

- 1. Fronds decumbent or ascending, monostromatic, brittle.....2
- 1. Fronds elate, becoming homogeneo—polystromatic, with stipe branching and terminal blades flexible.....5. *Metamastophora*
- 2. Fronds entire on margins, proliferating obliquely and lamellately, producing superposed layers devoid of rhizoids.....3
- 2. Fronds lobed on margins, neither proliferating nor superposed, attached by adventitious rhizoids.....4. *Mastophora*
- 3. Fronds superposed, agglutinated into a common crust.....3. *Goniolithon*
- 3. Fronds superposed, free.....4
- 4. Thallus cells palisade-like.....2. *Lithoporella*
- 4. Thallus cells nearly isodiametric.....1. *Litholepis*

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*THE PEDIGREED CULTURE OF PARAMECIUM AURELIA AT YALE UNIVERSITY*

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It seems desirable, as a matter of record, to bring up to date the history of the long-continued pedigreed culture of *Paramecium* at Yale University, because it is now more than two decades since a summary appeared in these PROCEEDINGS.<sup>1</sup>

The culture was started on May 1, 1907, by the isolation of a "wild" specimen of *Paramecium aurelia* on a depression slide in about five drops of culture fluid. Descendants of this individual constitute the various lines of the pedigreed race. During the first eight months the culture medium consisted solely of hay infusion, but thereafter infusions of various materials common in the usual environment of *Paramecia* proved to be more favorable and were employed. The media have always been thoroughly boiled to prevent any possible contamination with foreign strains of *Paramecium*. In brief, the cells of the culture today are direct lineal descendants by division from the single animal isolated in 1907.

The main object of starting the culture was to determine whether *Paramecium* can reproduce by division indefinitely without recourse to conjugation. Therefore during the first eight years of the culture's life, to May 1, 1915, during which 5071 generations were attained, the possibility of conjugation was absolutely precluded by the daily observation and isolation of the products of division. After this date daily isolation was judged unnecessary, because the continued life and health of the culture had long since justified the conclusion that conjugation is not, as had been previously generally maintained, a *sine qua non*, under favorable environmen-

tal conditions, for the continued life of *Paramecium* and, presumably, of unicellular animals in general.

However, at the formal termination of the experiment in 1915, the culture was still maintained but without the exacting daily observation and recording of the division rate previously required. So, from this point, there is the possibility that conjugation between closely related individuals of the pedigreed culture may have occurred without being detected.

In this manner the culture has been maintained up to the present (March 1943). From time to time, thirty-day tests have been made of the division rate of the animals under the former rigid culture conditions, and in nearly every case the same general average division rate has been revealed as during the first eight years of life; that is, between 50 and 60 generations per month. There is no evidence of waning vitality. On the basis of these tests it is fair to estimate 600 generations attained each year since May 1, 1915, which gives, in round numbers, 21,800 generations attained by the culture during the nearly 36 years of its life to date. The vitality of the culture is further attested by the fact that it is continuously affording animals for various other experiments in the Osborn Zoölogical Laboratory and elsewhere.

It may be recalled that studies on this culture by Woodruff and Erdmann<sup>2</sup> revealed a periodic internal nuclear reorganization process to which the name endomixis was given. The establishment of endomixis raised new problems though obviously without affecting the basic conclusion that conjugation is not intrinsically a necessary phenomenon in the life history of the organism. If, however, it prove true that synkaryon formation may occur during reorganization in this race, as first stated by Diller,<sup>3</sup> so that the process becomes autogamic, then, of course, *self*-fertilization has not been excluded in the experiments.<sup>4</sup>

<sup>1</sup> Woodruff, L. L., "The Present Status of the Long-Continued Pedigreed Culture of *Paramecium aurelia* at Yale University," *Proc. Nat. Acad. Sci.*, 7, 41-44 (1921).

<sup>2</sup> Woodruff, L. L., and Erdmann, R., "A Normal Periodic Reorganization Process without Cell Fusion in *Paramecium*," *Jour. Exp. Zool.*, 17, 425-518 (1914).

<sup>3</sup> Diller, W. F., "Nuclear Reorganization Processes in *Paramecium aurelia*, with Descriptions of Autogamy and Hemixis," *Jour. Morph.*, 59, 11-67 (1936).

<sup>4</sup> Woodruff, L. L., "Endomixis," *Protozoa in Biological Research*, edited by G. N. Calkins and F. M. Summers, Columbia University Press, 1941, pp. 646-665.