electron microscope. Material was processed for thin-section studies as described previously[6]. Changes in nuclear morphology were monitored using a Zeiss photomicroscope equipped with phase contrast optics.

Results. Light microscopy revealed a reduction in numbers of nucleoli, an increase in total nucleolar volume and development of nucleolar vacuoles on cell activation (compare Figures 3 and 4). Furthermore, the nucleus enlarged and developed an irregular outline with deep infoldings (Figures 1 and 2; 3 and 4). As a consequence of this, the nuclei isolated from activated cells had a much larger surface area. However, their pore frequency did not differ significantly ($p \gg 0.01$) from that of dormant cell nuclei (Table and Figures 5 and 6), despite the fact that at the relatively low pore densities observed, there appears to be sufficient space to accommodate many more pores. Both types of nuclei revealed a number of different appearances of their pores in freeze fracture replicas. These can be understood in terms of the position of the cleavage plane through the pore[9-11] and do not indicate any alteration in nuclear pore structure.

Discussion. The changes occurring in the nucleolus are in agreement with those previously reported[12]. The development of an irregular nuclear profile has been noted in activated *D. carota* root cells[7] and is not an uncommon feature of other active cells[13]. Although the nuclear changes in *H. tuberosus* follow those of *D. carota* it is interesting that they differ with regard to the density of pores in the nuclear envelope. In view of the fact that an increase in nuclear pore frequency commonly accompanies cell activation in a number of systems[2-5] and in particular, *D. carota* root cells activated in an identical manner to that used here for *H. tuberosus*[7], the lack of a corresponding change in *H. tuberosus* may seem surprizing.

If nuclear pore complexes are regarded as relatively stable entities having the capacity to vary the rate at which nuclear products are transported through them, then formation of new pores might not occur unless the amount of material to be exported to the cytoplasm is in excess of that which existing pores can process. Data on flow rates of material through nuclear pores shows variation between species and in the same system at different developmental stages[1,14,15]. Thus, the difference in response between *H. tuberosus* and *D. carota* may be accounted for in terms of differences in the capacity of the nuclear pores already present to meet the new transport demands.

Any explanation for the difference must also take into account the increase in nuclear surface area. Although a similar pore frequency is shown in dormant and active cells of *H. tuberosus*, the absolute number of nuclear pores per nucleus must rise with the development of undulations in the nuclear surface. It might be that although formation of new nuclear pores is required, a restriction of an unknown nature on pore frequency exists, making an increase in nuclear pores dependent on the formation of new nuclear envelope.

Whatever the explanation, it is clear that the relationship between nuclear pore frequency and cell metabolism is more complex than originally anticipated, and emphasizes that an increase in total pore number is not always accompanied by an increase in pore frequency. Further work is in progress to attempt to determine more precisely the factors which lead to nuclear pore formation in this and other cell systems[16].

Summary. The ultrastructure of nuclei from dormant and activated *Helianthus tuberosus* tuber cells has been investigated with particular reference to nuclear pore frequency and nuclear envelope invaginations, and the results discussed in relation to observations made on other cell types.

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Occurrence of Extra-Ovarian Ovules in Sunflower Plants (*Helianthus annuus* L.) Treated with Chlorflurenol

Morphactins (derivatives of fluorene-9-carboxylic acid) have been reported to increase or decrease the number of flowers[1], favour femaleness[2-4], and cause suppression or fusion of flowers or of floral parts[2,5,6]. In this laboratory, the effects of chlorflurenol (2-chloro-9-hydroxy fluorene-(9)-methylate, EMD 7301 W) are being studied on the development of the inflorescence in some members of the Compositae. One of the interesting observations made with sunflower is reported here.

Plants of *Helianthus annuus* L. var. Armavirsakij, have a terminal inflorescence bearing a whorl of sterile ray florets and 800–2,000 bisexual disc florets which form fruits. The inferior ovary has a basally attached ovule (Figure 1).

A foliar spray of aqueous chlorflurenol solution was given to 6-week-old plants at the following concentrations: 3×10^{-3} *M*, 10^{-3} *M*, 3×10^{-4} *M*, 10^{-4} *M*, and 3×10^{-5} *M*, along with 0.01% Tween 80 as the surfactant. The controls received only the surfactant solution. 8 to 10 weeks later, certain inflorescences of treated plants were observed in which the initiation of the disc florets was haphazard instead of being in spirals as in controls. Some of the florets showed exposed ovules (Figure 2). 1 to 7 (rarely up to 14) ovules were found projecting through the narrow apex of the corolla tube, or lying in the middle of the split-open boat-like corolla, or emerging laterally through the ovary wall. Some florets showed 2 ovules each, one basally attached, normal ovule con-

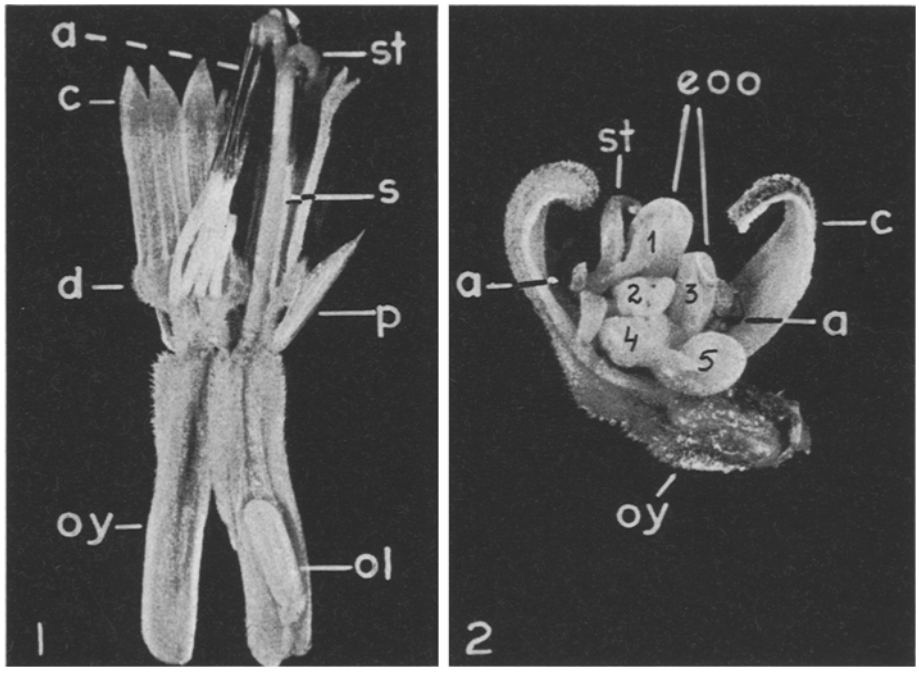

Fig. 1. Vertical halves of a normal disc floret showing a single basally attached intra-ovarian ovule.

Fig. 2. Disc floret from chlorflurenol-treated plant showing the boat-shaped corolla lobes and the 5 extra-ovarian ovules. a, anther; c, corolla; d, disc; eoo, extra-ovarian ovule; ol, ovule; oy, ovary; p, pappus; s, style; st, stigma.

fined to the ovary, another emerging laterally through the ovary wall. The florets in which the ovules had come out of the corolla were of 2 kinds: a) those in which the length of the ovary was the same as in controls and the loculus was filled with ovules, b) those in which the ovary was short and solid; the ovules being borne at the base of the corolla or on it. The extra-ovarian ovules differed from the normal ones in their size and shape, but showed the endothelium and the embryo sac.

There are many papers dealing with the effects of morphactins on flower development. To our knowledge, the only previous report on the occurrence of exposed ovules is by UMA[7,8] in the treated linseed plants. The ovules were found to protrude from the top of the ovary or occasionally attached to the base of a stamen. The exposed ovules of linseed contained smaller embryos and their ultimate fate was not known. In the sunflower also mature exposed seeds have not been observed. The formation of extra-ovarian ovules was recorded in plants treated at all concentrations of chlorflurenol. However, the maximum incidence of this feature was noted at the lowest concentration. The increase in the number of ovules suggests an accentuation of female sex expression. The details of ontogeny and embryology of the exposed ovules are being studied.

Summary. Foliar spray of aqueous chlorflurenol solution induced the development of 1–7 (rarely up to 14) extra-ovarian ovules in the disc florets of sunflower in contrast with a single intra-ovarian ovule found in the controls. The incidence was highest at 3×10^{-5} *M* concentration.

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Relationship Between Size of Muscle Fibres and Body Dimensions in a Number of Teleosts

In 1956, JOUBERT[1] reviewed some of the literature which dealt with the effect of species on muscle fibre size. He quoted BOWMAN[2], who in 1840, must have been one of the first to suggest some sort of genetic control over muscle fibre size. He stated that within each class of animals there is an extensive range of body size and probably also muscle fibre size. Since then, several studies have been made to investigate the effect of species on muscle fibre size within the mammalian class. WARRINGSHOLZ[3], and later JOUBERT[1], measured muscle fibre diameter in 4 domestic mammals, but they found no relationship with body size. However, GAUTHIER and PADYKULA[4], in a more recent extensive survey, did

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