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Epicarp microcharacters in some European Angelica species

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SEZIONE III

(Botanica, zoologia, fisiologia e patologia)

Botanica. — *Epicarp microcharacters in some European* Angelica *species.* Nota di RENATA TREVISAN, ELSA M. CAPPELLETTI e ROSAMARIA CANIATO (*), presentata (**) dal Socio C. CAPPELLETTI.

RIASSUNTO. — Sono stati studiati, mediante il microscopio elettronico a scansione, i microcaratteri differenziali dell'epicarpo degli acheni di *Angelica archangelica*, della specie sofisticante *A. sylvestris* e di due altre specie europee dello stesso genere.

La droga polverizzata di *A. archangelica* può essere riconosciuta per la contemporanea presenza di cellule del mesocarpo con caratteristici inspessimenti reticolari della parete (riscontrabili tuttavia in tutte le specie del genere preso in considerazione) e di corti peli verrucosi, esclusivi di *A. archangelica*.

INTRODUCTION

Anatomical fruit features have played a very significant role in the taxonomy of the *Umbelliferae* [14, 15].

In previous papers [2, 4, 5] the diagnostic value and the taxonomic reliability, sometimes even at the specific level, of the *Umbelliferae* epicarp microcharacters, have been pointed out.

In the present paper the epicarp microcharacters of Angelica (*Angelica archangelica* L.) fruits, sometimes employed as a stomachic in folk medicine [12], but at present largely utilized as a flavouring agent [6, 10, 11, 17], and of *Angelica sylvestris* L. which is reported to be a frequent adulterant species [1], have been comparatively investigated.

In order to get a broader insight into *Angelica* epicarp features, two European species of the same genus, namely *A. razulii* Gouan and *A. pachycarpa* Lange, have been taken into account too.

MATERIALS AND METHODS

Angelica archangelica L. subsp. *archangelica*: fruits from wild plants were sent by the Botanical Garden of Oslo (Norway) and by the Department of Ecological Botany of Umeå (Sweden). Fruits from cultivated plants, sent by the Botanical Gardens of Friburg (Switzerland) and Pavia (Italy), were also examined.

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(**) Nella seduta del 12 febbraio 1983.

Angelica sylvestris L.: fruits collected in natural habitats were obtained from the Botanical Gardens of Trieste and Pisa (Italy) and Vácrátót (Hungary). Fruits from cultivated plants were sent by the Botanical Garden of Friburg (Switzerland).

Fruits of both *Angelica archangelica* and *A. sylvestris* from plants of known wild origin grown in the Botanical Garden of Padua, were also utilized.

Angelica razulii Gouan and *A. pachycarpa* Lange: fruits collected in the Royal Botanical Garden CSIC of Madrid (Spain) from plants of known wild origin.

The dried fruits were allowed to soak in 6% glutaraldehyde in 0.1 M cacodylate buffer (pH 6.9) in the dark at + 4 °C for 1–2 weeks; fixation time was reduced to 12 hours for fresh fruit samples of *Angelica archangelica* and *A. sylvestris* collected from plants grown in the Botanical Garden of Padua.

All the samples were gradually dehydrated in acetone of increasing concentration, then dried by the critical point method in a Critical Point Dryer Balzers Union, coated with gold in an Edwards S 150 A Sputter Coater. Powdered fruits were merely metallized.

Observations were made under a Cambridge Stereoscan 250 (accelerating voltage 20 kV) at the " Centro Universitario Grandi Apparecchiature Scientifiche " (CUGAS) of the University of Padua.

Results

The advisability of previous examination of fresh and fixed samples before taking into account the dried powdered ones, in order to avoid misinterpretations due to cell coarctation, has been repeatedly pointed out [2, 3, 9].

Dried fruit samples sent by Botanical Gardens or from herbarium specimens have however to be often examined.

A series of preliminary tests comparing epicarp features of fresh and of dried *Angelica* fruits submitted to different soaking times, provided evidence that a soaking period of 1–2 weeks in buffered glutaraldehyde is quite adequate to allow cell imbibition. By this method no difference in epicarp cell shape was observed between freshly collected and dried fruit samples.

Gross fruit morphology.

Wing and rib morphological features represent important characters for classification within the genus *Angelica*: membranous wings, wider than the mericarps, can be found in *A. sylvestris* in contrast of the more or less thick wings not wider than the mericarps found in the other species [16].

Fruit outlines as seen in median transections (Fig. 1) put in evidence the gross morphology of wings originating from lateral ribs, and the presence of acute dorsal and intermediate ribs in *Angelica archangelica* and *A. pachycarpa*, in contrast of the obtuse ones in *A. sylvestris* and *A. razulii.*

At maturity the pericarp of *A. archangelica* breaks, a cavity develops in the fruit inside, the endocarp and secretory canals remaining adherent to the seed (Fig. 1 a).

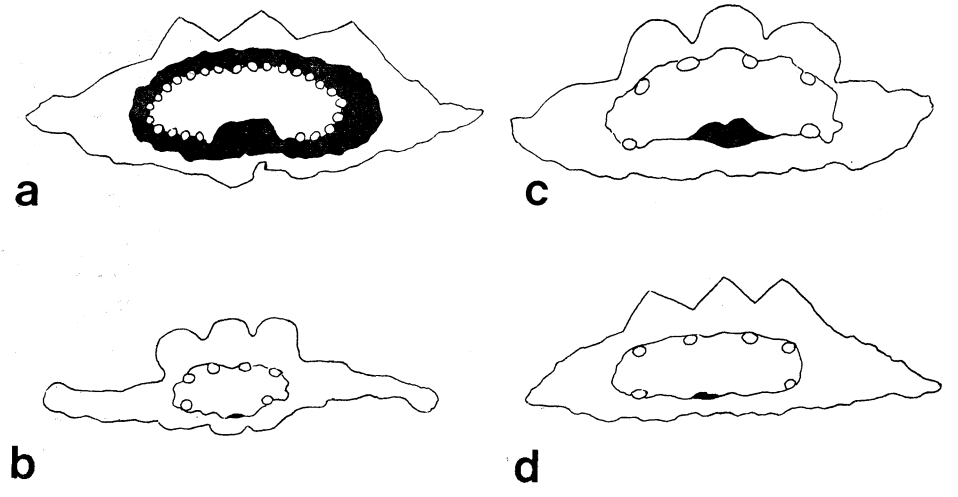

Fig. 1. – Mericarp median transections — a: *Angelica archangelica*; b: *A. sylvestris*; c: *A. razuli*; d: *A. pachycarpa* (×40).

Epicarp microcharacters.

On the dorsal ribs epicarp cells exhibit cuticular striations parallel to the longer fruit axis. Cell outlines are not apparent in *A. archangelica* (Fig. 2), while in *A. sylvestris* and *A. razulii* a longitudinal furrow is interposed between contiguous cell rows (Fig. 3). Less marked cuticle striations and the occurrence of stomata can be observed on the dorsal rib of *A. pachycarpa* (Fig. 4).

Cell features on the intermediate ribs are quite similar to those described for the dorsal ones (Fig. 5). In *A. archangelica* short, warty hairs can however be found (Fig. 6 and Fig. 7).

Elongated and longitudinally striated epicarp cells can also be found on the intercostal spaces; on the deepest vallecular region smooth epidermal cells and stomata are present in the four species considered (Fig. 8 and Fig. 9).

Longitudinally striated, elongated epicarp cells occur on the dorsal page of fruit wings both in *A. archangelica* (Fig. 10) and *A. razulii* (Fig. 11). Epicarp cells which are isodiametric in surface view occur on the contrary on the dorsal wing page in the other two species; these isodiametric cells show striated tangential walls in *A. sylvestris* (Fig. 12), smooth walls in *A. pachycarpa* (Fig. 13).

On the commissural mericarp surface of *A. archangelica*, *A. sylvestris* and *A. pachycarpa* wing epicarp cells with features quite similar to those described for the dorsal wing surface, can be found; isodiametric and strongly striated cells occur on *A. razulii* wings.

Towards the middle plane of the commissural mericarp surface, subpolygonal cells (smooth in *A. pachycarpa* and provided with cuticular striations in the other species) can be observed (Fig. 14, Fig. 15 and Fig. 16).

In close proximity of the carpophore region, an area with smooth cells is present (Fig. 16 and Fig. 17).

In the furrow where the carpophore occurs, the epicarp cell layer is often broken off and therefore the mesocarp parenchyma cells with the reticulate wall thickenings described by Roth [13] for *A. archangelica* can be observed (Fig. 16 and Fig. 18). This kind of parenchyma cells occurs in all the *Angelica* species taken into account and represents perhaps the most typical anatomical feature of the powdered *Angelica* fruits (Fig. 19).

A. pachycarpa seems to be the species where cuticle striations of epicarp cells are least marked or absent.

Discussion and conclusions

The very conservative fruit structure explains why it is used as the main criterion for the classification of the *Umbelliferae* [15].

The taxonomic reliability of epicarp microcharacters has been demonstrated at generic level [8] and in some instances at specific level too [2].

The carpological macrocharacters generally regarded as having taxonomic significance within the genus *Angelica* are wing thickness and wing width in comparison with mericarp width. According to some Authors [7, 16, 18] the outlines of dorsal and intermediate ridges provide further valuable characters for classification purpose.

According to Bencivenga *et al.* [1] who carried out a morphometric research on a statistical base, the best differential characters between *A. archangelica* and *A. sylvestris* are: fruit and lateral wing thickness, the distance between intermediate ribs, and the achene breadth/thickness ratio.

In contrast with what has been pointed out for morphometric data [1], we have observed fairly constant epicarp microcharacters in fruit samples of the same species but of different origin.

As regards microcharacters, the epicarp features observed on *Angelica* fruit ribs (i.e. striated, elongated cells) are not unusual but on the contrary rather widespread among the *Umbelliferae* [2, 4, 5].

The mesocarp cells with reticulate wall thickenings (easily recognizable even in powdered samples, Fig. 19) have been observed in all the *Angelica* species taken into account; therefore they seem likely to be a requisite of all the species of the genus.

The differences in both epicarp cell shape and ornamentation observed on the wings, can provide useful diagnostic characters when entire mericarps are examined, but cannot represent reliable criteria when the drug has been minutely minced or powdered.

The only valuable character whereby to discriminate *A. archangelica* fruits from its frequent adulteration *A. sylvestris* (as well from the other species taken into account) even in powdered drug samples, seems therefore to be the short warty hairs (Fig. 6 and Fig. 7).

Short warty hairs being however present on other *Umbelliferae* fruits as well (Cappelletti, unpublished data), the presence in the sample of both mesocarp cells with reticulate wall thickenings and short warty hairs, must be considered as the most reliable diagnostic character of powdered angelica drug.

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EXPLANATIONS OF PLATES I–V

PLATE I

Fig. 2. – *Angelica archangelica*: epicarp features on dorsal rib (×725).

Fig. 3. – *Angelica sylvestris*: epicarp features on dorsal rib (×725).

Fig. 4. – *Angelica pachycarpa*: weakly striated epicarp cells and stomata on dorsal rib (×725).

Fig. 5. – *Angelica razulii*: epicarp features on intermediate ribs (×740).

PLATE II

Fig. 6. – *Angelica archangelica*: short, warty hairs on intermediate ribs (×725).

Fig. 7. – *Angelica archangelica*: a warty hair (×2,200).

Fig. 8. – *Angelica archangelica*: epicarp features on the vallecular region (×220).

Fig. 9. – *Angelica razulii*: epicarp features on the vallecular region (×450).

PLATE III

Fig. 10. – *Angelica archangelica*: eloganted epicarp cells on the dorsal page of fruit wings (×725).

Fig. 11. – *Angelica razulii*: elongated epicarp cells on the dorsal page of fruit wings (×450).

Fig. 12. – *Angelica sylvestris*: isodiametric and striated epicarp cells on the dorsal wing page (×650).

Fig. 13. – *Angelica pachycarpa*: striated epicarp cells of intermediate ribs (at the left) and smooth epicarp cells on the dorsal wing page (at the right) (×220).

PLATE IV

Fig. 14. – *Angelica archangelica*: striated cells on commissural mericarp surface (×725).

Fig. 15. – *Angelica razulii*: striated cells on commissural mericarp surface (×3,800).

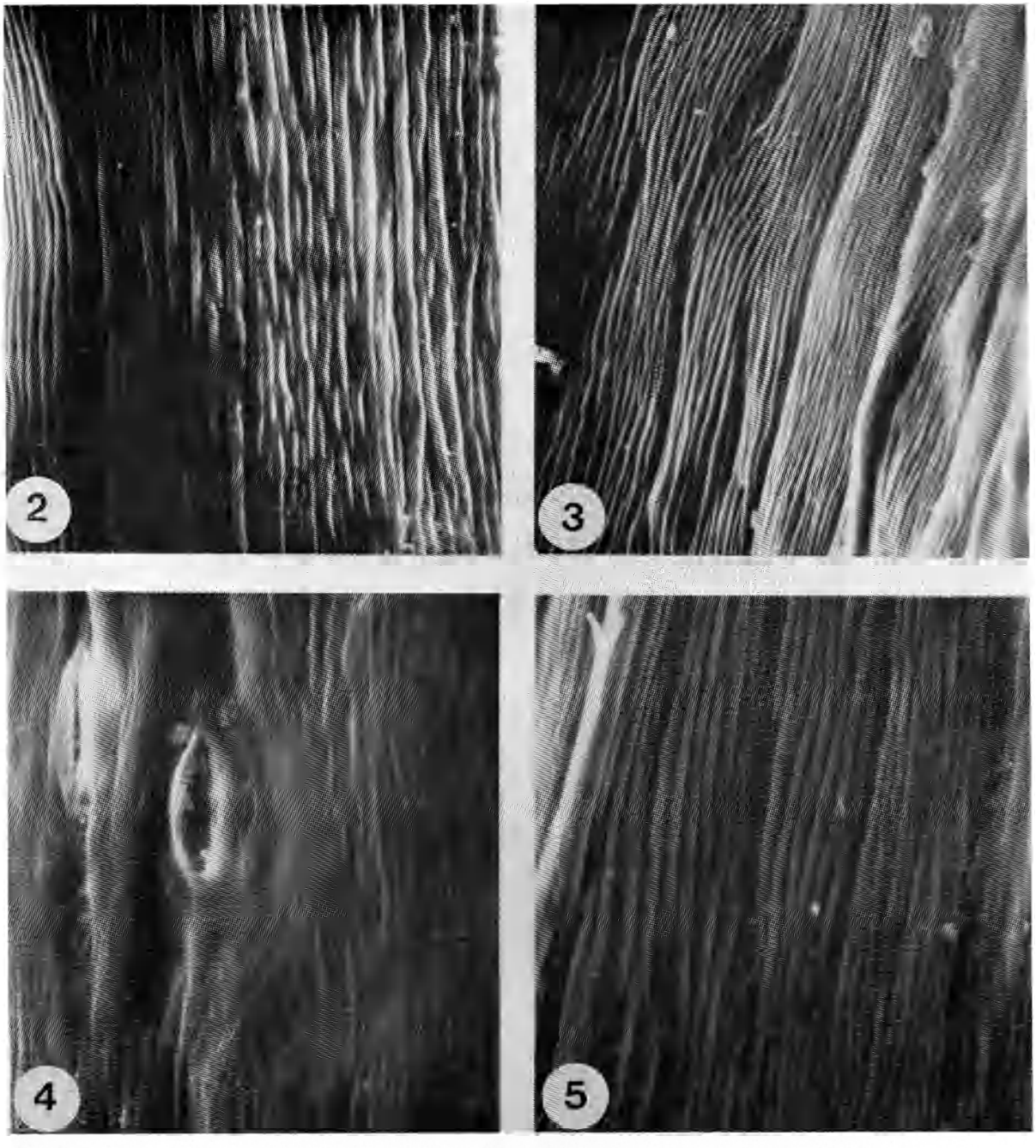
Fig. 16. – *Angelica sylvestris*: striated cells on commissural mericarp surface (×2,500).

Fig. 17. – *Angelica archangelica*: smooth cells in proximity of the carpophore region (×2,400).

PLATE V

Fig. 18. – *Angelica razulii*: mesocarp parenchyma cells with reticulate wall thickenings in the carpophore furrow (×725).

Fig. 19. – *Angelica archangelica*: mesocarp cells with reticulate wall thickenings in the powdered drug (×5,100).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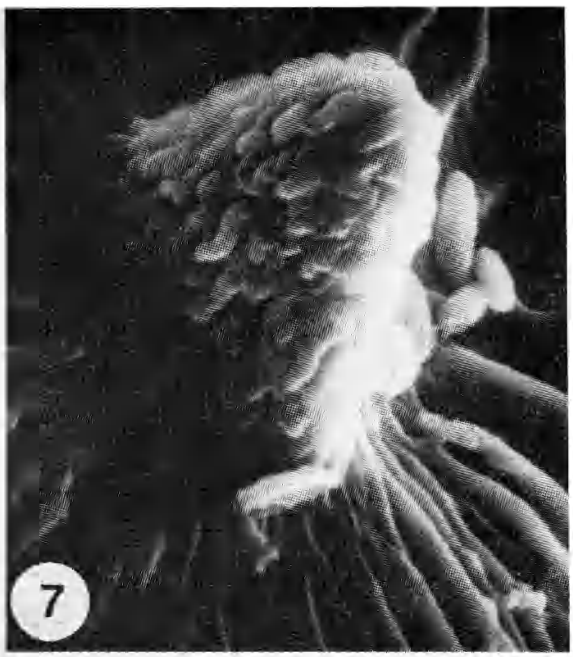
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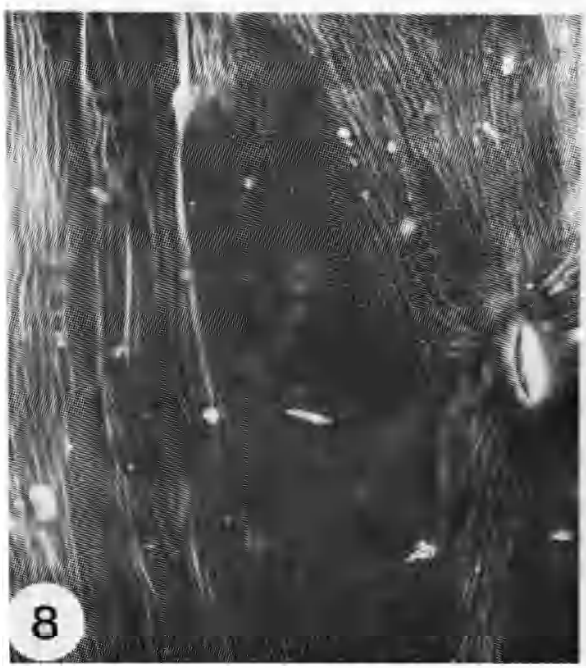
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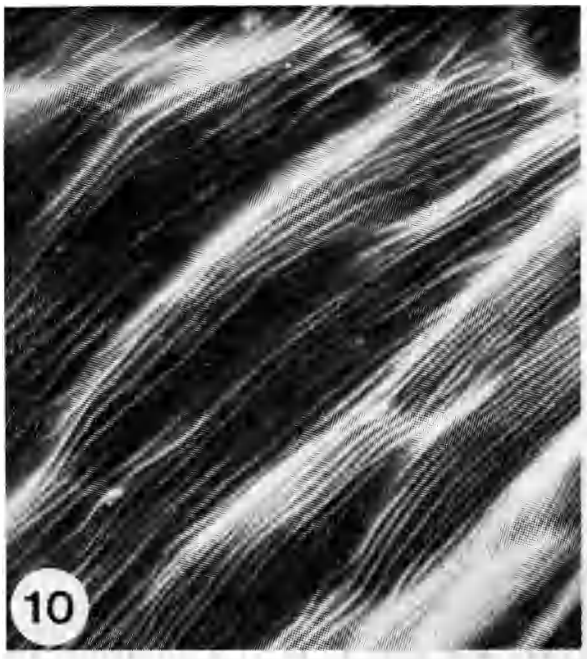
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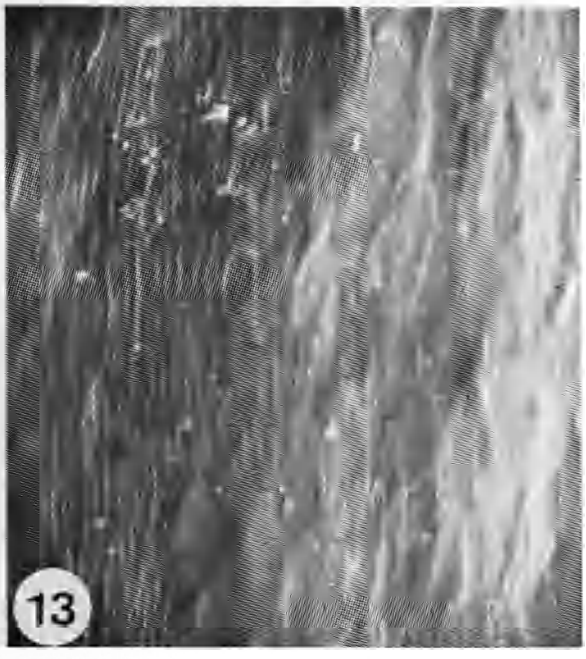
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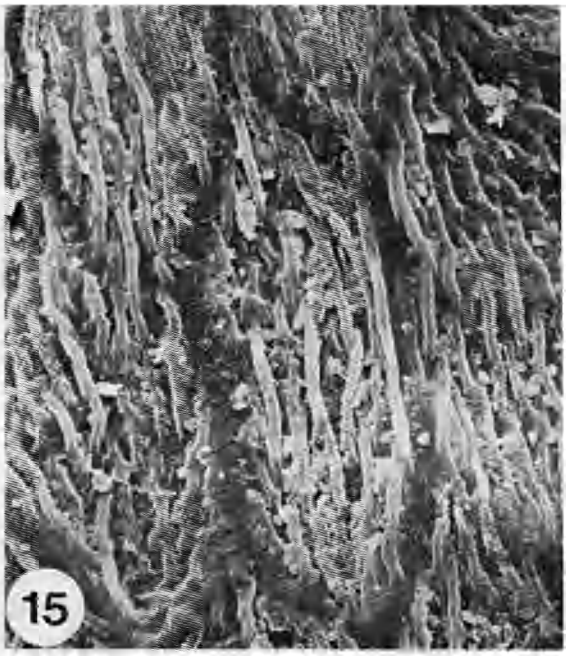
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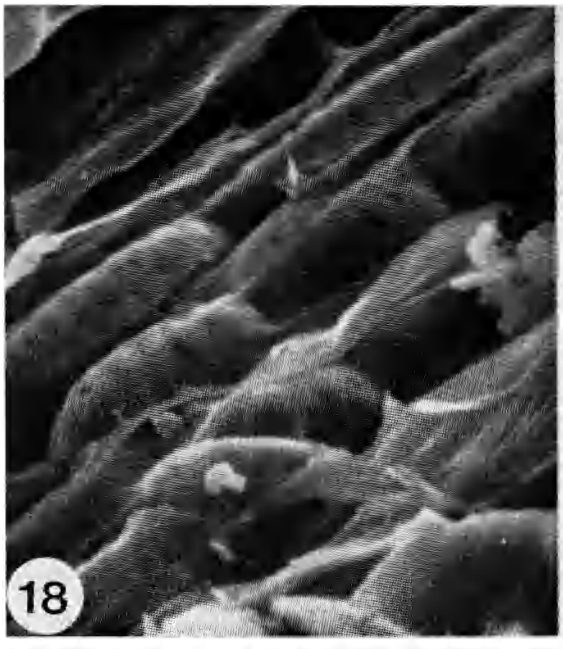
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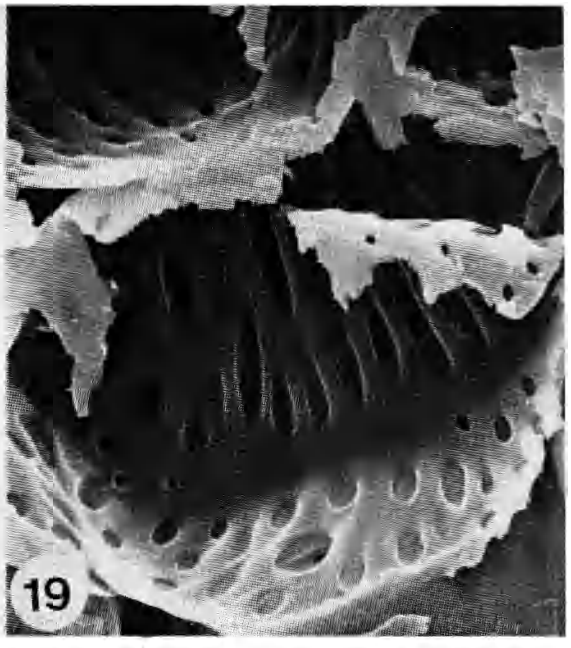
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