trioxalotochromate (Cr^{3+}) form. The present findings on the distribution of chromium in bean plants and in the major biochemical moieties present in bean pods are of environmental significance since they are indicative of the chemical forms in which chromium occurs in the edible parts of leguminous crops grown in contaminated soils.

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Arnaud's 'enigmatic little marks': an extension (type 6) to the manginuloid hyphae series of epiphyllous microfungi

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Summary. The use of manginuloid hyphae (a category of epiphyllous microfungal structures) in the interpretation of Tertiary vegetation palaeohabitats is discussed briefly. A new type (6) is added to the known series of types of present-day manginuloid hyphae. This type apparently is restricted to very wet, near-equatorial mid-montane rainforest and extends the basis for uniformitarian deductions about tertiary vegetational palaeohabitat.

Identical or closely similar kinds of distinctive microfungi can be found on both living and Tertiary fossil leaves[1-9]. The likelihood of finding certain kinds of microfungi by standardized short search in living vegetation of the Australian region is linked to particular habitats and vegetation-types[8,9]. These links are used to interpret the palaeohabitat and palaeovegetation-type of fossil leaf beds in the region via the fossil microfungi exhibited[7-9].

Mycological taxonomy has yet to deal with many of the species detected on living leaves by palaeontologists in their search for comparison material[8,9]. Where that is so, palaeobotanical work has to rely on ad hoc form-systematics of living as well as fossil forms, which is the case when epiphyllous microfungi exhibiting manginuloid hyphae are under consideration[9].

A special characteristic of manginuloid hyphae is the invisibility or evanescence of external walls, resulting in display of the pronounced septa as 'enigmatic little marks'[10] upon the host leaf. An ad hoc classification of present-day manginuloid hyphae devised to allow palaeontological progess with fossil forms culminates in type 5, of which *Vizella banksiae* Swart[11] is typical. In this paper a new present-day form extending the series (type 6) is reported.

Hyphae of both types 5 and 6 involve extremely short broad dark cells interspersed with long hyaline cells but in type 5 the 2 pronounced septa delineating short dark cells look similar and are close together but do not touch each other[11]. In type 6 they are dissimilar and do touch each other (figs 1, 2). Throughout type 6 hyphae, the short cell septum distal to the hyphal apex appears ordinary and transverse, but the septum proximal to the hyphal apex appears as a semicircle based on the misection of the transverse septum which projects on either side of the semicircle (fig. 2).

Mycological interpretation of such structure is difficult because external hyphal walls cannot be seen clearly. In these circumstances various interpretations are possible. If the hyphal outer wall is an invisible cylindrical tube, then the 2 septa appear to be arranged like a cup upside down in a saucer, so that the dark cell is totally enclosed within the hypha and its transverse septum is shared by three cells. If the hypha is flattened like a ribbon, some alternative interpretation may be correct.

A knowledge of type 6 further refines the available basis for uniformitarian interpretation of Australasian Tertiary vegetation habitats via fossil manginuloid hyphae, of which more discoveries are under investigation[12]. Type 5, which in

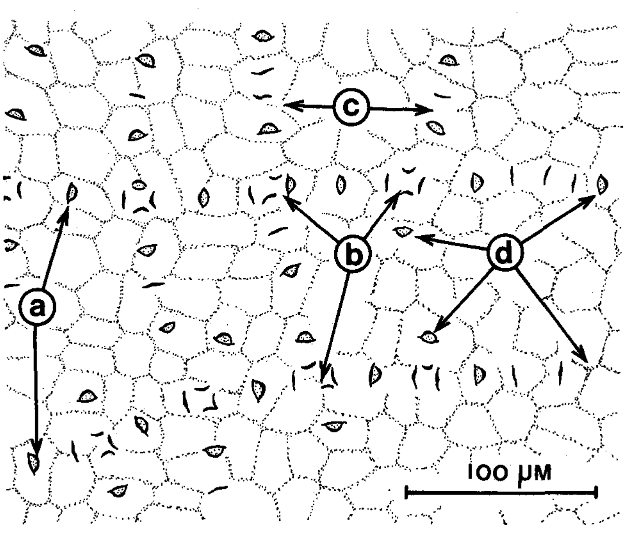

Figure 1. Drawing of hyphae at the periphery of a type 6 manginuloid mycelium: a, cells of main hyphae which run from left to right; b, cells bearing bilateral branch hyphae; c, cells of branch hyphae; d, hyphal tips of branch (left) and main (right) hyphae.

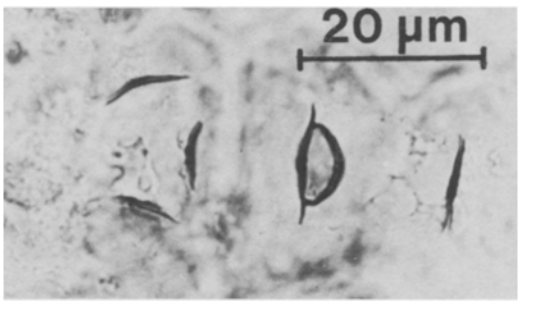

Figure 2. Oil immersion brightfield detail of type 6 manginuloid hypha showing branch cell (left), short cell (centre) and hyaline long cells.

part resembles type 6, is the only type in the region that extends to places receiving less than 1250 mm average annual rainfall[9]. After extensive search, type 6 is detected only from the following habitat: Telefomin district, Papua New Guinea; 5° 10′ S, 141° 35′ E, altitude about 1700 m; rainfall in excess of 2500 mm average annual; vegetation, mid-montane rainforest dominated by *Nothofagus* spp.; source of hyphae, different sorts of undetermined meso- and macrophylls from the forest floor leaf litter. A microscope slide of the illustrated specimen (Telefomin No. 394) is available from the Botany Department, Adelaide University, South Australia.

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Electron probe microanalysis of pyroantimonate precipitates in the cilia of *Paramecium*

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Summary. Electron-dense deposits were observed at the bases of the cilia of *Paramecium* fixed in 1% OsO_4 solution containing 2% potassium pyroantimonate. The deposits were shown to contain Ca and Sb by X-ray microanalyzer.

Ca ions are now known to modify ciliary and flagellar movement both in protozoa and in metazoa, e.g. the ciliary reversal response in ciliates and the ciliary arrest response in the lamellibranch gill. *Paramecium* extracted with Triton X-100 and reactivated with Mg-ATP swam backwards when the Ca ion concentration was raised above 10^{-6} M[1]. Similarly, extracted lateral cilia of *Mytilus* gill showed an arrest response that was controlled by Ca ions[2,3]. In the living cell, such an increase in Ca ion concentration could result directly from the influx of Ca ions across the excited cell membrane[4] and/or Ca ions necessary for the ciliary response could be liberated from some intracellular binding sites[5]. Recent electron microscopic studies on *Paramecium* fixed in glutaraldehyde solution containing $CaCl_2$ (glutaraldehyde method) have shown the localization of electron dense deposits at the bases of the cilia[6,7] and it was clearly demonstrated that the deposits consisted of Ca and P[8]. In the above-mentioned experiment, however, the fixative contained considerable amounts of Ca ions, which were supposed to bind with the sites at the base of the cilia.

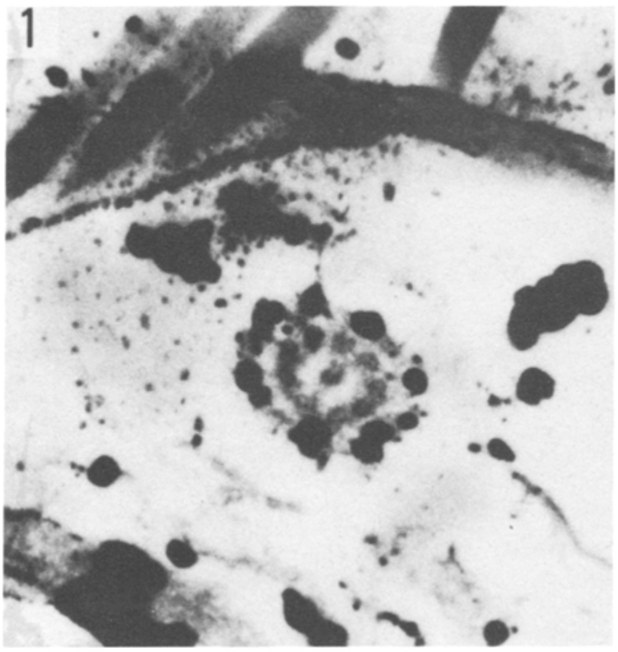

Figure 1. Tangential section through the cell surface of *Paramecium caudatum*. Deposits are seen at the inner side of the ciliary membrane. The irregularly shaped deposits around a cilium are extracellular ones. Weakly stained with uranyl acetate and lead citrate. × 60,000.

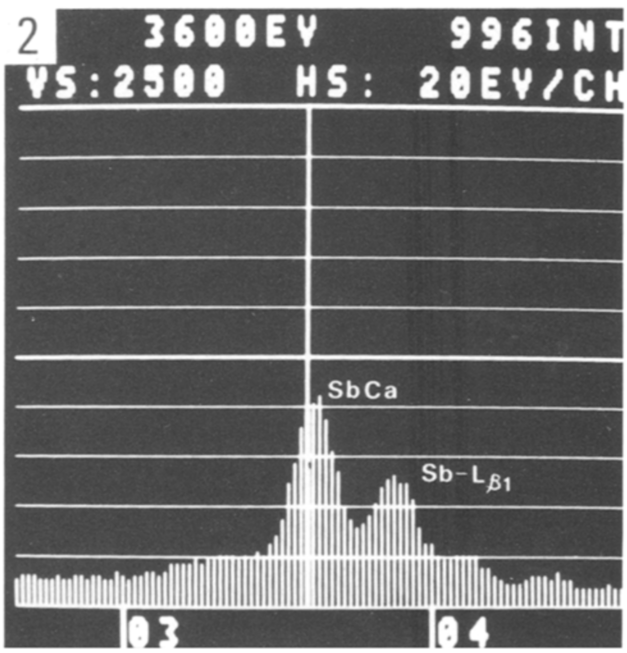

Figure 2. X-ray energy spectrum obtained at the intracellular deposit. Note the most distinct peak at 3620-40 eV; the combined peak of Sb-Lβ, emission (3840 eV) is also seen. Vertical white line indicates the position of Sb-Lα.