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Actin in the Mitotic Spindle

I PREVIOUSLY suggested that the shape of the metaphase spindle cannot be maintained if there is tension in the component microtubules[1]. Spindle tension has been detected[2,3] and could be due to some other component pulling the chromosomes over the rigid microtubular framework.

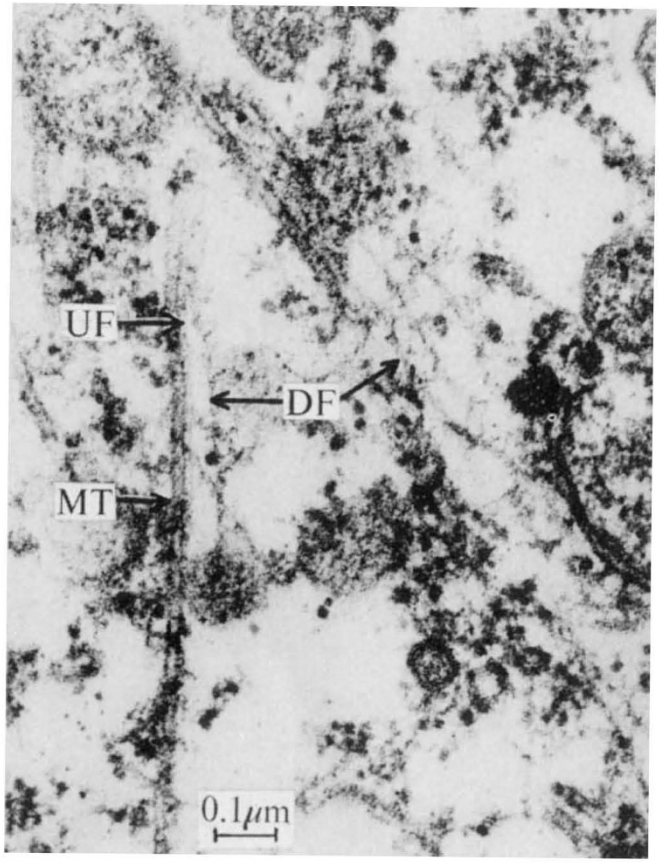

Fig. 1 Part of a metaphase mitotic spindle, long axis of spindle running from top left to bottom right of picture. Oriented, decorated filaments (DF) are shown, and an undecorated filament (UF) associated with a microtubule (MT) (×108,500).

Aronson[4] established that fluorescein-labelled heavy meromyosin (HMM) binds to isolated sea-urchin spindles as well as to muscle fibrils, indicating that actin is present in both. I have now located the actin in electron micrographs with the method used by Ishikawa *et al.*[5].

Locust testis tissue was treated for 24 h at room temperature with 50% glycerol in a buffer containing 0.1 M KCl, 0.006 M phosphate, and 0.005 M $MgCl_2$. The testis follicle wall was torn slightly with a glass needle and the tissue was incubated for a further 24 h with rabbit HMM in a similar buffer at 4° C. The tissue was fixed in 2.5% glutaraldehyde treated with 1% osmium tetroxide, and embedded in araldite. Sections were stained with uranyl acetate and lead citrate.

Mitotic cells of the testis were studied because their spindle microtubules survive glycerination and incubation, whereas spindle microtubules in meiotic cells do not. Three types of filament, in addition to microtubules, can be seen in metaphase mitotic cells. One type runs parallel at a distance of 100 Å to an associated microtubule but there are no apparent cross links (Fig. 1). This type of filament is never associated with heavy meromyosin. Another type forms a complex with HMM, which characterizes the filament as actin. Most of these filaments lie parallel to the long axis of the spindle but are not closely associated with any microtubules. The third type of filament is found at the periphery of the cell, parallel to the surface, and always forms a complex with HMM. It is found in all testis cells, whether in division or not.

Although actin has only been shown to be present in the spindle, it is probably involved in the movement of chromosomes in which case chromosome movement would involve, like many other cell movements[6,7], an interaction between actin and myosin. The observations suggest that either the microtubules themselves have myosin-like properties or they are associated with myosin which is lost during preparation of the tissue.

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Protein Polymorphism

IN their well known study of protein polymorphism in *Drosophila pseudoobscura*, Prakash, Lewontin and Hubby[1] showed that most loci reveal little or no differentiation in allele frequencies in different sub-populations; they concluded that the observed polymorphisms cannot be due to random genetic drift of neutral mutations and are most likely to be caused by some form of balancing selection. This conclusion has been challenged by Kimura and Ohta[2] on the grounds that only a small amount of migration between the sub-populations is required to make them into an effectively single panmictic population in which one would not expect to find much local differentiation in allele frequencies under the neutral mutation theory originally proposed by Kimura[3]. The purpose of this letter is to point out another feature of the data of Prakash