

Figure 2. Altitude vs CaO , TiO_2 and K_2O of basaltic lava flows of Ajra-Mahagaon area (38 samples) (symbols used are the same as shown in figure 1).

Modal composition of the 38 representative samples corroborates differentiation into two groups, the average modal values in per cent for group I being, plagioclases 42.57, pyroxenes 49.69 and opaques 7.72; for group II the values are 49.23, 45.15 and 5.61 respectively. Thus group I (lower flows) is richer in pyroxenes, while group II (upper flows) is richer in plagioclases.

Figure 2 demonstrates the relation between the height of the lava flows and the critical oxide (TiO_2 , CaO and K_2O) content of the rocks. It is observed that the CaO content is greater while TiO_2 and K_2O are less in the upper flows; the situation is reversed in the lower flows.

From the foregoing account it is found that the chemical composition of the flows apparently differs according to the present height. Two flows are distinguishable, the lower flows being richer in TiO_2 and K_2O , while the upper ones are richer in CaO . Though minor elements Sr and Ba are present at different levels, the lower flows being richer in these elements. Mineralogically too, the lower flows contain more pyroxenes than the plagioclases, the situation being reversed in the upper flows.

Though the distinction into two flows is possible in terms of chemistry and mineralogy, these compo-

sitional variations appear to have occurred at depth from where these were later brought to the surface. In conclusion it may be said that the chemical composition also can be utilized to distinguish flows from one another, in addition to the other criteria used, such as vesicularity, chilled contact, etc.

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ORIGIN OF 'CYTOSPINDLE' MICROTUBULES IN *PARAMECIUM*

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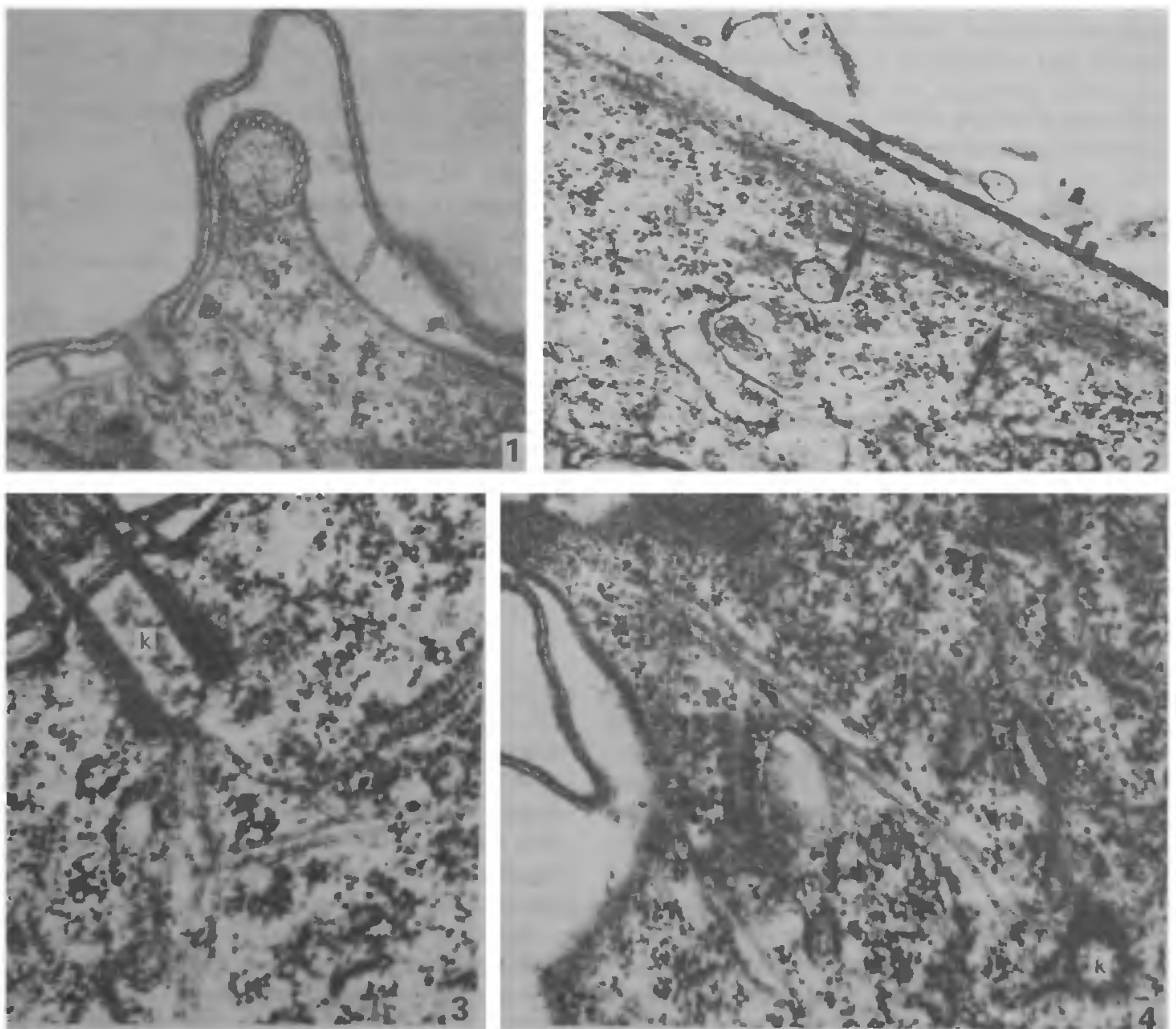
MICROTUBULES are ubiquitous organelles in all the eucaryotic cells which can form complex cell structures such as centrioles, kinetosomes, cilia, etc. The cortex of ciliates like *Paramecium* is replete with microtubule systems. In the cortex of *Paramecium* two sets of microtubular ribbons are seen associated with the ciliary kinetosomes^{1,2}. These are the post-ciliary and transverse tubular fibrils. Apart from

these permanent microtubule systems an array of subcortical longitudinal microtubules are seen in dividing cells^{1,3}. This array of microtubules extends the entire length of the dividing cell and possibly plays a role in the fission process³. Recently, the occurrence of this array was elegantly demonstrated at the light microscopical level using the immunofluorescent technique and because of the organization at the whole cell level, the authors proposed to call the whole array 'cytospindle'⁴. For the sake of convenience the same terminology will be used here.

Microtubules are generally known to originate from specific organelles such as centrioles or kine-

somes and these organelles are called microtubule organizing centre (MTOC)⁵. The origin of cytospinde microtubules is not clear. Though a clear relationship between the ciliary kinety (rows of cilia with the kinetosomes) has been shown, it is not known whether kinetosomes act as the nucleating centre⁴. In the present report, the morphological evidence for the possible origin of cytospinde microtubules from the kinetosomes is presented.

Paramecium species belonging to the 'Aurelia complex'⁶ was collected from a local pond and cultured according to the standard procedure in Cerophyl medium inoculated with *Klebsiella*



Figures 1-4. 1. Transverse section of a longitudinal ridge showing the ringlet arrangement of the cytospinde microtubules ($\times 84,000$); 2. Longitudinal section showing the microtubules entering the ridge (arrow) ($\times 52,000$); 3. Kinetosomes (k) with microtubules originating from the base. Note the directional difference of the microtubules ($\times 75,000$), and 4. Oblique section microtubules leaving the kinetosomes (k) and entering the ridge ($\times 60,000$).

*pnemoniae*⁷. Dividing cells were isolated from log phase culture and fixed for electron microscopy³. Fixation was done in 2.5% glutaraldehyde buffered with 0.1 M sodium cacodylate, pH 7.2 and post-fixed in 1% osmium tetroxide prepared in the same buffer. Cells were then dehydrated in ethanol series and embedded in Epon-Araldite. Sections were cut with an LKB IV ultramicrotome and stained with uranyl acetate and lead citrate. Sections were observed using an electron microscope (Philips EM 400).

As described earlier³, the cytospinde microtubules are readily seen in cross-sections of dividing cells (figure 1). Both electron microscopic and immunofluorescent studies have shown that the number and arrangement of microtubules are chronologically linked to the course of fission. From longitudinal sections of dividing cells, it appears that microtubules arise from the lower cytoplasm and enter the longitudinal ridges (figure 2). Observations of kinetosomal region reveal that 2-4, microtubules arise from each kinetosome (figure 3). Cross-sections near the base of kinetosomes reveal microtubules extending to the ridge (figure 4). The fact that permanent microtubule ribbons are also seen in the same region suggests that these microtubules belong to the cytospinde.

Observations from a number of micrographs show that the cytospinde microtubules possibly arise from each kinetosome and enter the longitudinal ridge just like the kinetodesmal fibres. It appears that at least 2-4 microtubules arise from a single kinetosome and then turn right to extend upward towards the anterior. It is not clear from the present observation how long each microtubule extends; but it is apparent that each one extends at least a few microns to cover the length of a few ciliary units before probably terminating into the side of the longitudinal ridge.

The final ringlet arrangement of about 18 microtubules in each ridge (figure 1) is possibly achieved by taking a spiral course as they extend, by the microtubules arising from the kinetosomes of a single kinety. It also appears that each microtubule is linked to the adjacent ones at this stage (figure 1).

Though up to 5 microtubules are seen arising from a single kinetosome (figure 3) not all of them extend towards the longitudinal direction. It appears that at least one or two microtubules traverse transversely. These microtubules are seen deeper in the cortex in many sections. This shows that two sets of microtubules viz. the cytospinde and the transverse microtubules appear in the cortex of dividing paramecia,

both originating from the kinetosomes.

Thus the present study reveals that the cytospinde microtubules originating from the base of kinetosomes form part of the kinety as suggested earlier⁴. This is why in mutant cells, with reversed kinety microtubule, bundles are seen on the wrong side of the kinetosomes⁴. Both transverse and cytospinde microtubules possibly play different roles in the process of binary fission.

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1. Jurand, A. and Selman, G. G., *The anatomy of Paramecium aurelia*, MacMillan, London, 1969.
2. Allen, R. D., *J. Cell Biol.*, 1971, **49**, 1.
3. Sundararaman, V. and Hanson, E. D., *Genet. Res. Camb.*, 1976, **27**, 205.
4. Cohen, J., Adoutte, A., Grandchamp, S., Houdebine, L. M. and Beisson, J., *Biol. Cell*, 1982, **44**, 35.
5. Dustin, P., *Microtubules*, Springer-Verlag, Berlin, 1978.
6. Sonneborn, T. M., *Trans. Am. Microsc. Soc.*, 1975, **94**, 155.
7. Sonneborn, T. M., *Methods Cell Physiol.*, 1970, **4**, 241.

AFLATOXIN PRODUCTION BY *ASPERGILLUS PARASITICUS* ON SEEDS AND CAKES OF *BRASSICA CULTIVARS* UNDER VARIED MOISTURE AND TEMPERATURE REGIME

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SEEDS and cakes of important oil crops like rape and mustard are susceptible to aflatoxin contamination if stored under normal conditions. The present study examines the role of environmental factors on the production of aflatoxins by *A. parasiticus* growing on rape and mustard seeds and cakes.

Seeds of three varieties of rape and mustard viz. T-15 (*Brassica juncea*, Czern. & Cos, Kranti.), T-59 (*B. juncea* Verna) and Sangam (*B. campestris* var. Toria L.) were obtained from the Agronomy Department of the University. A culture of *A. parasiticus* was obtained from the Plant Pathology Department of this University.

Rape and mustard seeds and cakes were autoclaved in bulk at 1.05 kg/cm² for 15 min. After