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.

SPERMATIZOIDS 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 spermatocytic 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

spermatozoids of the lower and higher Cryptogams known till now, for it measures $82\ \mu$ in length and $49\ \mu$ in breadth. That of *Cycas* is larger than that of *Ginkgo* both in breadth and length. It is oval in shape. The head consists of three spiral windings in *Ginkgo*, and of four in *Cycas*, on which cilia, the organs of motion, are abundantly present. The tail is also formed, but is visible only after the element has broken out of the pollen-tube. Anatomically considered, it consists of a nucleus and cytoplasm, which covers it completely.

If we examine the ovules both of *Ginkgo* and *Cycas* towards the time of fertilization, we find a quantity of sap present between the apical concavity of the endosperm-body and the nucellar skin. This sap is necessary for the act of fertilization, for spermatozoids, by swimming there, are able to reach the archegonia. For it is a remarkable fact that in our plants the pollen-tube is far apart from the neck-cells of the female organ. As is well known, in other Gymnosperms the pollen-tube penetrates in fertilization more or less deeply into the archegonia, but in our plants the tube does not come at all into contact with the neck-cells. We think that this fact explains the reason why spermatozoids occur in *Ginkgo* and *Cycas* but not in other Gymnosperms, so long as the motile elements shall not have been discovered in such Gymnosperms, where the relation of the tube to the archegonia is different from that of our plants.

Since Hofmeister's classical researches, we know that there is no sharp boundary between the higher Cryptogams and the Phanerogams. On the other hand, however, it was generally accepted as a fact without exception, that in the former fertilization takes place by spermatozoids, while in the latter it occurs by pollen-tubes, so that we must have concluded that in this respect only there exists a sharp boundary between these two great groups of plants. But now this boundary has been broken down, and therefore the truth of the fact that both are very intimately connected becomes more and more prominent.

Finally we have to draw the attention of our readers to the fact that Hofmeister long ago stated his supposition that in the pollen-tube of Conifers spermatozoids would be found to be produced. Pringsheim also repeatedly stated his opinion that they must be present in the pollen-tube of Phanerogams. The supposition of these great botanists has now been proved to be partly right.

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Tokyo.

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