ACTA PALAEOBOTANICA

XVIII (1): 37—44, 1977

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NEW HERBS DESCRIBED FROM THE TERTIARY OF POLAND

Nowe rośliny zielne opisane z trzeciorzędu Polski

ABSTRACT. Seeds of *Gratiola tertiaria* n. sp. *(Scrophulariaceae)* and *Campanula palaeopyramidalis* n. sp. *(Campanulaceae)* and fruits of *Acorellus distachyoformis* n. sp. *(Cyperaceae)* have been found in the Miocene deposits from Nowy Sącz Basin (West Carpathians). The last of these species occurs also in the Miocene and Pliocene of the Nowy Targ Basin (Czarny Dunajec, Koniówka and Domański Wierch).

INTRODUCTION

The seed-and-fruit flora obtained with the help of bores (cf. Oszczypko & Stuchlik 1972) from the Miocene deposits of the Nowy Sącz Basin contains many herbs, which together with cryptogams constitute as much as 70 per cent of the total. Taxa found in the Tertiary of Poland for the first time and species hitherto unknown from the Tertiary are relatively numerous among them. These last are, among others, *Gratiola tertiaria* n. sp. *(Scrophulariaceae)*, *Campanula palaeopyramidalis* n.sp. *(Campanulaceae)* and *Acorellus distachyoformis* n. sp. *(Cyperaceae)*.

The scanning photographs of fossil seeds and fruits and of related modern species included in this paper were made at the Marceli Nencki Institute of Experimental Biology, Polish Academy of Sciences, in Warsaw.

Family *SCROPHULARIACEAE*

Genus *Gratiola* L.

Gratiola tertiaria n. sp.

Pl. I, figs. 1—3; Pl. II, fig. 1

Locality: Nowy Sącz II, samples Nos. 30 and 31 (at a depth of 42—44 m).

Material: 3 seeds and 1 seed fragment, stored in the collection of the Palaeobotanic Museum, Institute of Botany, Polish Academy of Sciences, in Cracow.

Description: Seeds small, about 0·8 mm in length and about 0·3 mm in width. Measurements of two specimens fit for measuring: 0·65 × 0·35 and 0·63 × 0·3 mm. Seeds elongate, cylindrical, somewhat asymmetrical, with obliquely truncated base and narrowed top. The seed surface is covered with a thick network made up of projecting sharp-edged ridges. Six to seven meshes of this network go into the diameter of either side surface of the seeds, which underwent a flattening in the course of fossilization. Tetra- to hexagonal meshes are arranged in fairly regular longitudinal rows. The seed testa is thin and brittle, the surface finely spotted, brown in colour.

Comparison: Seeds similar in shape, size and sculpture occur in the families *Scrophulariaceae* and *Gentianaceae*, and also *Lentibulariaceae*. The fossil seeds most resemble the seeds of the genus *Gratiola* of the family *Scrophulariaceae*, in which the surface ridges are thick but not very high. The genus *Chlora* of the family *Gentianaceae* has these external ridges higher and as if with membranous wings, and in the genus *Centaurium* the seeds are more rounded, the meshes of the surface network elongate and arranged in less regular rows. In the genus *Pinguicula* of the family *Lentibulariaceae* the meshes are considerably smaller and more delicate.

Now the genus *Gratiola* numbers about 20 species, widely distributed in the temperate zone and in the mountains of the tropics (Melchior 1964). Only one of this species, *G. officinalis* L. occurs in Central and South Europe. This Eurasian species grows in the lowlands and at low altitudes in the mountains, on the banks of waters and in swampy meadows. Although the specimens from the Miocene of Nowy Sącz much resemble the seeds of this species, they cannot be related to it, because we lack comparative materials of seeds of other, so numerous, modern species.

Occurrence: This genus has not hitherto been described from the Tertiary. The seeds of *G. officinalis* L. have been found in the Holocene formations near Uralsk on the River Ural (Kac *et al.*, 1965, Table 93, Fig. 11).

Family *CAMPANULACEAE*

Genus *Campanula* L.

Campanula palaeopyramidalis n. sp.

Pl. III, figs. 1—3; Pl. IV, fig. 1

Locality: Nowy Sącz I, sample No. 278 (at a depth of 285·6—286·8 m).

Material: 3 seeds, stored in the collection of the Palaeobotanic Museum, Institute of Botany, Polish Academy of Sciences, in Cracow.

Description: Seeds measuring 1·25—1·5 × 0·5—0·7 mm, longitudinally cylindrical in shape, somewhat narrowed and rounded at base, horizontally trun-

cated at top and a little damaged, which shows a relatively great thickness of the seed testa. The seeds are mat greyish, brittle and delicate, as if frothy. All the three specimens have irregular longitudinal folds and indents, which indicates that originally they were longitudinally cylindrical in shape. The external surface of the seeds is covered by a network composed of large polygonal cells, distinctly elongated in a direction parallel to the seed height in some places and shorter, almost equilateral in other places (notably at the base). The walls of these cells are clear-cut and relatively high, and the spaces enclosed within them are light-grey in colour and subtly opalescent. This is a characteristic network of large and sharp-edged meshes, differentiated in shape and not arranged in regular longitudinal rows.

Comparison: The identification of the remains described was not easy, although they are relatively well preserved and have very specific sculpture. Structurally similar seeds happen in the families *Gentianaceae*, *Scrophulariaceae* and *Saxifragaceae*, but I failed to find any specimens corresponding to the fossil specimens from Nowy Sącz unreservedly.

Seeds with a very similar morphological structure and a reticular structure of the surface occur in some species of *Campanula* in the family *Campanulaceae*, although most of the numerous (about 300) species of this genus living today have almost smooth and only gently longitudinally ridged seeds, which is not visible but under the high power of the microscope.

In the available comparative materials (87 taxa, including cultivated varieties) I found seeds strikingly resembling the fossil specimens in size, shape and surface structure, namely, those of *C. pyramidalis* L., which now occurs in Lombardy, Istria, southern Kranj province, Croatia and Dalmatia in the Mediterranean. The fossil seeds, with deep longitudinal grooves on the surface, give the impression of being somewhat broader than the recent ones. Moreover, the meshes on the surface of the fossil seeds have their walls slightly lower than in the recent specimens. However, these differences are not distinct and, in great part, they can be explained by distortion and damage in the course of the fossilizing process. Neither is the difference in the size of meshes of the surface network, seen in micrographs obtained with the scanning microscope, of essential importance (Pl. IV, figs. 1, 2), because it results from the inadequate selection of fossil material. In taking scanning microphotographs one destroys the remains being photographed and for this reason the best-preserved seeds with meshes of the surface network equal in size to those in recent specimens were not employed. The great similarity of seeds, representing the type rarely met with in the genus *Campanula*, permits the supposition that the newly described species, *C. palaeopyramidalis*, is a Tertiary counterpart of the species *C. pyramidalis* L., now living in the Mediterranean.

C. pyramidalis is a species which has a great ecological amplitude, e. g. in the valley of the River Isonzo it occurs at an altitude of 150—200 m, beside such plants as *Tamus communis* L., *Ruscus aculeatus* L., *Eryngium amethystinum* L., *Andropogon gryllus* L. etc. and in the valley of the River Idrica it

grows at an altitude of 450 m, together with subalpine and alpine plants (cf. Hegi VI/1, p. 345). It is a bi- to triennial plant with large blue-violet flowers arranged in a high pyramid. It is often grown in gardens as a decorative plant.
Occurrence: Seeds of *Campanula* corresponding in structure to those under description have never been reported from fossil materials before.

Family *CYPERACEAE*

Genus *Acorellus* Palla

Acorellus distachyoformis n. sp.

Pl. V, figs. 1—9

Localities: Nowy Sącz I, samples Nos. 134, 286, 291, 301, 303, 348, (at depths of 137—138 m, 295·4—296·9 m, 302·2—303·4 m, 315·2—3 16·3 m 319—320·4 m and 427·5—429·5 m);
Nowy Sącz II, samples Nos. 18 and 33 (at depths of 22·1—23 m and 47·8—50 m);
Domański Wierch, about 25 samples from a depth of 23—175 m;
Czarny Dunajec, samples from bore-hole;
Koniówka, samples from bore-hole.

Material: Nowy Sącz — 9 fruits and 6 fragments, Domański Wierch — about 190 fruits, Czarny Dunajec and Koniówka — unknown number, since the materials from the bore-holes had not been sorted yet. All the specimens are in the possession of the Palaeobotanic Museum, Institute of Botany, Polish Academy of Sciences, in Cracow.

Description: The fruits are 1·2—1·5(1·8)×0·7—0·95 mm in dimensions and bilaterally flattened, one side being often longitudinally creased, which points to the fact that originally it was more convex than the opposite side; the cross-section of these fruits was a one-sidedly convex lens in outline. The fruits are elliptic-rhomboid in shape, truncated at the top, almost flat and also bluntly truncated or slightly concave at the base. The greatest width of the fruit is usually below and only sometimes at its equator. A very delicate, short and narrow beak occurs in the small semicircular depression at the top. The beak is often destroyed. Longitudinal rows of small, thin-walled, 4—6-sided cells can be seen on the external surface of the fruit (Pl. V, fig. 4a).

Comparison: The fossil fruits resemble some species of the genus *Carex*, with two-sidedly flattened nuts, from which they however differ clearly in the structure of the top part, where in most species of the genus *Carex* there are "beaks", usually thick and sturdy and of various length. These are the basic parts of the style and have a structure similar to that of the wall of the

pericarp. Sometimes they are in the form of a small thickening of the style base and then the nut has no beak but only a fairly broad, small and flat prominence at its top.

A beak similar to that in the fossil specimens under description, i. e. very small and delicate, cylindrical in shape and not connected with the pericarp, occurs in the fruits of the genus *Acorellus*, closely related to the genus *Cyperus* (Kowal 1958; Kowal & Marek 1961). Seven species, of which three, *A. pannonicus* (Jacq.) Palla, *A. laevigatus* (L.) Palla and *A. distachyus* (All.) Palla, occur in southern Europe (Palla 1907), have been included in the genus *Acorellus*. They are plants of wet environments and grow on river banks and at the edges of salty lakes and marshes.

On account of their elongated shape the fossil fruits most resemble the fruits of *A. distachyus* (All.) Palla (= *Cyperus distachyos* All.), a Mediterranean species, which in the Nice region has its northernmost range in Europe. It grows also in northern Africa, Minor Asia, Central Asia, Iran and India (Szyszkin 1935). The fossil and recent fruits agree also in dimensions, but there happen exceptionally big fossil specimens, which reach a length of 1·8 mm, whereas the fruits of *A. distachyus* (All.) Palla, judging by the comparative materials from Ashkhabad in Turkmenia, do not exceed 1·6 mm in length.

Occurrence: This genus has never been reported from fossil materials before.

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STRESZCZENIE

NOWE ROŚLINY ZIELNE OPISANE Z TRZECIORZĘDU POLSKI

Flora owocowo-nasienna, występująca w osadach mioceńskich Kotliny Sądeckiej, zawiera dużo szczątków roślin zielnych, a wśród nich nowe dla trzeciorzędu. Należą do nich m. in. *Gratiola tertiaria* n.sp. (*Scrophulariaceae*), *Campanula palaeopyramidalis* n.sp. (*Campanulaceae*) i *Acorellus distachyoformis* n.sp. (*Cyperaceae*).

Nasiona *Gratiola tertiaria* n. sp. wykazują znaczne podobieństwo do szeroko dziś rozpowszechnionego na północnej półkuli gatunku *G. officinalis* L., którego nasiona są znane w stanie kopalnym z holocenu okolic Uralska w Kazachstanie. Nasiona *Campanula palaeopyramidalis* n. sp. mają budowę zbliżoną do gatunku śródziemnomorskiego *C. pyramidalis* L. Tego typu nasiona, bardzo rzadkie u gatunków współczesnych rodzaju *Campanula*, nie były do tej pory znane w stanie kopalnym. Budowa owocków *Acorellus distachyoformis* n. sp. wskazuje na wyraźne pokrewieństwo z euroazjatyckim gatunkiem *A. distachyus* (All.) Palla. Rodzaj *Acorellus* nie był dotychczas wyróżniany w stanie kopalnym.

Dwa z nowo opisanych gatunków, tj. *Gratiola tertiaria* n.sp. i *Campanula palaeopyramidalis* n.sp., występują tylko w miocenie Kotliny Sądeckiej, natomiast trzeci gatunek — *Acorellus distachyoformis* n.sp. — został stwierdzony także w osadach pliocenu (Domański Wierch) i neogenu (Czarny Dunajec, Koniówka) Kotliny Nowotarsko-Orawskiej.

PLATES

TABLICE

Plate I

1—3. *Gratiola tertiaria* n. sp., Nowy Sącz II, 31. Seeds; × 50
1a. *Gratiola tertiaria* n. sp.; × 100
1b. *Gratiola tertiaria* n. sp.; × 150 (skanning)
3a. *Gratiola tertiaria* n. sp.; × 100
4. *Gratiola officinalis* L. Holocene seeds from Uralsk on the River Ural; × 50
5—8. *Gratiola officinalis* L. Recent seeds; × 50
9. *Gratiola officinalis* L. Recent seed; × 150 (skanning)

Tablica I

1—3. *Gratiola tertiaria* n. sp., Nowy Sącz II, 31. Nasiona; × 50
1a. *Gratiola tertiaria* n. sp.; × 100
1b. *Gratiola tertiaria* n. sp.; × 150 (skanning)
3a. *Gratiola tertiaria* n. sp.; × 100
4. *Gratiola officinalis* L. Nasiona holoceńskie znad rzeki Ural; × 50
5—8. *Gratiola officinalis* L. Nasiona współczesne; × 50
9. *Gratiola officinalis* L. Nasienie współczesne; × 150 (skanning)


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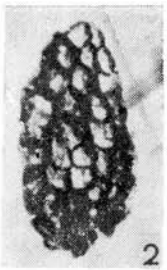
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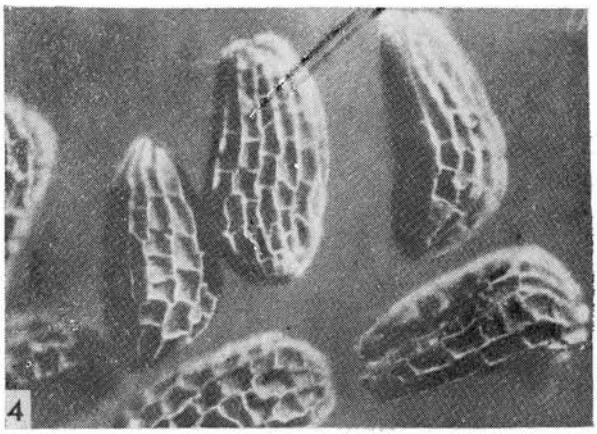
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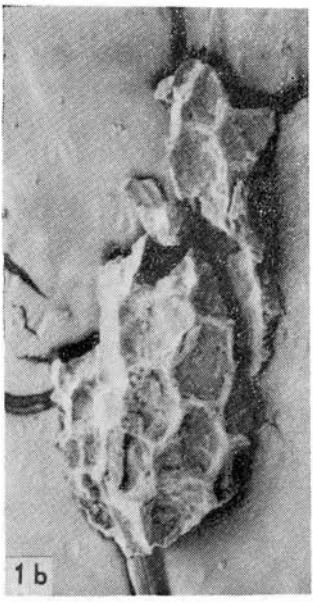
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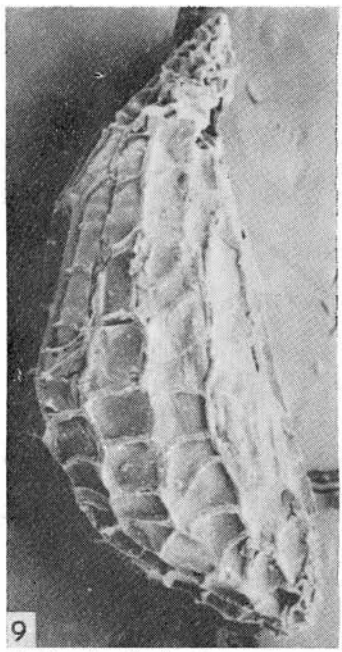
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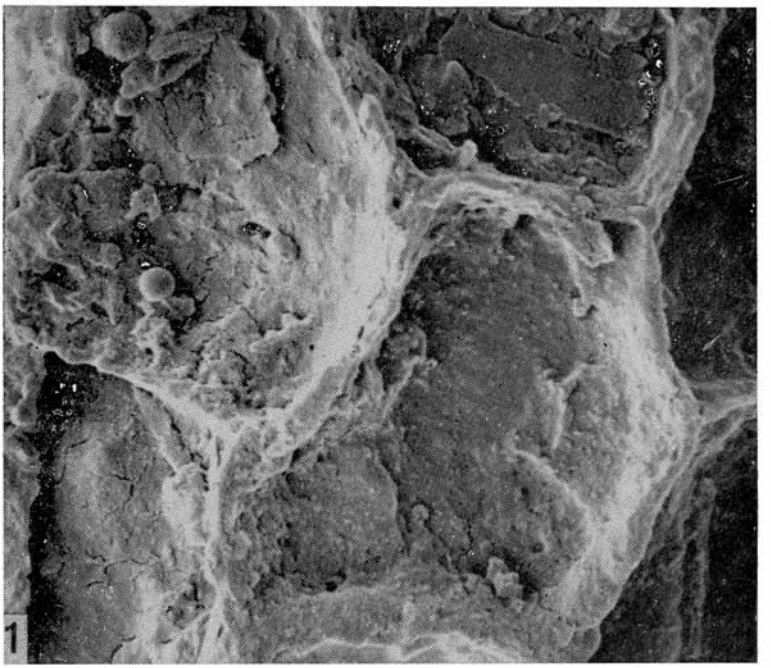
Plate II

1. *Gratiola tertiaria* n. sp., Nowy Sącz II, 31. Sculpture of seed surface; × 750 (skanning)
2. *Gratiola officinalis* L. Sculpture of recent seed surface; × 750 (skanning)

Tablica II

1. *Gratiola tertiaria* n. sp., Nowy Sącz II, 31. Skulptura zewnętrzna nasienia; × 750 (skanning)
2. *Gratiola officinalis* L. Skulptura zewnętrzna nasienia współczesnego; × 750 (skanning)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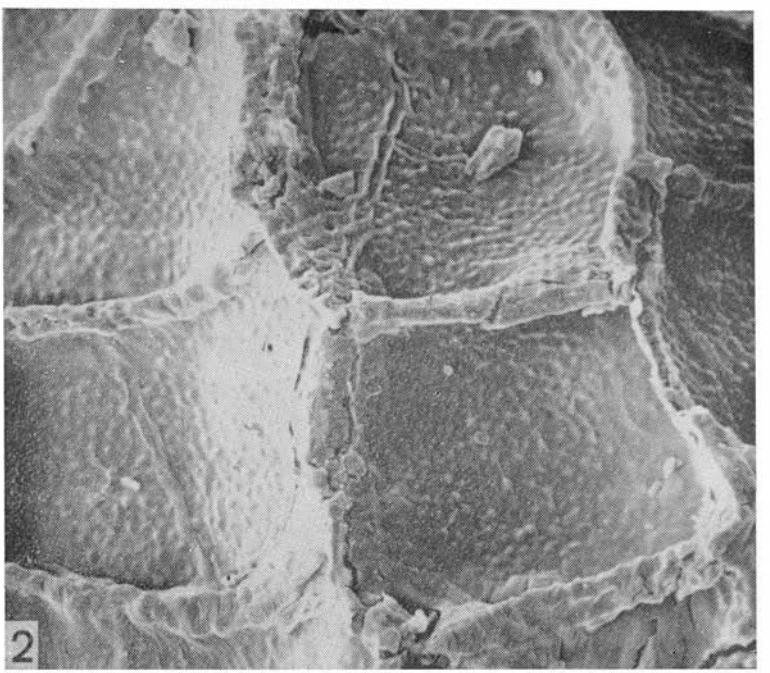
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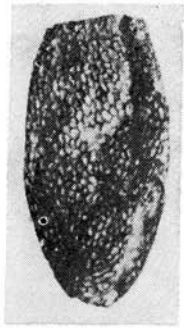
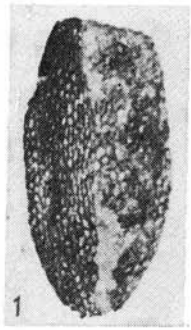
Plate III

1—3. *Campanula palaeopyramidalis* n. sp., Nowy Sącz I, 278. Seeds; × 28
1a. *Campanula palaeopyramidalis* n. sp.; × 55
1b. *Campanula palaeopyramidalis* n. sp.; × 65
1c. *Campanula palaeopyramidalis* n. sp. Schemae of seed sculpture; × 65
4—6. *Campanula pyramidalis* L. Recent seeds; × 30
7. *Campanula pyramidalis* L. Recent seed; × 70 (skanning)

Tablica III

1—3. *Campanula palaeopyramidalis* n. sp., Nowy Sącz I, 278. Nasiona; × 28
1a. *Campanula palaeopyramidalis* n. sp.; × 55
1b. *Campanula palaeopyramidalis* n. sp.; × 65
1c. *Campanula palaeopyramidalis* n. sp. Schemat budowy skulptury zewnętrznej nasienia; × 65
4—6. *Campanula pyramidalis* L. Nasiona współczesne; × 30
7. *Campanula pyramidalis* L. Nasienie współczesne; × 70 (skanning)

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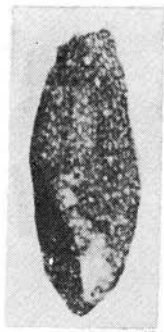

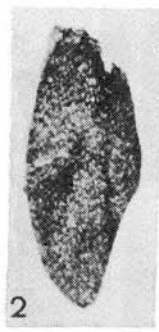
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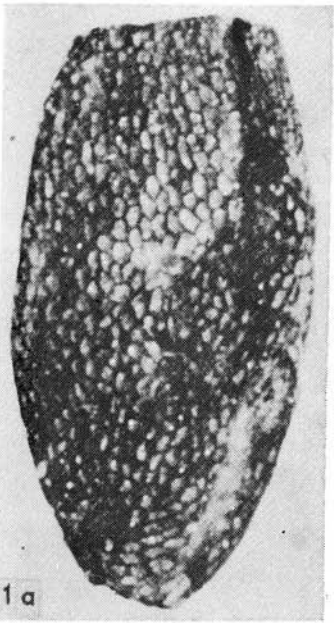
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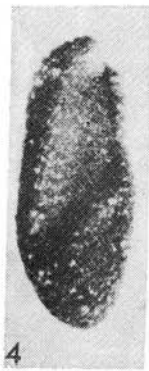
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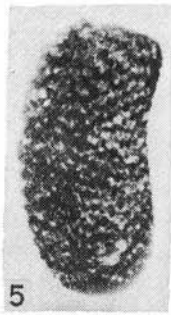
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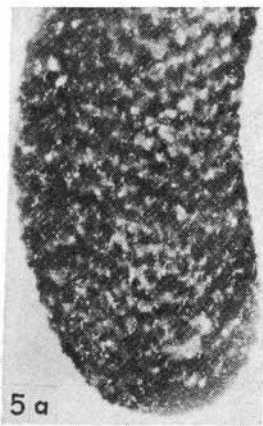
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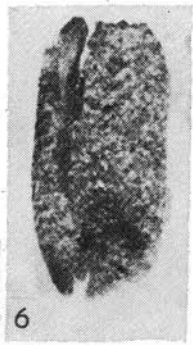
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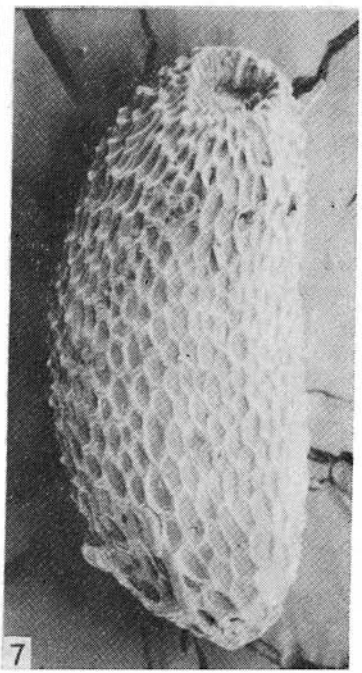
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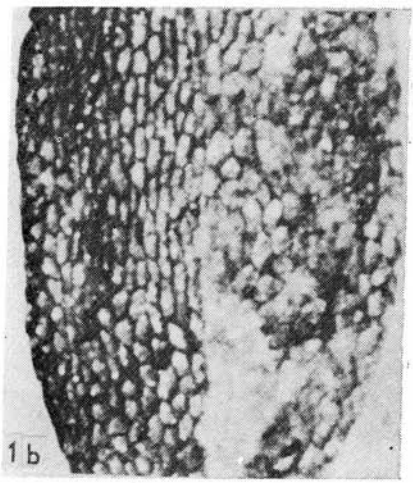
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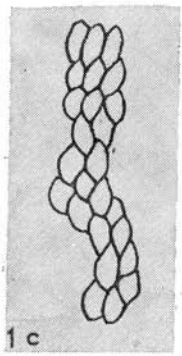
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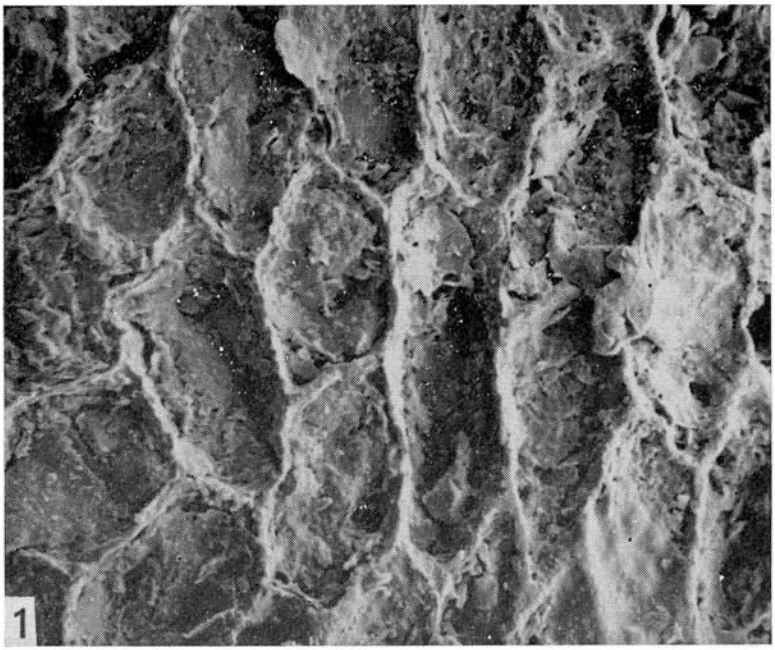
Plate IV

1. *Campanula palaeopyramidalis* n. sp., Nowy Sącz I, 278. Sculpture of seed surface; × 750 (skanning)
2. *Campanula pyramidalis* L. Sculpture of recent seed surface; × 750 (skanning)

Tablica IV

1. *Campanula palaeopyramidalis* n. sp., Nowy Sącz I, 278. Skulptura zewnętrzna nasienia; × 750 (skanning)
2. *Campanula pyramidalis* L. Skulptura zewnętrzna nasienia współczesnego; × 750 (skanning)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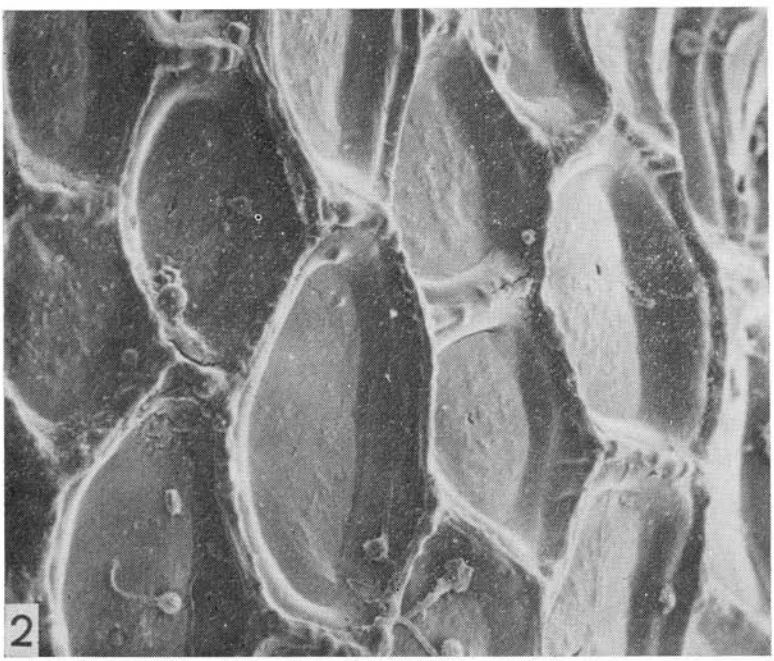
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Plate V

1—3. *Acorellus distachyoformis* n. sp., Nowy Sącz I, II. Fruits; × 23
1. Specimen from the sample Nowy Sącz I, 286
2. Specimen from the sample Nowy Sącz II, 33
3. Specimen from the sample Nowy Sącz I, 348

4. *Acorellus distachyoformis* n. sp., Nowy Sącz. Fruit; × 50 (skanning)

4a. *Acorellus distachyoformis* n. sp., Nowy Sącz. Sculpture ot seed surface; ×450 (skanning)

5—8. *Acorellus distachyoformis* n. sp., Domański Wierch, sample 28, Pliocene. Fruits; × 20

9. *Acorellus distachyoformis* n. sp. Schemae of tbe top part of fruits

10—13. *Acorellus distachyus* (All.) Palla. Recent fruits; × 20

14. *Acorellus distachyus* (All.) Palla. Recent fruit; × 50 (skanning)

Tablica V

1—3. *Acorellus distachyoformis* n. sp., Nowy Sącz I, II. Owoce; × 23
1. Okaz z próby Nowy Sącz I, 286
2. Okaz z próby Nowy Sącz II, 33
3. Okaz z próby Nowy Sącz I, 348

4. *Acorellus distachyoformis* n. sp., Nowy Sącz. Owoc; × 50 (skanning)

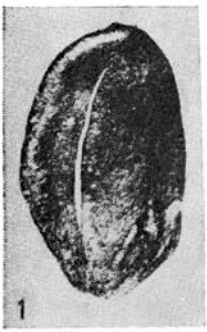
4a. *Acorellus distachyoformis* n. sp., Nowy Sącz. Skulptura zewnętrzna owocu; × 450 (skanning)

5—8. *Acorellus distachyoformis* n. sp., Domański Wierch, próba 28, pliocen. Owoce; × 20

9. *Acorellus distachyoformis* n.sp. Schemat budowy części wierzchołkowej owoców

10—13. *Acorellus distachyus* (All.) Palla. Owoce współczesne; × 20

14. *Acorellus distachyus* (All.) Palla. Owoc współczesny; × 50 (skanning)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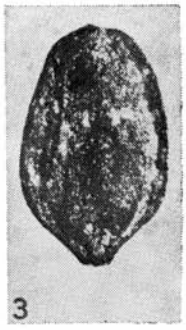
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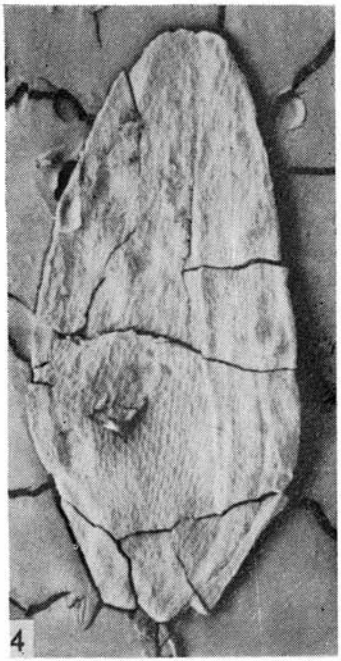
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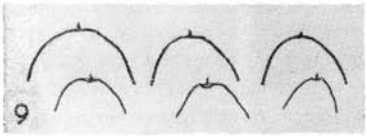
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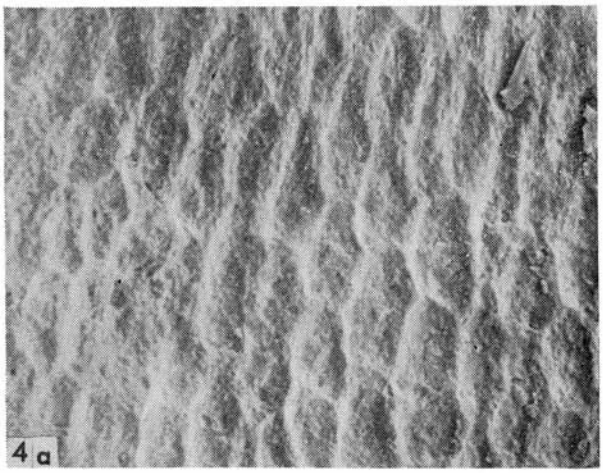
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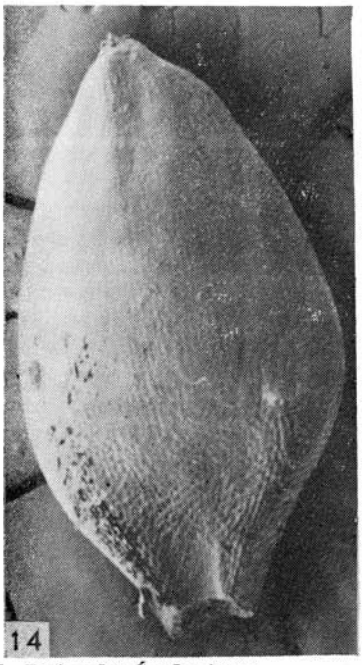
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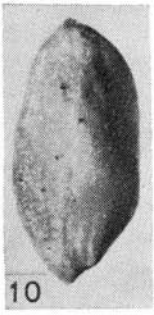
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