CELL DIVISION AND THE FORMATION OF PARAMYLON IN EUGLENA OXYURIS SCHMARDA.

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The method of reproduction in *Euglena oxyuris* Schmarda has not been observed, while the characteristic manner and the time element involved in the formation of the constituent parts of the cell is also of some interest. Therefore, the following notes made in connection with some uncompleted studies on the life cycle of Euglena are presented.

Of the forty or more species constituting the genus, *E. oxyuris* Schmarda is by far the largest, often attaining a length of approximately 500μ. In the study mentioned, several of the smaller species of Euglena had been observed by the writer, to encyst and after repeated divisions pass through an apparent sexual stage, in consequence of which it was desirable to check the results with a larger form, permanent preparations of which could be more easily made. Therefore, several specimens of *E. oxyuris* were transferred from a culture to a lens paper aquarium, the margins of which were closed by paraffin oil to prevent evaporation and placed under observation, Feb. 4, 1906. No reproductive processes similar to those in the smaller species mentioned were observed, but several in the process of division were noted and studied with the 1-12 immersion objective. The characteristic organs of the species (Fig. 1, A) are the oval nucleus (n), the large anterior (p^1) and posterior (p^2) paramylon granules, the stigma (s), reservoir (r), pharynx (p) and chloroleucites (c). The figures are all based on camera lucida drawings.

On Feb. 6, at 10:03 A. M., a single individual (Fig. 1, B) was observed much broader anteriorly than the normal form and in which the nucleus had approached the stigma while the anterior paramylon granule occupied very nearly the normal position of the nucleus. It was not until 1:45 P. M. (Fig. 1, C) that the division of the stigma was observed, the nucleus in the meantime having become obliquely elongated, and the anterior paramylon granule having moved down to a position beside the posterior granule. At 3:35 P. M. (Fig. 1, D) division had so far progressed that the anterior fourth of the individual—individuals?— were separated, the two nuclei being almost distinct. At 4:15 P. M. (Fig. 1, E) longitudinal division was nearly complete and the two nuclei were moving slowly posteriorly to their normal position. At the same time a peculiar phenomenon was taking place in connection with the two paramylon granules. The protoplasm containing the granule of the individual on the left would rapidly flow posteriorly, so that the granule was actually in the posterior end of the individual on the right as indicated by the solid arrow.

The time consumed was 20 seconds. Then the reverse flow occurred and the protoplasm containing the granule of the individual on the right would flow to the left as indicated by the dotted arrow. It would seem at times as if an observer could scarcely refrain from concern as to the probability that one individual would inherit all the paramylon. At 4:25 P. M. (Fig.1, F)

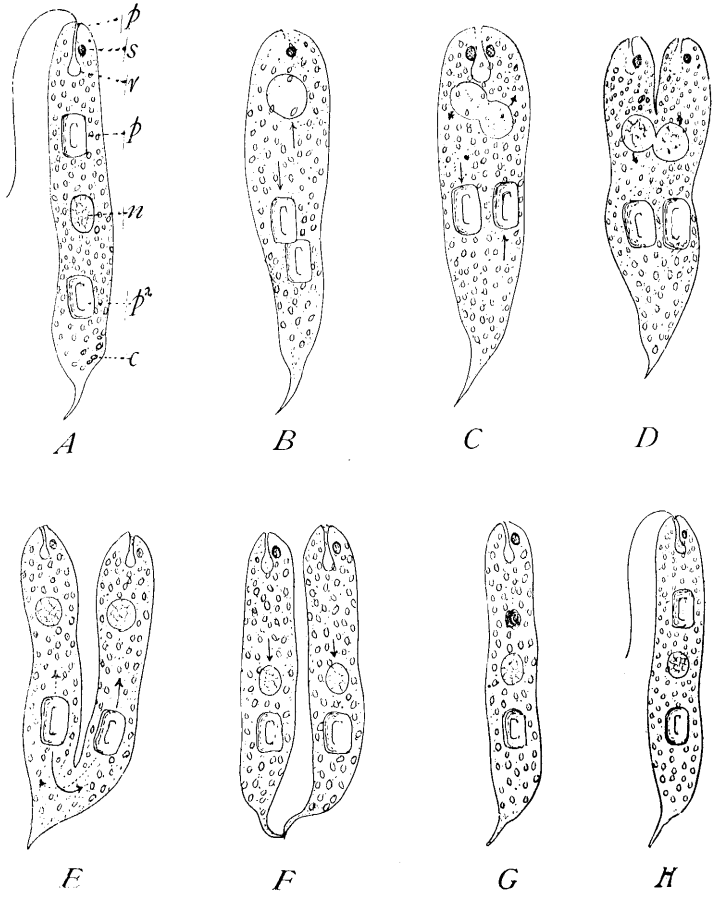

Fig. 1. (x 500). Cell division in *Euglena oxyuris* Schmarda and Formation of Paramylon. p=pharynx. s=stigma. p^1=anterior paramylon granule. n=nucleus. p^2=posterior paramylon granule. c=chloroleucites.

the process of division was completed, the nuclei having moved posteriorly and the individuals appearing normal in every way with the exception that each lacked the large anterior paramylon granule. Observations were made periodically the follo ing day with the expectation of noting the development of the new

granule. It was, however, not until the succeeding day at 9:00 A. M. (Fig. 1, G), approximately 40 hours from the time of the complete division that an irregular, but distinct granule became visible. This gradually increased in size, but had not attained its full development at the end of the day, when the observations were brought to a close. The other twin individual had in the meantime disappeared.

There are two factors, however, which may have been instrumental in delaying the formation of the anterior granule, the lowering of the room temperature nearly to freezing at night, and the possible lack of the necessary nutrient material in the small closed lens paper aquarium.

While the synthesis of "paramylon," a term first suggested by Gottleib, (1851) because of the similarity in chemical composition to amylon (starch), normally occurs in connection with the chloroleucites present in the Euglenidae, the question as to its possible free formation as an assimilation product of the protoplasm has long been one of interest and one concerning which no definite statement may up to the present time be made. The mode of formation of the anterior paramylon granule in *Euglena oxyuris* is extremely suggestive, however, that the result is due to the activities of the protoplasm quite independently of the numerous small chloroleucites present. Distributed irregularly as they are throughout the cell body, it seems difficult to believe that their products should unite to make a structure so definite in form and position.

The time taken for the division of the individual was 6½ hours, with the assumption that the condition as figured in "B" had occupied only a brief period. Keuten (1895) notes the time of division in *Euglena virdis* as 3-4 hours. There are apparently no notes concerning the time necessary for division among other related forms, although Doflein (1911) gives a comparative table for various species of Protozoa. The factor is undoubtedly a variable one and largely dependent on the surrounding conditions particularly temperature and nourishment.

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