DISCUSSION

SPINDLE TWISTING IN THE GIANT AMOEBA

DURING a comparative study of the nutritional requirements and nuclear structure of *Amoeba proteus* and the giant amoeba, *A. carolinensis*,[1] observations of anaphase in the latter have revealed what appears to be a property of the spindle which has not previously been recognized. The giant amoeba is multinucleate and during mitosis all the nuclei in one individual are in approximately the same stage of division. During anaphase the half spindle regions do not appreciably change in length, but the spindle between the daughter groups of chromosomes elongates as these chromosomes (or early telophase nuclei) move sometimes as far as 62 μ apart. As this elongation progresses, the interzonal spindle undergoes a twisting such as would result in the rotation of the daughter groups of chromosomes in opposite directions. This twisting is easily seen until the chromosomes are up to 45 mμ apart. With further elongation a more complex distortion appears and dissolution of the fibers of the interzonal region occurs.

A single amoeba[2] was found with all its nuclei, 33 in number, at anaphase or early telophase. Of these 4 are at early telophase and the remainder at the anaphase stage. Twelve of the spindles are so elongated, contorted and in such a state of dissolution that they could not be properly resolved. Of the 21 spindles that lend themselves to analysis, one, with chromosomal plates 17 μ apart, shows no twisting of the interzonal region of the spindle (Table 1).

TABLE 1

Distance of daughter groups apart (μ)	Number spindles right	Number spindles left	Number not twisted
13–17	0	0	1 (17 μ)
18–22	9	0	0
23–27	3	0	0
28–32	4	0	0
33–37	1	0	0
38–42	2	0	0
43–47	1 (44 μ)	0	0
Total	20	0	1

The other 20 spindles, the chromosomal groups of which are 19 to 44 μ apart, have their interzonal regions clearly twisted, while the fibers of the half spindle region are straight. The direction of the twist in every one is clockwise or to the apparent right (Fig. 1, ×1660).

These observations, though limited, are of considerable significance. The fact that the spindles consistently twist in one direction indicates that this twisting which accompanies spindle elongation is not

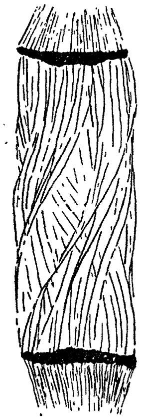

FIG. 1.

a chance phenomenon brought about by cytoplasmic movement or other external factors operating on the spindle. This interpretation is further strengthened by the fact that the spindles are oriented at random in the cell. The constancy in direction of the twisting would result from a property inherent in the spindle apparatus, possibly an uncoiling of spindle elements as elongation proceeds.

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[1] = *Chaos chaos* of some authors.

[2] Fixed in Carnoy and stained in Haidenhain's Iron-Haematoxylin.

ONE-PARENT PROGENY OF TUBIFICID WORMS

UNDER this title, is a recent article, Purdy[1] has reported the production of young by isolated tubificid worms of the genera *Tubifex* and *Limnodrilus*. This phenomenon was studied by Černosvitov[2] in *Tubifex tubifex* (Müller) and has been further investigated by Gavrilov[3,4] in several other species of oligochaets. Both these authors believe that some form of self-fertilization occurs, although the possibility of parthenogenesis does not appear to be completely excluded. In one case (*Limnodrilus udekemianus* Clap.) spermatophores were found in the spermathecae of isolated individuals, from which Gavrilov concludes that self-fertilization takes place by way of a process of self-copulation. However, in two other species of this genus (*L. hoffmeisteri* Clap. and *L. claperedeianus* Ratzel), as in *T. tubifex* and also in the lumbricid *Eiseniella tetraedra* (Sav.), the spermathecae never contain spermatozoa unless reciprocal copulation has occurred. If the production of uniparental progeny is the result of self-fertilization it must, in these species, be achieved by some other means than self-copulation. Gavrilov, supporting earlier findings of

[1] W. C. Purdy, SCIENCE, 102: 182, 1945.

[2] L. Černosvitov, *Biol. Zlb.*, 47: 587–595, 1927.

[3] K. Gavrilov, *Biol. Zlb.*, 51: 199–206, 1931.

[4] K. Gavrilov, *Acta Zool.*, 16: 21–64, 1935.