turgor gradient (if this is possible)—using both direct and indirect methods of measurement.

Results of radiotracer work on *Equisetum giganteum* indicate that the rate of translocation is variable but can be of a speed comparable to Angiosperms, i.e. rates of up to 25 cm/hr have been found.

An investigation into the products translocated (using chromatography and autoradiography) suggests that sucrose is the major translocate.

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Potential allelopathy in *Equisetum*

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Allelopathy probably occurs in many species of flowering plants (Rice 1979). However, there have been very few reports of this phenomenon in pteridophytes (Duckett 1979; Glass 1976). Nevertheless, it seems plausible to suppose that *Equisetum* spp. may be allelopathic. The reasons for this are:

(i) *Equisetum* spp. have a tendency to form large, monospecific stands. This could be due to allelopathy, probably enhanced by a vigorous growth habit.

(ii) *Equisetum* spp. are known to produce a wide range of secondary compounds, in particular, flavonoids (Saleh *et al.* 1975) and phenolics (Syrchina *et al.* 1975). Both these groups of chemicals have been implicated as agents of allelopathy in other plants (Rice 1979).

(iii) Zelenchuk and Gelemei (1967) showed that water extracts of *E. arvense* L. have a strong inhibitory effect on seed germination and seedling vigour of 30 species of meadow grass.

(iv) Duckett and Duckett (1980) note that on reservoir mud, *E. fluviatile* L. gametophytes are not found near stands of the sporophytes, even though the habitat is apparently quite suitable. This, they suggest, may be due to allelopathy.

(v) Experiments by Duckett (1979) suggest that rapid death of gametophytes following fertilisation is at least partly due to chemicals produced by the sporophyte, that are toxic to the gametophyte.

Our preliminary experiments described below further explore the suggestions of allelopathy in *Equisetum*.

Under axenic conditions, spores of *E. sylvaticum* L. were sown on plates of Parker's medium (Duckett 1979) and a surface-sterilised 4 cm section of *E. sylvaticum* sporophyte was placed in the centre. After 4 weeks of growth, gametophytes nearest the sporophyte consisted of rounded cells with few plastids, showing little differentiation. Gametophytes progressively further from the sporophyte had an increasing number of the lamellae characteristic of *Equisetum* gametophytes (Duckett and Duckett 1980). Differentiation of rhizoids was also inhibited by proximity to the gametophyte. This strongly supports the suggestion of Duckett (1979) and Duckett

and Duckett (1980) that *Equisetum* sporophytes produce toxic chemicals which adversely affect the growth of *Equisetum* gametophytes.

Sporophyte extracts (1 g fresh sporophyte : 100 g distilled water) of *E. arvense, E. palustre* L. and *E. variegatum* Schl. ex Web. and Mohr all significantly reduced the germination of *Festuca rubra* ssp. *rubra* L. The relative potencies in reducing germination were: *E. arvense* = *E. palustre* > *E. variegatum*. This is in full agreement with the earlier work of Zelenchuk and Gelemei (1967).

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F. HYBRIDISATION, EVOLUTION AND TAXONOMY OF FERNS

Flavonoids as biochemical markers in fern taxonomy

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Many Cheilanthoid ferns (Polypodiaceae, Gymnogrammoideae) are characterised by a white or yellow layer of natural products (ceraceous indument) on their lower leaf surface. This farinose frond exudate consists mostly of flavonoid aglycones and sometimes also of diterpenses. They are excreted by and deposited on capitate cells of glandular trichomes.

Once the flavonoids forming the 'wax' of a given species have been analysed (bulk material required sometimes), further studies can be undertaken by comparative TLC. Minute frond fragments are sufficient to check specimens for constancy and significance of flavonoid patterns. Examples are given for the genus *Notholaena*.

Apart from some mostly quantitative infraspecific variability, the flavonoid profiles are constant and specific for species like *N. bryopoda, N. grayi, N. pallens* and others.