water from below, without the intervention of the gametophytic tissues which had mostly withered. Indeed it looks as if these large sporophytes may have attained very nearly the complete independence characteristic of the Pteridophytes.

Usually *A. fusiformis* ripens its spores in the late spring, and both gametophyte and sporophyte dry up completely. The former, however, revives with the autumn rains. These large sporophytes were undoubtedly left over from last season and probably began to form some time in the autumn of 1922, as fertilization normally takes place within a short time after the first heavy rains, which last year fell early in October.

The writer visited the locality, San Jose Canyon, where these were collected. This is one of many small canyons south of Monterey, open to the ocean, so that they are invaded by the summer sea-fogs. There is a permanent stream, along whose banks fine redwoods, sycamores and alders were growing, as well as a rich growth of such liverworts as Fegatella and Marchantia, and several mosses.

The Anthoceros plants grew on low sandy banks, not far above the water level, and some of them showed fresh growth and bore a number of relatively young sporophytes.

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THE EFFECT OF THE REMOVAL OF THE MICRONUCLEUS

THE micronucleus in ciliates has commonly been considered to have solely a germinal function. In contrast with the macronucleus which, it is thought, serves for the upkeep of the individual, the micronucleus on the other hand is believed to provide exclusively for the maintenance of the race. This theory chiefly originates in applying to the *Ciliata* Weismann's hypothesis on the continuity of the germ plasm.

To ascertain the actual function of the micronucleus one must, of course, finally provide experimental means. This has been done by certain investigators (Balbiani, LeDantec, Lewin, *et al.*) who have removed the micronucleus from several ciliates, but this was accomplished by the excision of that part of the organism wherein the organelle lies. This method entails the burden of the regeneration of more or less of the organism and involves the possible removal of equally important stuffs.

The removal of the micronucleus from the fresh-water ciliate, *Euplotes patella,* has been successfully accomplished in more than fifty specimens by means of a mercury micropipette without causing any additional injury except the loss of a meager amount of cytoplasm immediately surrounding the removed organelle. *Euplotes* so operated upon have never lived longer than five days nor have they divided more than twice, so far as could be observed. A number failed to divide at all and lived only two days. The average life is about three days. Specimens which were fixed and stained showed an absence of the micronucleus, hence it was not regenerated. Individual controls from which cytoplasm of various regions of the organism or portions of the macronucleus had been removed formed vigorous races.

The few earlier reports, especially of Lewin and LeDantec, of ciliates having formed thriving races or having regenerated the micronucleus, after the experimental removal of this organelle, have not been substantiated by any of the experimental work done within the past dozen years. Several races of different species of ciliates have recently been intensively studied (Woodruff) and found to exhibit no morphological micronucleus. These races thrive apparently indefinitely. Conjugation either is not attempted or the conjugants always die. Two of these races have been known to arise from a micronucleate race which did conjugate normally. Woodruff (1921) has suggested that the macro- and micro-nucleus may have formed together in such races an "amphinucleus," which would be adequate for all life phenomena, but which would not permit the germinal chromatin in the micronucleus to become available for conjugation and endomixis. A morphological micronucleus would, accordingly, not be necessary for the vegetative life of the organism. The occurrence of such a nuclear change, however, is as yet not established.

If the micronucleus is solely germinal in function, it would be expected that a ciliate with no other injury than the loss of this organelle would give rise to a race asexually. The evidence from experiments on *Euplotes patella* goes to show that it can not continue to live and divide without the micronucleus. Just what rôle further than germinal the micronucleus plays is problematical. Hertwig, Calkins and others have maintained that the nucleus gives off certain formative substances, perhaps like enzymes, which are exhausted during cell-division. The results of the experiments thus far carried out on *Euplotes* suggest that the micronucleus performs some such rôle in the economy of this ciliate. The amount of the hypothetical substance present in the cytoplasm at the time of the removal of the micronucleus would determine the number of divisions possible before death. Division being impossible, death might ensue from a condition comparable to senescence in the metazoan cell or possibly from a surfeit of food which would normally be relieved by division.

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