that the spores required passage through the body of the slug as a condition for germination.

Here again, however, nothing but failure attended all my efforts. It was very easy to obtain the spores, in the dung, in hanging-drops; yet in no case would they germinate, but behaved as if dead, until Bacteria obscured the view and the culture had to be abandoned.

Failure to germinate the spores has also attended every attempt made since the winter, in the hope that exposure to frost and a winter-rest might be necessary for germination, as is known to be the case with other spores.

H. MARSHALL WARD.

ON THE GINGER-BEER PLANT.—In my work on the Ginger-Beer Plant (Phil. Trans., B. 1892, p. 187) I pointed out the resemblances between Kephir and this symbiotic compound organism. On p. 186 I also gave reasons for believing that the *Bacterium* was introduced with the sugar.

I have now good reasons for believing that the early accounts of Kephir are not correct, or that there are several distinct varieties of this and other Ginger-beer plants, and that in all cases the Schizomycete I named *Bacterium vermiforme* is concerned, but associated with different yeasts; in any case, it appears certain that it can be artificially made to form a symbiotic union with other yeasts than the one I used in 1892; the aerobic yeast protecting the anaerobic *Bacterium*.

The following note is of interest in this connexion.

My wife recently received from a lady in Paris a number of grains of a body looking like boiled sago, and obviously of some such nature as Kephir or the Ginger-beer plant. It was said to have been given to our hostess by a missionary from Madagascar, who described it as 'an excrescence on the sugar-cane.'

It is used as follows. A table-spoonful of the Kephir-like grains is put into a litre-bottle—a champagne-bottle does well—with three table-spoonfuls of moist sugar (*cassonade*), and the bottle quite filled with water, securely corked and tied.

It is then left for three days, when a violent fermentation is found to be in play, so much CO_2 escaping that the pressure may burst the flask or blow the cork out violently if care be not taken.

The liquor is now strained into a second strong flask and securely corked down, the sago-like grains being returned with more sugar and water to the first flask to repeat the process. In four days it is ready for drinking, and is a slightly turbid, violently effervescing, lemonade-like drink, to which all kinds of curative and medicinal properties were ascribed by the missionary.

A microscopic examination of the grains show that they consist almost entirely of the sheathed form of a *Bacterium* so like *B. vermiforme* that I have little doubt it will prove to be the same. In much smaller quantity I found a yeast with long sausage-shaped pyriform and oval cells not very like *S. pyriformis*, and probably different from it.

On following the directions, I found the fermentation to occur exactly as described.

On carrying the experiments further, I was impressed by the particular stress laid on the direction to fill up the bottles and cork thoroughly, since this seemed to imply the necessity for keeping the organism out of contact with air. I therefore decided to try the following method. A bottle of Schweppe's soda-water was carefully opened, and a supply of ordinary sugar together with some of the 'Paris Kephir' (as I term it in my notes) added, and the flask, quite full, rapidly corked and tied. To my surprise the fermentation at once began, and all the sugar disappeared in a few days, the gas-pressure being tremendous.

The fermentation was almost entirely due to the *Bacterium*, very little yeast being present and apparently not increasing, and the conditions show that no oxygen is necessary to start the action.

Here we have clearly a case of an aerobic *Bacterium*, capable of fermenting sugar to carbonic acid and some other organic acid —the liquid has a pleasant acid flavour at the end of the fermentation —and requiring merely such traces of nitrogen as would be present in moist sugar.

Whether the soda-water and sugar will prove to be the best medium to cultivate it in or not remains to be seen, but it is clear from the five cultures I have made so far that the organism ferments very well under these circumstances.

I also desire to call attention to the following quotation from Cross and Bevan's book on Cellulose, 1895, p. 71, in this connexion, as it seems not impossible that the clots of 'white insoluble substance' there referred to may be this remarkable organism. On referring to Durin's paper in the Comptes Rendus—I can only find the second of the two papers mentioned—I find no evidence of any microscopic analysis of the clots, and it seems by no means unlikely that the existence of the micro-organism was overlooked.

'As a result of a change which is observed to be set up "spontaneously" in beet-juice, a white insoluble substance is formed, and separated in lumps or clots; this substance has all the characteristics of cellulose. After separating this insoluble cellulose, the solution gives with alcohol a gelatinous precipitate resembling the hydrates of cellulose previously described. These results are independent of the so-called viscous or mucous fermentations. That the process by which the cellulose is formed has the essential features of a fermentation-process, is seen from the fact that when the lumps or clots are transferred to a solution of pure cane-sugar or beet-molasses, a further formation of the cellulose ensues. When the process proceeds in neutral solution no carbonic anhydride is evolved; but in presence of acids this gas is evolved, and at the same time acetic acid is formed in the solutions.'

'E. Durin, by whom these phenomena have been investigated (Compt. Rend. 82, 1078; 83, 128), regards the ferment as allied to diastase, and states that fresh solutions of diastase itself act on solutions of sugar to form the soluble cellulose, precipitable by alcohol. There is also some evidence that cellulose may be formed from cane sugar in the plant by processes of this kind.'

The above, and several other problems connected with this interesting group of organisms, are now being investigated by Dr. Green in this laboratory.

But the proof that *B. vermiforme* is introduced with the sugar is all but complete. On referring to a paper by Koch and Hosaeus in the Cent. f. Bakt. B. xvi, 1894, p. 225, I find these authors discovered and figure a form evidently identical with mine, or so close to it that they were quite unwarranted in giving it a new specific name until they had cultivated it, especially as they knew of my work and pointed out the resemblances between their form and mine. They could not cultivate it by ordinary bacteriological methods, and were puzzled by the specimens being contaminated with a yeast. They do not seem to have tried anaerobic cultures, or to have really looked closely into my work; otherwise I cannot help thinking they would at least have tested the resemblances, amounting to identity as far as can be seen, to *B. vermiforme.*

My own impression is that their form was a case of wild Ginger-beer plant.

H. MARSHALL WARD.

SPERMATOZOIDS IN GYMNOSPERMS.—At the request of Dr. D. H. Scott, one of the editors of this Journal, we publish here in the English language a short *résumé* concerning the spermatozoids of *Ginkgo biloba* and *Cycas revoluta,* which we have lately discovered.

In *Ginkgo,* as well as in *Cycas,* the behaviour of the pollen-tube towards the archegonium is quite different from what we observe in all the Conifers investigated by Professor Strasburger and others. For the growing end of the tube, instead of elongating towards the neck-cells of the female organ, points towards the opposite direction, and produces in the nucellus, which is now a paper-like thin skin, many slender branches, which, acting like a root, serve to maintain the tube in that place. The other end of the tube, which is easily recognized as such by the remains of the exine covering it, produces within it, shortly before fertilization, two generative cells, each with a spermatic nucleus. Then an especially interesting phenomenon takes place, for here each of these cells begins to be metamorphosed into a spermatozoid.

The motion of the spermatozoid after its having broken out of the pollen-tube has been observed in *Ginkgo*; as to *Cycas,* however, its motion has not yet actually been observed; but the form as well as the development are so alike in both that now there is no reason to deny its motility. (As one of us has found that the fertilization in *Cycas* takes place at the end of September or the beginning of October, he intends in this year to prove its actual motility.)

The spermatozoid of *Ginkgo* is considerably larger than that of any