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Mitosis in *Pyrsonympha.*

By

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With 1 figure in the text and plate 12.

Pyrsonympha LEIDY, 1877 is a polymastigote flagellate and probably occurs in all termites of the genus *Reticulitermes.* Five species have been described; but, since mitosis is the same in each species, only the genus is considered. KOIDZUMI (1921) and POWELL (1928) have given the most detailed accounts of *Pyrsonympha.* However, their descriptions are inadequate and inaccurate in a good many respects. The early stages of the origin and development of the achromatic figure are not given and the nature of the achromatic figure is anything but clear. POWELL describes an extranuclear central spindle ("paradesmose"), which is not present; and KOIDZUMI figures rod-shaped chromosomes, which do not exist. Their descriptions of the body and its intra- and extranuclear organelles, except for their interrelations, are mostly correct and need not be repeated.

In the interphase, there are probably two centrioles lying very close together, although I have not been able to establish this fact definitely (Text-Fig. A, 4). In some instances two may be seen clearly; in others only one. When two can be seen, this may be a result of division of the centriole preparatory to cell division; or, when only one can be seen, the other may lie above or below it, and for this reason cannot be seen.

Irrespective of whether one or two centrioles are present in the interphase, it is interesting to note that the centriole, flagella,

axostyle, and paraxostyle are all interconnected just as in hypermastigote flagellates, many of which possess large centrioles that may be studied in detail (CLEVELAND, HALL, SANDERS, and COLLIER, 1934). But the centrioles of hypermastigotes lie entirely outside the nucleus and have no connection with it, while those of *Pyrsonympha*, *Oxymonas* (CLEVELAND, 1935), and probably several other genera of polymastigotes lie partly inside and partly outside the nucleus; the portion from which the achromatic figure arises lies inside, and the portion from which the extranuclear organelles arise lies outside. However, in certain polymastigotes, notably *Trichomonas* and allied genera, the centrioles, like those of hypermastigotes, lie entirely outside the nucleus. Whenever the centrioles are entirely extranuclear, the achromatic figure produced by them is outside the nucleus; and when a portion of them lies within the nucleus, the achromatic figure produced by them is inside the nucleus.

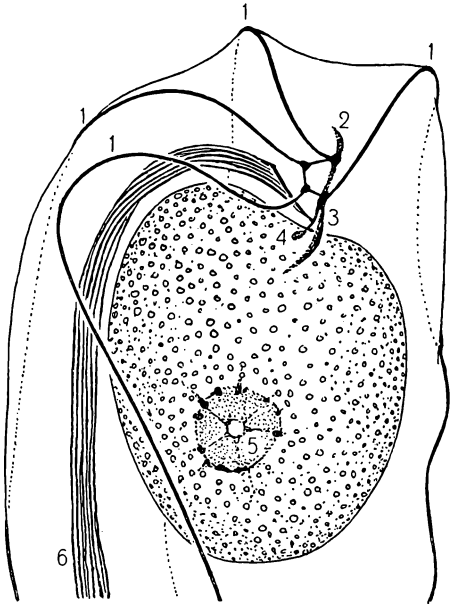

Fig. A. *Pyrsonympha*. (1) The four flagella. Each flagellum arises from a basal granule, is attached to the surface of the body, extends posteriorly, and forms an undulating ectoplasmic chord. (2) Holdfast or attachment organelle. (3) Paraxostyle. (4) Centriole. (5) Nucleus. (6) Axostyle, which is fibrillar and is directed posteriorly through the endoplasm. × 4800.

In the early stages of the formation of the achromatic figure of *Pyrsonympha*, the fibres, in many instances, all appear to radiate from a common point, that is, from a single centriole, and thus resemble unipolar mitosis; but prolonged observation shows beyond question that they arise from two points, from two centrioles which lie close together (Pl. 12 Fig. 1). And even in later stages, all the fibres of the achromatic figure extend more or less in the same direction and appear to arise from a common point except when examined critically (Pl. 12 Figs. 2, 3). In other words, it is impossible, in many nuclei, owing to the manner in which they are viewed, to ascertain

the origin of the fibres of the achromatic figure. And in certain instances, such as in Pl. 12 Fig. 2, they appear to arise from the edge of the nuclear membrane; while a different view, as in Pl. 12 Fig. 3, shows clearly that they arise from two circular centrioles.

When the central spindle is first formed by the joining and overlapping of the astral rays arising from the centrioles, it does not extend in a straight line from centriole to centriole, but is considerably curved, as shown in Pl. 12 Fig. 4. This is due to the fact that the astral rays extend for a considerable distance from their points of origin before they meet. Before the development of the central spindle has progressed very far, the chromosomes are formed, and some of the astral rays, by attaching themselves to the chromosomes, become chromosomal fibres and move the chromosomes to the centre of the nucleus, producing the so-called equatorial plate stage (Pl. 12 Figs. 3, 4). Then the centrioles (poles) move apart, and as they do the astral rays arising from one meet, join, and overlap those arising from the other to complete the formation of the central spindle, which, when fully formed, together with the chromosomal fibres and astral rays, has the appearance of the usual intranuclear achromatic figure (Pl. 12 Fig. 5). Meanwhile, the chromosomes have remained in more or less the same position they were in when only a few of the astral rays had joined in the formation of the central spindle portion of the achromatic figure (Pl. 12 Figs. 3, 4).

As the central spindle increases in length, half of the chromosomes, which now become more elongate, are carried toward each pole (centriole) by the chromosomal fibres (Pl. 12 Fig. 6).

The intranuclear achromatic figure of *Pyrsonympha* consists of a central spindle portion which extends from centriole to centriole, chromosomal fibres which extend from the centrioles to the chromosomes, and astral rays which radiate from each centriole. In composition it is the same as the extranuclear achromatic figure, but as a rule there are fewer free astral rays than in extranuclear achromatic figures, particularly the large ones of certain hypermastigotes, and the chromosomes encircle the central spindle more closely, thus making it somewhat more difficult to distinguish clearly chromosomal fibres from those of the central spindle.

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Explanation of plate.

Plate 12.

The drawings were made with the aid of a camera lucida from material fixed in Schaudinn's fluid and stained with Heidenhain's haematoxylin. Magnification. × 3500.

Fig. 1. Prophase nucleus. An early stage in the development of the achromatic figure. A few astral rays have arisen from each of the centrioles which lie close together near the nuclear membrane.

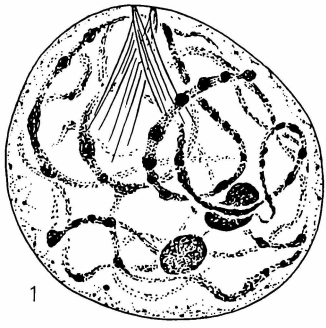
Fig. 2. Later stage in the development of the achromatic figure. Here the fibres of the achromatic figure appear to arise from the nuclear membrane because the centrioles, which lie beneath, cannot be seen. Chromosomes have formed, either by the splitting or separation of the strands shown in the previous illustration, and are moving toward the centre of the nucleus.

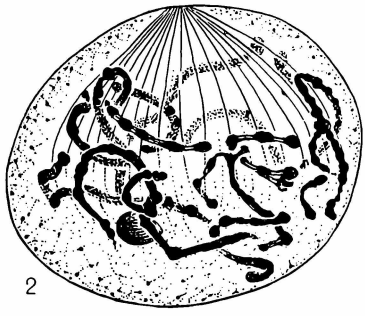
Fig. 3. The development of the achromatic figure has progressed to about the same stage as in Fig. 2 and the two circular centrioles from which it arises may be seen clearly.

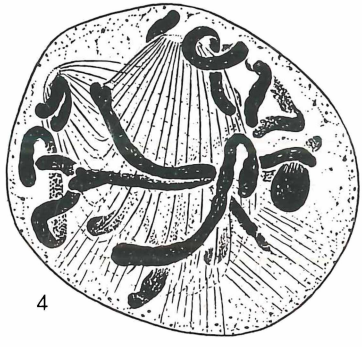
Fig. 4. A slightly later stage. The centrioles have begun to move apart and some of the astral rays arising from them have met and have grown along one another to form the early central spindle, which is considerably curved. Some of the astral rays here and in the two previous illustrations have become chromosomal fibres by connecting with the chromosomes; others radiate in the nucleus, extending through most of it.

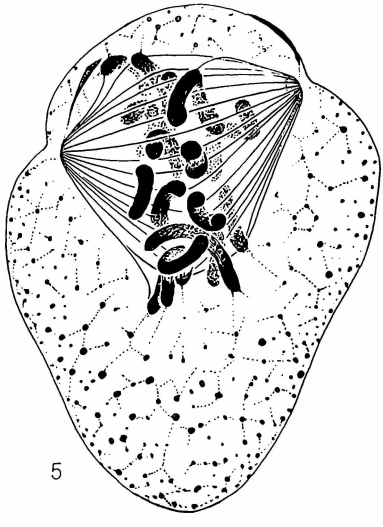
Fig. 5. The formation of the central spindle portion of the achromatic figure is complete and it extends directly from centriole to centriole. The centrioles are much farther apart then in Fig. 4. Some of the chromosomes are becoming V-shaped owing to the poleward pull of the chromosomal fibres connecting them with the centrioles.

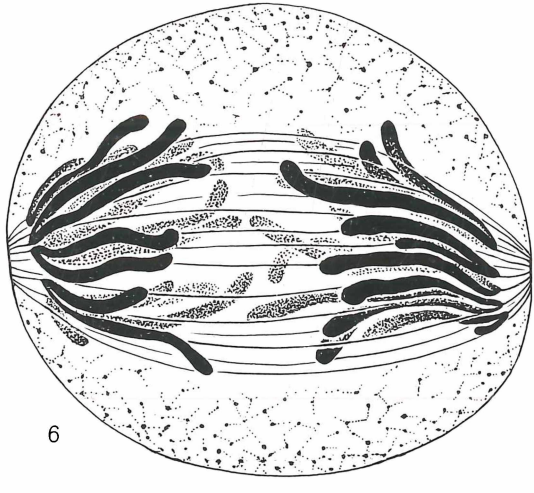
Fig. 6. A late anaphase. Central spindle has elongated and the chromosomal fibres have pulled the long, V-shaped chromosomes almost to the poles (centrioles).











Cleveland.

VERLAG VON GUSTAV FISCHER IN JENA