SBORNÍK NÁRODNÍHO MUZEA V PRAZE
ACTA MUSEI NATIONALIS PRAGAE
Volumen XXX B (1974), No. 1-2
REDAKTOR JIŘÍ ČEJKA

ANTONÍN HLUŠTÍK
Moravské muzeum Brno

CONTRIBUTION TO THE SYSTEMATIC AND LEAF ANATOMY OF THE GENUS DAMMARITES PRESL IN STERNBERG

INTRODUCTION

Presl (in Sternberg 1838: 203, Pl. 52, figs. 11, 12) described an interesting plant remain from the Upper Cretaceous sandstones near Nový Bydžov (Bohemia). It is a flattened sandstone cast of a sphaeric cone-like body. The disk-shaped cast is about 45 mm long and 54 mm wide and covered by spirally arranged rhombic flat scale-like projections (Pl. 1, figs. 1, 2). After comparison with similar organs of living plants Presl was sure to find out affinities to the fossil to the family *Araucariaceae*. He named it *Dammarites albens* PRESL taking its identity with the cones of recent *Agathis* spp. for granted.

Later many authors expressed their opinion as to the systematic and nature of this problematical fossil. Renger (1866) quoted the Czech translation of Corda's manuscript in which allegedly similar cone was described as *Krannera mirabilis* independently on Presl's description. Velenovský (1885) and Bayer (Frič and Bayer 1900, 1902) also mentioned Corda's work to be deposited in the library of the Department of Botany in the National Museum, Prague. The author has searched for this manuscript without any success. It seems to be lost. Velenovský (l. c.) preferred Corda's binominal although it was not published and Presl's name has an evident priority. In this way the name *Krannera mirabilis* has come into current practise in paleobotanical literature. Nevertheless after *The Code of Nomenclature Dammarites albens* was validly published and it will therefore be used in this paper as a correct name instead of *Krannera mirabilis*.

The author wants to sum up the data known until now and to present his new investigation concerning *Dammarites* PRESL.

DESCRIPTION

Cone-like casts

The sandstone casts with the structure of *Dammarites albens* show various kinds of preservation. They originate from the Upper Cretaceous deposits of Bohemia and Poland (Cenomanian). In the palaeobotanical collection of the Department of Palaeontology in the National Museum in Prague (Czechoslovakia) there are deposited about 35 specimens. They differ not only in the degree of preservation, but also in the morphology of their surface. After the detailed studies of the above mentioned specimens the morphology can be described as follows.

The cone-like casts are egg-shaped to globular, sometimes with distinctive stalk-like remains at the base. If the "stalk" is preserved it is up to 20 mm long. Most often it is broken off near the "cone" base. In these cases only a roundish scar of the "stalk" is observable. It is about 10 mm in diameter (Pl. 2, fig. 1, Pl. 4, fig. 5, Pl. 5, figs. 1—6, Pl. 6, figs. 2, 3). The "cones" are obviously compressed in disk casts or in various incompletely fossilized sphaeric bodies (Pl. 1, figs. 1, 2, Pl. 2, Pl. 3, figs. 1, 2, Pl. 4, figs. 2, 4, 5, Pl. 5, figs. 1—6, Pl. 6, figs. 1—3). Sometimes only a part of the "cone" surface is impressed in the sandstone (Pl. 1, figs. 3, 4, Pl. 3, figs. 4, 5, Pl. 4, figs. 1, 3, Pl. 7). Two rare claystone impressions are also known from the Cenomanian of Bohemia (e. g. Pl. 7). The casts were found mainly during the work in sandstone quarries. Their outer impressions were probably broken by stonebreakers. Because of that collectors got mostly isolated casts and earlier authors first described the cast surface.

The surface is formed by rhombic scale-like projections, more or less clinging together (Pl. 1, figs. 1—3, Pl. 2, Pl. 3, figs. 1, 2, 4, 5, Pl. 4, figs. 1—5, Pl. 5, Pl. 6, figs. 1—3, Pl. 7). They are arranged in the spirals round the "cone" axis. The calculation of the divergence of the scale-like projections shows the ratio 8/21. In all measured cones the scales are arranged in eight and thirteen spiral rows — parastichi — running sinistraly or dextrally (Fig. 7). It was caused by pushing down sinistral or dextral genetic spiral. In Presl's holotype (Pl. 1, figs. 1, 2) the scales cling together, but in the collection there are other specimens with the protruding ones (Pl. 1, fig, 3, Pl. 3, fig. 5, Pl. 4, fig. 3). This fact gives a chance to observe other details. On the abaxial side of the projections there are transversal grooves (Pl. 1, fig. 3, Pl. 3, fig. 2, 4, Pl. 7) and small pits above them (Pl. 1, fig. 3, Pl. 4, fig. 2, Pl. 6, fig. 1). The adaxial side of each projection can be more or less perpendicularly wrinkled (Pl. 3, fig. 5, Pl. 4, fig. 3, Pl. 7, fig. 3). Neither the scale-like projections clinging together nor the protruding ones are distinctly limited to each other — no free spaces were observed between them. They project from the entire surface (Pl. 1, figs. 1—3, Pl. 3, figs. 2, 4, Pl. 4, figs. 2—5, Pl. 7). The inner structure of the cone-like casts is not well known. In one badly preserved specimen from the Vyšerovice locality radial and narrowly pyramidal cavities can be seen corresponding to the surrounding surface projections (Pl. 6, fig. 2, 3). Another specimen from the Cenomanian sandstones from Mšené near Budyně nad Ohří (Bohemia) bears

some remains of wood-like structures fossilized by limonite. These traces seem to support the interpretation of Velenovský (1885) — see Discussion, p. 54. — but they are rather doubtfull. We have no more convincing evidence as to the inner structure of the casts. It is cenceivable according to the fossilizing sandstone material.

In the specimens with the preserved stalk-like remains (Pl. 5, figs. 5, 6) as well as in bald stems belonging probably to *Dammarites albens* there are sometimes observable the traces of leaf scars. On both bald and stalk-like stems the leaf scars are arranged in divergence ratio 2/5. These calculations, however, must be corrected. The detached bald stems are assigned to *Dammarites albens* on the basis of collector's opinion only.

Goeppert (1841) described similar cone-like casts from the sandstones near Schömberg Silesiae (l. c. p. 122, Pl. 53, fig. 3) and named it *Dammarites crassipes.* He established the difference between *D. albens* and *D. crassipes* on the basis of the shape of "stalk" of *D. crassipes.* Corda (in Reuss 1846) expressed his correct opinion as to the identity of both species. I have studied only the photographs of a plastic cast of Goeppert's holotype and found the surface structure of both species to be identical (Pl. 2, figs. 1—2). Similarly the shape of stalk of *D. crassipes* resembles that of *D. albens.* Some slight differences might have arisen secondarily in the sediment, or they can be explained as natural variability.

A very interesting sandstone cast is described and figured in Schimper (1870: 255, Pl. 76, fig.2) from the Cretaceous sediments near Nogent-le-Rotrou, north-east of Le Mans, France. It was named *Araucaria cretacea* BRONGNIART. The surface morphology of the specimen seems to be similar to *Dammarites albens.*

Leaves

The systematic and morphological interpretation of *Dammarites albens* is complicated by the casts and impressions in which leaflike remains are preserved. Renger (1866, Pl. 1, fig. 3) first figured such cast with distinctive leaf-like impressions. Later Velenovský (1885, Pl. 1, figs. 1—7, Pl. 4, fig. 4) described and figured isolated long ribbon-shaped leaves from the Cenomanian sandstones near Nehvizdy (east of Prague). Many such detached leaf remains have been found in the Cenomanian claystone and sandstone freshwater beds (Peruc Formation) in Bohemia up to now. In 1965 I got an important claystone impression of the cone-like body with carbonized leaves in natural position. My colleague dr. Drábek happened to find this specimen in the brickkiln quarry near Hloubětín in Prague (Pl. 7, figs. 1—3). The specimen originates from a lower dark claystone deposit above the basal sandy sediment. The claystone is impregnated by pyrite and sulfates. Because of the presence of water horizon the fossil is rather dammaged by sulfatic solutions. Nevetheless the cuticle of the leaves was obtained and macerated. At the same time I macerated the cuticles of similar ribbon-shaped leaves solitarily found in the same sediment. On the basis of the comparison between the sand-

stone and claystone specimens the leaf morphology and epidermal structure can be described as follows.

Morphology

Single, oblongly lanceolate to ribbon-shaped leaves up to 40 cm long (and probably more because of partly preserved specimens), 1—5 cm wide. The blade is bluntly pointed at the apex, rather narrowed and truncate at the base, somewhat keeled on the abaxial side (Fig. 0, Pl. 3, fig. 3, Pl. 4, fig. 6, Pl. 6, figs. 4, 5). The venation dense, parallel, containing probably interstitial veins (they can be recognized reliably neither in transverse sections nor in undermacerated leaves, although they were described by Velenovský 1885). The leaves were probably massive, rigid and protruding of the stem. The shape of the blade base conforming with the leaf-scars on bald stems as well as with the grooves on the scale-like projections of the casts. The leaves were, however, found in direct connection with the scale-like projections only. The connection with the scars on the "stalks" or bald stems is only supposed.

Epidermides

The leaves were heavily cutinized on both sides of the blade. The thickness of the cuticle varying from 0, 0035 mm to 0,0065 mm (0,005 mm on the average). The maceration is rather difficult because of cracked cuticles. The lower cuticle is slightly less cutinized and its elements are not clearly observable especially as to the organisation of the stomata. From this reason only the photographs of the epidermides are presented to eliminnate author's subjective errors (Pl. 8). Sometimes it is possible to observe traces of hypodermal cutinization. The use of phase-contrast observation has not revealed new details because of heavy cutinization. Similarly the state of preservation influenced the quality of light microscope photographs.

The upper epidermis is formed by elongated rectangular to oblongly hexagonal cells. The length of those varies from 0,018 mm to 0,091 mm (0.040 mm on the average), the width from 0,018 mm to 0,036 mm (Pl. 8, fig. 1). The cells are arranged in longitudinal wedge-shaped rows occasionally up to 2 mm long. The cutinization of the cell walls is different. Transversal walls are twice or more strongly cutinized (about 0,006 mm) than the lonigitudinal ones (from 0,0015 mm to 0,003 mm). The traces of hypodermal cutinization can be seen occasionally. Solitary stomata occur but rarely. Another kind of cells was not observed.

Lower epidermis is built of epidermal cells and stomata arranged in longitudinal rows. Large stomata are haplocheilic, perigenous, mostly amphicyclic, arranged in longitudinal single rows between non-stomatal areas. Stomatal apertures are orientated strictly longitudinally. The stomatal apparatus is built of two polar and two lateral subsidiary cells, which can be redoubled by the narrow ones (Pl. 8, figs. 2—6). The rows of stomata are from 0,060 mm to 0,080 mm wide (0,072 mm on the average). The length of stomata varies from 0,080 mm to 0,110 mm in the longitudinal (polar) direction. Ordinary epidermal cells are also

arranged in wedge-shaped rows between the stomatal areas. They are distinctly elongated, rectangular, narrow. The width of non-stomatal areas varies from 0,040 mm to 0,100 mm. The size of cells varies from 0,030 mm to 0,090 mm in length (0,055 mm on the average), and from 0,012 mm to 0,025 mm in width (0,018 mm on the average). Transversal cell walls are also more strongly cutinized like in the upper epidermis (Pl. 0, figs.0).

The described epidermides are of gymnospermic appearance (they recall closely coniferous hypostomatal leaves). The leaves obviously belong to the cone-like fossils determined as *Dammarites albens* PRESL (Pl. 7, figs. 1—3). Identical structures were observed in the leaves solitarily dispersed in the Cenomanian freshwater deposits as well as in the leaves found in direct connection to the above mentioned cone-like specimen from Hloubětín. On the basis of cuticular analysis Dammarites albens Presl can be determined as a gymnospermic plant.

SUPPLEMENT

Velenovský (1885: 5, Pl. 1, figs. 10—13, 18) described and figured flattened globular casts from the Cenomanian standstones near Nehvizdy (Bohemia). Roundish stalk-like traces are visible on the casts (Pl. 1, figs. 5—7). According to Velenovský's opinion the casts represent fruit remains of *Krannera mirabilis* CORDA in lit. They are about 3 cm in diameter, their surface smooth, sometimes covered by shallow depressions or irregularly corroded (Pl. 1, figs. 6, 7). They were collected solitarily detached in the sandstone among the leaves of D. albens. There is no evidence of their connection with the described fossil. Velenovský emphasized their resemblance to the fruits of *Cordaites spp.* It is rather surprising that the shape of the fruit-like casts resembles the shape of the "cones". This fact gives a chance to interpret the "fruits" as more or less corroded cone-like casts or as the casts of their inner part. Neither these presumptions nor Velenovský's suggestion have been proved. The problem may be explained after more convincing specimens have been found. For the time being the fruit-like casts cannot be included into the synonymy of *Dammarites albens.*

SYNONYMIC

Family *Kranneriaceae* CORDA in RENGER, 1866
(syn. *Dammaritaceae* KNOBLOCH, 1973)

Genus *Dammarites* PRESL in STERNBERG, 1838

1866 *Krannera* CORDA in RENGER, p. 133—135
1866 *Palaeostrobus* RENGER, p. 135—137
1873 *Lepidocaryopsis* STUR, p. 3

Type species

Dammarites albens PRESL in STERNBERG, 1838

Pl. 1—8, textfigs. 6—7

1838 *Dammarites albens* PRESL in STERNBERG, p. 203, Pl. 52, figs. 11, 12.

1841 *Flabellaria chamaeropifolia* GOEPPERT, p. 120, Pl. 52.
1841 *Dammarites crassipes* GOEPPERT, p. 122, Pl. 53, fig. 3.
1846 *Dammara albens* (PRESL) CORDA in REUSS, p. 92—93, Pl. 49, figs. 6—8.
1866 *Krannera mirabilis* CORDA in RENGER, p. 134—135, Pl. 1, fig. 1.
1866 *Pinus papyracea* CORDA ex RENGER, p. 137 (pro synonyme).
1866 *Palaestrobus mirabilis* (CORDA) RENGER, p. 137, Pl. 1, fig. 1.
1866 *Palaestrobus crassipes* (COEPPERT) RENGER, p. 137—138, Pl. 1, figs. 2—5.
1870 ? *Araucaria cretacea* BRONGNIART ex SCHIMPER, p. 255, Pl. 76, fig. 2.
1873 *Lepidocaryopsis westphaleni* STUR, p. 3.
1885 *Krannera mirabilis* CORDA in lit.: Velenovský, p. 1—6, Pl. 1, figs. 1—7, Pl. 4, figs. 1, 2, 4, 7—9 (non Pl. 1, figs. 10—13, 18 — *fruit like casts are excluded!*)
1917 *Pelourdea mirabilis* (CORDA) SEWARD, p. 281.

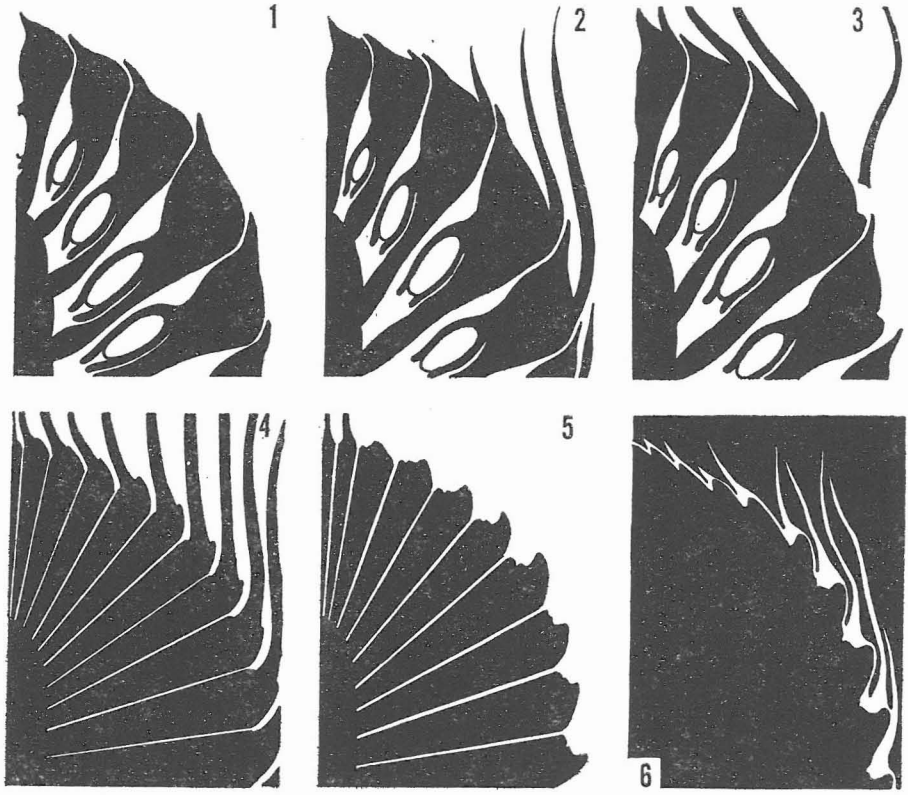
Note: In palaeobotanical literature some detached Araucarian cone scales are included in the genus *Dammarites* PRESL (Seward 1919, Knobloch 1964). There is no evidence that these solitarily found scales can be assigned to this genus (see also Knobloch, 1973).
Holotype: the specimen from Nový Bydžov (Neubidschow after Presl in Sternberg 1838) west of Hradec Králové, eastern Bohemia, Czechoslovakia, figured and described by Presl (in Sternberg 1838: 203, Pl. 52, figs. 11, 12) and refigured in Pl. 1, figs. 1, 2 in this paper. It is deposited in the palaeobotanical collection of the Department of Palaeontology, National Museum, Prague, under Inv. No. F 82. (The specimen Inv. No. E 177 was erroneously mentioned by Knobloch (1973) as Presl's holotype. Careful examiantion of all deposited specimens allowed me to designate the correct holotype.)
Stratigraphical range: The Upper Cretaceous of the Bohemian Massif, the Lower and Middle Cenomanian freshwater deposits (Peruc Formation) and the Upper Cretaceous of Poland.
Localities: Bohemia — Nový Bydžov, Nehvizdy, Kounice near Český Brod, Vyšerovice, Mšené near Budyně nad Ohří, Vojice near Jičín, Kralupy nad Vltavou, Hořice, Charvatce: sandstones: Praha-Chuchle?, Praha-Hloubětín, Kralupy nad Vltavou, Bohdánkov near Hodkovice nad Mohelkou, Lidice near Slaný; claystones. Poland — Chełmsko Śl. (Schömberg); ? the Cenomanian sandstones. (After Velenovský 1889, Frič and Bayer 1900, 1902, Presl in Sternberg 1838, Goeppert 1841, Velenovský and Vinklář 1931, and original field observation).

DISCUSSION

Principally *Dammarites albens* has been interpreted in two different ways. The interpretations tried to explain the nature of the "cones" without information of inner structure and leaf anatomy of the fossil.

1. The fossil represents some fossil female cones with relation to *Conifers,* especially to living *Araucariaceae* (Presl, Goeppert, Corda, Renger, Frič).

2. The fossil is a swollen part of the stem similarly as tuberous stems of *Cycads* (Velenovský).



Figs. 1—6

Schematical illustrations of different interpretations of *Dammarites albens* PRESL. 1 — Presl supposed that the casts represented fossil female cone with affinity to *Agathis*. 2, 3 — Renger considered the fossil to be a closely Araucarian cone covered by "stipules" (bract-scales) growing out of ovuliferous scales (2). Later the "stipules" fell off mature cone (3). 4, 5 — According to Velenovský's interpretation the cone-like stem is formed by crowded leaf scars bearing ribbon-shaped leaves at transversal grooves (4). Later the leaves fell off the stem (5). 6 — Ideal longitudinal section of the cast and outer impression as seen in the sandstone. Left — the cast with leaf scars, right — the outer impression with the remains of the leaves. White space indicates the most resistent structures of the fossil, which were the last to be destroyed. Fig. 1 is schematically sketched after Presl (in Sternberg 1838) and living Agathis sp. Figs. 2, 3 after Renger (1866, p. 135—137). Figs. 4, 5 modified after Velenovský (1885, Pl. 4, fig. 8). Fig. 6 is a reconstruction after several specimens. For explanation see Discussion. Sketched by the author.

These hypotheses were established with regard to the outer morphology of the sandstone cone-like casts and impressions. In the mentioned manuscript Corda established a new family *Kranneriaceae* with the genus *Krannera* and the species *Krannera mirabilis* (after Renger's verbal trans-

lation of Corda's manuscript 1866, p. 133—135). Corda provisionally assigned the fossil near to *Cycadales* and *Coniferales* considering it as a cone-like fruit incertae sedis. Later he accepted Presl's interpretation (Corda in Reuss 1846, p. 92—93). Similarly Goeppert (1841, p. 122, 1850, p. 237—238) respected the genus *Dammarites* and established a new species *Dammarites crassipes*. All these authors were more or less convinced of the affinities to the genus *Agathis* (Fig. 1).

Renger's interpretation (1866, p. 135—139) is rather strange. On the basis of different kinds of preservation he established a new genus *Palaeostrobus* with two species — *P. mirabilis* and *P. crassipes*.

The type specimen of *Kranera mirabilis* CORDA in RENGER (l. c. Pl. 1, fig. 1) with distanctively protruding "scales" and small pits between them was assigned to the species *Palaeostrobus mirabilis* (CORDA) RENGER (see Pl. 1, fig. 3).

Presl's holotype of *Dammarites albens* (l. c. Pl. 1, fig. 2) and Goeppert's species represent the species *Palaeostrobus crassipes* (GOEPPERT) RENGER (see Pl. 1, figs. 1, 2, Pl. 2). Renger also assigned *Pinus papyracea* CORDA ex RENGER and two other specimens from the Peruc Formation (l. c. Pl. 1, figs. 3, 4) to the same species — see Pl. 1, fig. 4, Pl. 3, figs. 1, 2.

Renger also supposed that the genus Palaeostrobus is a fossil cone with affinities to the genera *Araucaria* and *Agathis*. He rightly recognized that cone-like impression described as *Pinus papyracea* CORDA ex RENGER represented in fact an outer impression of the surface of *Dammarites albens*. In the specimen leaf impressions are observable (Pl. 1, fig. 4) similarly as in the second foliage cone-like cast figured by Renger (Pl. 3, fig. 1). As mentioned above these specimens were also assigned to the species *Palaeostrobus crassipes* (GOEPPERT) RENGER. Renger suggested three phases of the "cone" development of *P. crassipes* (figs. 2, 3) on the basis of the difference in preservation.

The juvenile phase is represented by the "cones" with clinging "scales" (as in Presl's holotype). During the next phase parallelly veined "stipules" grew out between the "scales" (as in the specimen of *Pinus papyracea* CORDA ex RENGER). Renger supposed that small pits between the "scales" represented the remains of vascular bundles penetraiting into the "stipules". In the third and ultimate phase the "stipules" fell off protruding "scales". The leaf impression in the cone-like fossils were interpreted as "stipules". In my opinion it would be better to call them bracteae (bract-scales) according to Velenovský's note (1885, p. 3).

This determination is rather confusing. The above mentioned phases of development were described on the basis of differently preserved specimens assigned by Renger to the species *Palaeostrobus crassipes* (GOEPPERT) RENGER. But the species *Palaeostrobus mirabilis* (CORDA) RENGER obviously represents the "third phase" with protruding "scales". Hence the specimens figured and described by Renger can be assigned to one species. In the mentioned collection of the National Museum in Prague there are specimens showing the transitional stages of the "cone" surface from clinging "scales" to protruding ones.

A. Frič (1871) published a reconstruction of the described "cone". He considered it to be a pine cone situated on a shoot bearing the spirally attached ribbon-shaped leaves.

The above mentioned interpretations regard *D. albens* as a fossil of female coniferous fructification (cone). Such presumption could have been confirmed by seed-like bodies or their impressions between the "cone scales". The authors, however, did not bring such evidence. Neither between the "scales" nor in the transverse sections of the "cones" any remains of seeds have been found. This interpretation is hardly acceptable also from another reason, Araucarian cones desintegrate into individual scales. It is most probable that also individual free scales of *D. albens* should have been found. Such phenomenon was not observed in this species. Somewhat morphologically similar cones are known from the English Jurassic (as also mentioned by Renger), but their Araucarian origin was proved (Seward 1919).

Renger's hypothesis cannot be accepted because the idea of an Araucarian cone (or closely Araucarian cone) with falling-off bractae ("stipules") is rather confusing. The bract-scales in *Conifers* are developed in an early stage, but later they either grew together with ovuliferous scales (*Araucariaceae*), or are persistent under ovuliferous scales (e. g. *Pinaceae*). In mature Araucarian cones the special processes of bract-scales can be seen. But they are not identical with the leaves observed in the "cones" of *Dammarites albens.*

The hypothesis suggested by Velenovský (1885, p. 2—3) takes this fact into consideration. The author did not believe the casts to be real cones He interpreted them as swollen parts of stems formed by crowded woody leaf scars. The author recognized approximately two phases of their development (Fig. 4, 5). At first swollen masive leaf scars grew aut of the stem (shoot) forming globular cone-like body. Long *Cordaites*-like leaves were attached in transversal grooves to the abaxial side of the scars. The pits above the scars can be interpreted as the remains of leaf traces. The second phase is characterized by shedding off the leaves. These two phases can be seen in different specimens. Moreover Velenovský speculates about the appearance of the living plant D. albens. He supposes it to be a low plant branching slightly or not at all, with a thin stem widening upwards into the described cone-like form. Coriaceous and ribbon-shaped leaves were situated in wood leaf scars. At this occassion the author remembers Saporta's *Bolbopodium pictaviense* from the Jurassic of France and tuberous stems of living *Cycads.* Seward (1919, p. 248) also suggests the possibility of comparing *D. albens* with *Cycadean* stems. On the contrary he does not believe that such stems could bear *Cordaites*-like leaves.

Velenovský's interpretation is supported mainly by the finds of completely preserved cone-like casts. The above mentioned specimen (Pl. 6, figs. 2, 3) from Nehvizdy, bears, however, the indication of radial pyramidal cavities directed to the central axis of the fossil like the scales. But the origin of the cavities cannot be proved and they could be hardly considered as real scales. Mostly the whole specimens or the impressions

of a part of their surface have been preserved (Pl. 1, figs. 1—4, Pl. 2, Pl. 3, figs. 1, 2, 4, 5, Pl. 5, fig 1). Probably they were solid, mostly woody (?). Partly preserved basal stalk-like stems suggest that cone-like bodies were breaking off. So far no more complete remains of the plant have been found. The original cone-like stem was dammaged during the transport, its leaves broken off. Further changes might occur in the sediment (decaying, rotting, compressing etc.). The individual leaves are found abundantly dispersed in sandstones and claystones. This fact suggests that they fell off. The leaves were stiff as inferred correctly by Velenovský (l. c., p. 3). Some broken leaves have been found in the sandstones, but always with the spread blade.

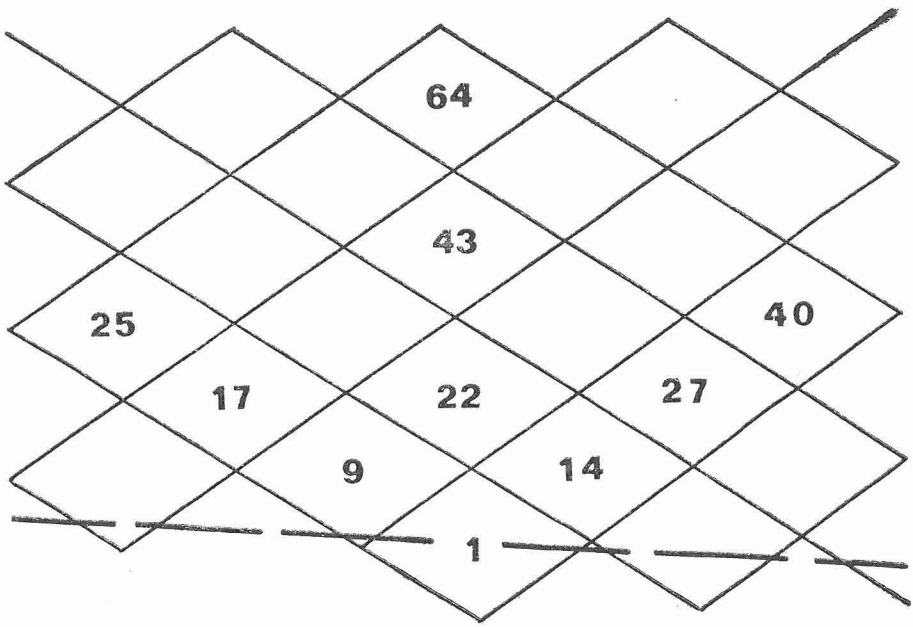


Fig. 7.
Arrangement of the leaf scars of *Dammarites albens* PRESL. Part of the conelike stem surface is transfered in the plane. Rhombs indicate the position of the scars, numbers show the succession of the cars in both sinistral and dextral spiral rows (parastichi — difference 8 and 13) as well as the succession in vertical rows (orthostichi — difference21). Dashed line indicates direction of sinistral genetic spiral. Divergence ratio 8/21 according to the calculations of original specimens. Magnified and sketched by the author.

The specimen from the claystones in the Hloubětín brickkiln Pl. 4, figs. 1—3) were sectioned longitudinally in order to ascertain how the leaves were attached to the leaf scars. Rather curved contour lines of the fossil surface on the side hidden in the sediment have revealed that the carbonized leaves are in fact connected with the leaf scars. The author is not quite sure what the pits between the leaf scars represent. The

structure is partly incompletely preserved and flattened, partly dammaged by irregular pyritization. Moreover precise sections cannot be prepared because of the surrounding sediment. It seems that the interior of the cone-like stems desinegrated earlier that the surface layers. Anatomical details could be explained only if a silicified (mineralized) specimen of *D. albens* was found (this kind of fossilization is adequate to that of *Tempskya varians* from the Cretaceous sandstones of Bohemia). It is surprising that the *Dammarites* fossils similarly petrified have not been found.

The question of the origin and systematic position of D. albens could be modified both by the above mentioned study of the stem anatomy and by the comparison of the epidermis of the leaves with those of living and fossil gymnosperms.

The epidermides of *Cycads* have a quite different structure. Neither the leaves of similar morphology occur among them (*Zamia*), therefore the affinity of the fossil to *Cycadales* is highly improbable. The analogy in the cuticle structure could be found rather in the *Cordaites* spp. and *Conifers.*

One of the outstanding features of the cuticle of *D. albens* is a rather close arrangement of large pores in single longitudinal rows regularly distributed on the whole surface of one side of the leaf. The cutinization of the pores is partly accented by a more cutinized ring along lateral subsidiary cells. Stomatal apertures are always longitudinally orientated. This phenomenon is met with both in living and extinct *Conifers.* Another situation is in the family Araucariaceae to which the cone-like stems have been assigned. The genus Araucaria has in section Colymbea the species with widely lanceolate hypostomatal leaves e. g. *Araucaria bidwillii,* but mostly they are amphistomatal. The longitudinally orientated stomata are not arranged in such outstanding single rows as in the described species. The leaves belonging to the genus *Agathis* are hypostomatal, but their pores are always orientated transversally and the epidermis differs from *D. albens* so distinctly that no affinity with this genus can come into consideration. The author therefore does not believe Presl's interpretation to be well-founded.

In other types of Conifers the genera with similar epidermal features as the described species are certainly to be found (e. g. in Podocarpaceae, Podozamitaceae, Cephalotaxaceae, Pinaceae etc.). Widely lanceolate leaves of these Conifers can have characteristic arrangement of stomata in strips (especially the species *Podocarpus* and *Podozamites* e. g. *Podocarpus angustifolius, P. costatis, P. elongata* etc.). Sometimes the epidermal walls are straight (*Podozamites* spp.) or undulated (*Podocarpus spp.).* The pores, however, are rather small and no distinct cutinization of transversal cell walls is to be seen. Neither in other groups of *Conifers* identical epidermal structure with *D. albens* could be found, nor the outer morphology of leaves of the described species is analogous to other *Conifers.*

The leaves of *Cordaites* with their inner and outer structure resemble most of all the described species. Long ribbon-like leaves of *D. albens*

with dense venation and stomata on one side of the blade are analogous with the *Cordaites borassifolius, C. principalis, C. crassus* etc. (Harms and Leisman 1961) as well as the shape of the base and the apex of the leaves of *D. albens* resemble those of the mentioned species. Two to four interstitial veins typical for *Cordaites,* mentioned by Velenovský (1885, p. 4) among the true veins cannot be proved (see Description). Perhaps they may be revealed by a more detailed study of better preserved specimens. Neither the round papillous thickenings and hairs characteristic in some *Cordaites* have been observed (Wartmann 1969, Harms and Leisman 1961). However, the transversal walls of epidermal cells in *Cordaites principalis* are conspicuously stronger than the longitudinal ones (Harms and Leisman 1. c., Pl. 126, fig. 4, 6 e. g.). It ccorresponds to the kind of cutinization of epidermal cells of *D. albens* (Pl. 1, figs. 1, 2). Besides the shape of leaf scars on the branches of some *Cordaites* from the Bohemian Carboniferous strongly resembles the leaf scars of the cone-like stems of *D. albens.* The stomatal organization of *D. albens* differs from that of *Cordaites.* The stomata are larger and cutinized in another way than in *Cordaites.* Further in *Cordaites* stomatal rows are not so regularly arranged on the whole surface of the blade. Neither the stomata are situated in longitudinal grooves as in *Rufloria* (Mejen 1963). The direct relation of *D. albens* with the *Cordaites* cannot be proved though it has some features in common with several Paleozoic leaves of this order (especially *Eucordaites).* Similar solitary leaves from the Mesozoic were described under different names e. g. *Yuccites* SCHIMP. et MOUG., *Bambusium* HEER, *Phyllotaenia* SALFELD, *Eolirion* SCHENK etc. They are mostly asigned to the *Monocotyledonous* plants. Seward (1917) suggested for such leaves a common name *Pelourdea.* Later, however, Florin (1936) studied the cuticles of some of the above mentioned leaves and arrived at a conclusion that they were neither *Monocotyledonous* nor *Cordaitean.* Some belong evidently to the older types of *Ginkgoales,* others resemble gymnosperms, but their exact systematic position has not been so far known (e. g: *Desmiophyllum latifolium* (HEER) FLORIN. Teixeira (1959) mentions from the Cretaceous deposits near Vila Flor (Portugal) morphologically very similar leaves as *Phyllotaenia sp.* (1. c., p. 20—21, Pl. 11, figs. 6—9, Pl. 13, figs. 1—4). Its stomata rather resemble those of *D. albens.* Seward (1917, p. 281) believes the name *Krannera mirabilis* CORDA in lit. (suggested by Velenovský 1885) to be valid only for the cone-like stems and not for leaves. He suggests for the leaves of *D. albens* a new combination *Pelourdea mirabilis.*

Some morphologically similar leaves were described as *Krannera mirabilis* and *K. marginata* (Bajkovskaja 1956) from the Cretaceous of the U. S. S. R. However, the epidermal structure of these carbonized leaves is not known. Rather uncertain remains of leafy forms and fruits from the Bohemian Cretaceous were described as *Eolirion primigenium* (Velenovský and Vinklář 1926: 19—20, Pl. 2, figs. 1—4). After a more detailed study the author believes these remains to be only the impressions of wood. The fruits mentioned by the authors in this connection have no direct relation to these impressions. The species *Lepidocaryopsis west-*

phaleni STUR and *Flabellaria chamaeropifolia* GOEPPERT seem to be only the inmpresions of the leaves of *D. albens* (as already mentioned by Velenovský 1885, p. 1—6).

The question of the fragments of leafless branches covered with scars and assigned to *D. albens* remains to be solved. The fragments are mostly cores or impressions from the quarries in the Cenomanian sandstones (Peruc Formation, Bohemia) and have been assigned to *D. albens* more or less on the basis of an unfounded hypothesis regarding their affinity to this species. They were found in the vicinity of leaves, but their relations cannot be proved. Neither the fruit-like casts can add anything to the systematic of the described specimen.

On the basis of the above studies the following conclusions can be presented:

1. *D. albens* PRESL can be with certainty assigned to Gymnosperms.
2. On the basis of the cuticular analysis certain relations to the *Coniferales* have been ascertained. At the same time, however, the morphology and anatomy of leaves resemble Paleozoic *Cordaitales.*
3. The cone-like casts do not belong in any case to the desintegrating cones met with in *Araucaria* and *Agathis.* They are most probably swollen parts of stems and shoots bearing long ribbon-like leaves on scale-like scars. Principally, Velenovský's opinion can be agreed with.
4. Leaves hypostomatic, probably coriaceous, rigid and falling off.
5. So far no substantial proofs about the general appearance have been offered. *D. albens* PRESL might be of low growth, as supposed by Velenovský (1. c.). It seems improbable that long and thin branches could bear such a massive swollen forms.
6. Small pits between the leaf scars have not been explained satisfactorily. They may represent the remains of vascular bundles. Such pits in the sandstone core could have been left only by resistent structures.
7. The whole cone-like form was at least partly woody, not desintegrating, only with outer morphological features including leaves preserved on the cores. Inner structure unknown.
8. Both *D. albens* and *D. crassipes* can be included into the homogenous species *Dammarites albens* PRESL on the basis of the morphological comparison of casts.

The studies of this problem have to continue. The author hopes further information will be brought forward which will help to find for *D. albens* PRESL a place in the natural systematic of plants.

Assemblage

Dammarites albens probably did not belong to a typical assemblage with the other plants of the Bohemian Cenomanian. It has been found practically all over the outcrops of fresh-water sediments of the Peruc Formation. Especially the leaves occur in the sandstones and claystones either together with gymnosperms (*Nehvizdya obtusa* (VEL.) HLUŠTÍK, *Frenelopsis alata* (K. FEISTM.) KNOBLOCH, *Sequoiopsis perucensis* VEL. et VIN. etc.) or even among the leaves of *Ferns* and *Angiosperms.* More abundant finds occur in sandstones.

ACKNOWLEDGEMENT

I would like to thank my colleague dr. F. Holý for allowing me to study the specimens of *Dammarites albens* PRESL deposited in the palaeobotanical collection of the National Museum, Prague, and Mgr. V. Micek from the Muzeum Palaeobotaniczne Uniwersytetu Wrocławskiego in Poland for the photographs of Goeppert's holotype. I especially thank prof. F. Němejc DrSc, dr. Z. Kvaček CSc and dr. E. Knobloch CSc for valuable suggestions. Mrs. M. Páralová prepared the photographs and Mrs. J. Böhmová kindly corrected the translation.

REFERENCES

ANDREWS H. N. (1970): Index of generic names of fossil plants, 1820—1965. — Geol. Surv. Bull. 1300, p. 354. Washington.

BAJKOVSKAJA T. N. (1956): Verchněmelovyje flory severnoj Asii. — Paleobotanika II, p. 47—194, Pl. 1—27. Izdat. Ak. Nauk SSSR, Moskva—Leningrad.

DOLUDĚNKO M. P. (1966): O strojeniji epidermisa listěv někotorych Podozamites. — Paleont. Ž., 2, p. 133—136, Pl. 13. Moskva.

FLORIN R. (1931): Untersuchungen zur Stammesgeschichte der Coniferales und Cordaitales. I. Morphologie u. Epidermisstruktur der Assimilationsorgane bei den rezenten Koniferen. — K. sven. Vetensk. — Akad. Handl., Ser. 3, 10, p. 1—588. Stockholm.

— (1936): Die fossilen Ginkgophyten von Franz-Joseph-Land nebst Erörterungen über vermeintliche Cordaitales mesozoischen Alters, I, II. — Palaeontographica, Abt. B, Bd. 81, 82. Stuttgart.

FRIČ A. (1871): Větev sosny z peruckých vrstev křídového útvaru v Čechách. — Květy, 6, 34, p. 270, fig. 268. Praha.

FRIČ A. — BAYER E. (1900): Studien im Gebiete der böhmischen Kreideformation. Perucer Schichten. — Arch. naturwiss. Landesdurchforsch. Böhmen 11, 2, p. 1—180. Prag.

— (1902): Studie v oboru křídového útvaru českého. Perucké vrstvy. — Arch. přírodověd. Prozk. Čech 11, 2, p. 1—179. Praha.

GOEBEL K. (1898): Organographie der Pflanzen. I. Algemeine Organographie. — Jena.

GOEPPERT H. R. (1841): Über die fossile Flora der Quadersandsteinformation in Schlesien, als erster Beitrag zur Flora der Tertiärgebilde. — Nova Acta leopold. 19, p. 99—134, Pl. 46—53. Halle.

— (1850): Monographie der fossilen Coniferen. — Hollandsche Maatschapii Wetensch. Natuurk. Verh. 6, p. 1—286, Pl. 1—58. Leiden.

HARMS V. L. — LEISMAN G. A. (161): The Anatomy and Morphology of certain Cordaites leaves. — J. Palaeont. 35, 5, p. 1041—1064, Pl. 125—128, 11 textfigs.

HARRIS T. M. (1935): The fossil Flora of Scoresby Sound, East Greenland, 4. Ginkgoales, Coniferales, Lycopodiales, and isolated Fructifications. — Meddr Grønl. 112, 1, p. 1—50. København.

HEER O. (1881): Contribution a la Flore fossile du Portugal. — Sec. Travaux Soc. Geol. Portugal. Lisboa.

KNOBLOCH E. (1964): Neue Pflanzenfunde aus dem südböhmischen Senon. — Jb. Staatl. Mus. Mineral. Geol. p. 133—201, Pl. 1—8, 45 Textfigs. Dresden.

— (1973): Nomenklatorische und taxonomische Bemerkungen zur Gattung Dammarites Presl in Sternberg. — Ber. Dtsch. Gesell. geol. Wiss., A. Geol. Paläont. Berlin. 1 (1973) 8, p. 967—973.

MEJEN S. V. (1963): Ob anatomii i nomenklature listěv angarskich kordaitov. — Paleont. Ž., 3, p. 96—107, Pl. 9, 10, 8 textfigs. Moskva.

NĚMEJC F. (1968): Paleobotanika. III. Rostliny nahosemenné. — Academia, p. 1—478, Praha.

RENGER K. (1866): Předvěké rostlinstvo křídového útvaru českého. — Živa 13, 2, p. 133—139, Pl. 1. Praha.

REUSS E. A. (1845—1846): Die Versteinerungen der böhmischen Kreideformation. — Stuttgart.

SEWARD A. C. (1917): Fossil Plants. III. — Cambridge.

— (1919): Fossil Plants. IV. — Cambridge.

SCHIMPER W. P. (1870—1872): Traité de paléontologie végétale ou la flore du monde primitif. 2. — p. 1. 968. Pl. 57—94. Paris.

STERNBERG G. K. (1838): Versuch einer geognostischen botanischen Darstellung der Flora der Vorwelt. II. — Part 7, 8, p. 81—220. Prag.

SVOBODA J. et all. (1960): Regionální geologie ČSSR. I. 2. Český masív, Algonkium-kvartér. — NČSAV Praha.

STUR D. (1873): Vorkommen einer Palmen-Frucht-Hulle Lepidocaryopsis westphaleni n. g. et sp. in Kreide-Sandstein der Peruzer-Schichten bei Kaunitz in Böhmen. — Verh. K. — kön. geol. Reichsanst., p. 1—3. Wien.

TEIXEIRA C. (1950): Flora mesozóica Portuguesa. II. — Serv. Geol. de Portugal, p. 1—31, Pl. 1—13. Lisboa.

VĚLEŇOVSKÝ J. (1885): Die Gymnospermen der böhmischen Kreideformation. — Com. Naturwiss. Durchf. Böhmen 7, 3, p. 1—34, Pl. 1—13. Prag.

— (1888): Ueber einige neue Pflanzenformen der böhmischen Kreideformation. — Sitz. — Ber. k. böhm. Ges. Wiss. 1887, p. 590—598, Pl. 1. Prag.

— (1907): Srovnávací morfologie. II. — p. 235—612. Praha.

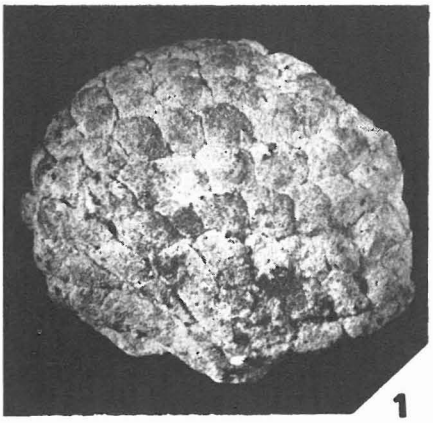
VELENOVSKÝ J. — VINIKLÁŘ L. (1926—1931): Flora cretacea Bohemiae. I (1926), II (1927), III (1929), IV (1931). — Rozpr. Stát. geol. Úst. Čs. Republ. sv. 1, 2, 3, 5 (1926—1931). Praha.

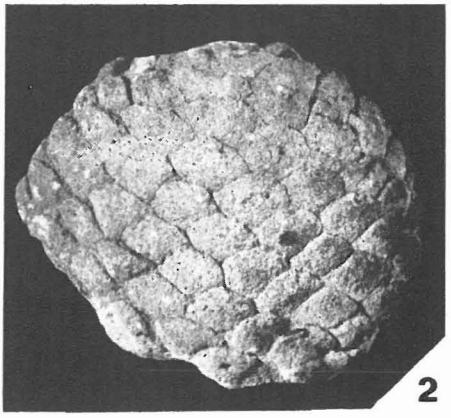
WARTMANN R. (1968): Vorläufige Mitteilung über disperse Kutikulen aus den Oberen Schulzbacher Schichten (Saar). — Argumenta Palaeobotanica 1, p. 165—171, Pl. 32, 33, Textfigs. 1—8. Münster.

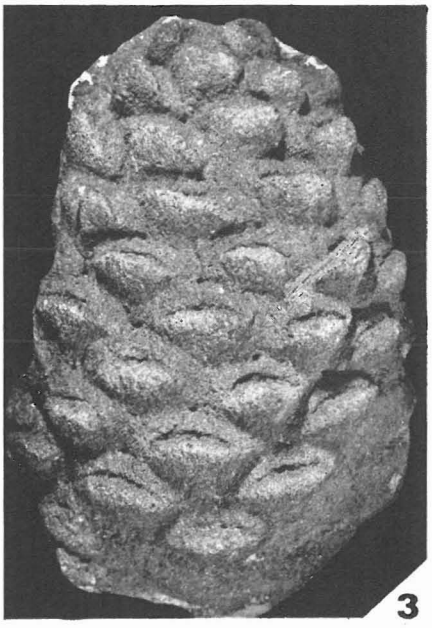
— (1969): Studie über die papillen-förmigen Verdickungen auf der Kutikule bei Cordaites an Material aus dem Westfal C des Saar-Karbons.

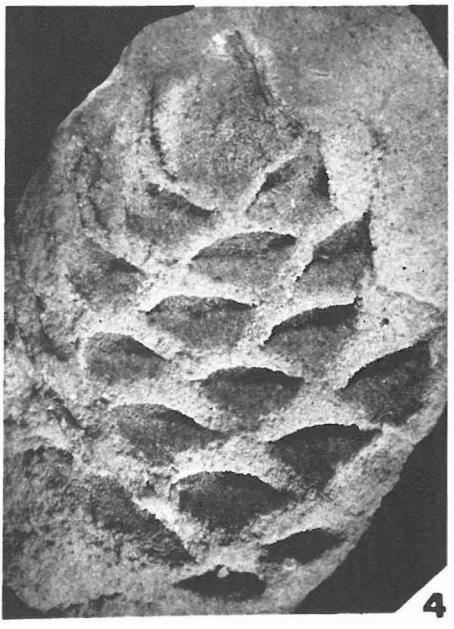
— Argumenta Palaeobotanica 3, p. 199—207, Pl. 34, Münster.

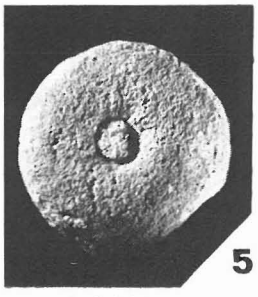
WARTMANN R. — BLASCHKE R. — VOGEL K. (1969): Vergleichende Beobachtungen mit dem Raster-Elektronen Mikroskop und dem Lichtmikroskop an fossilen Kutikulen und Megasporen. — Beitr. Elektronenmikroskop. Direktabb. Oberfl. 2, p. 307—312.


1


2


3

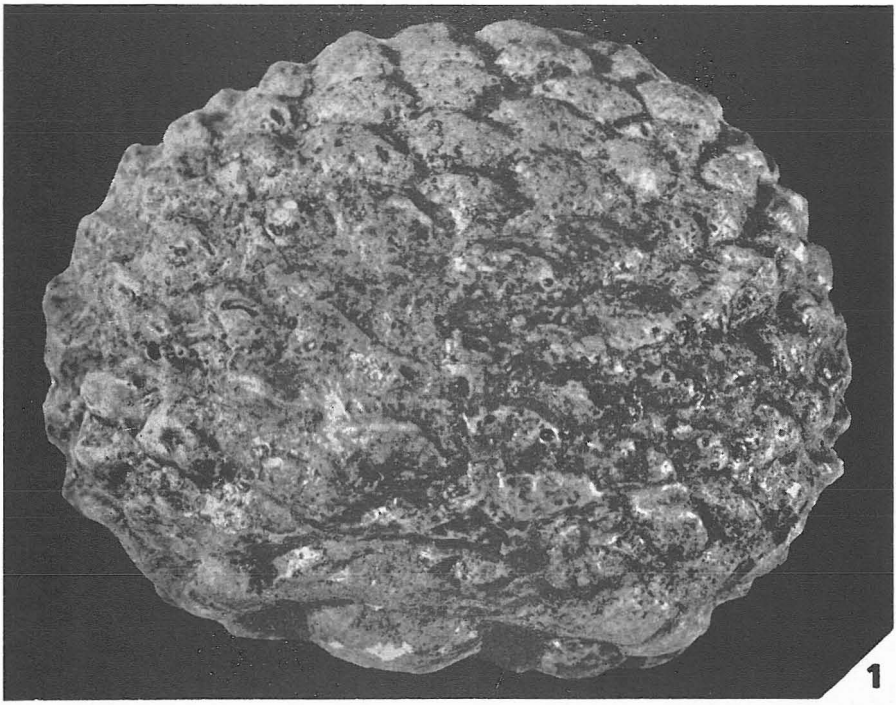

4


5

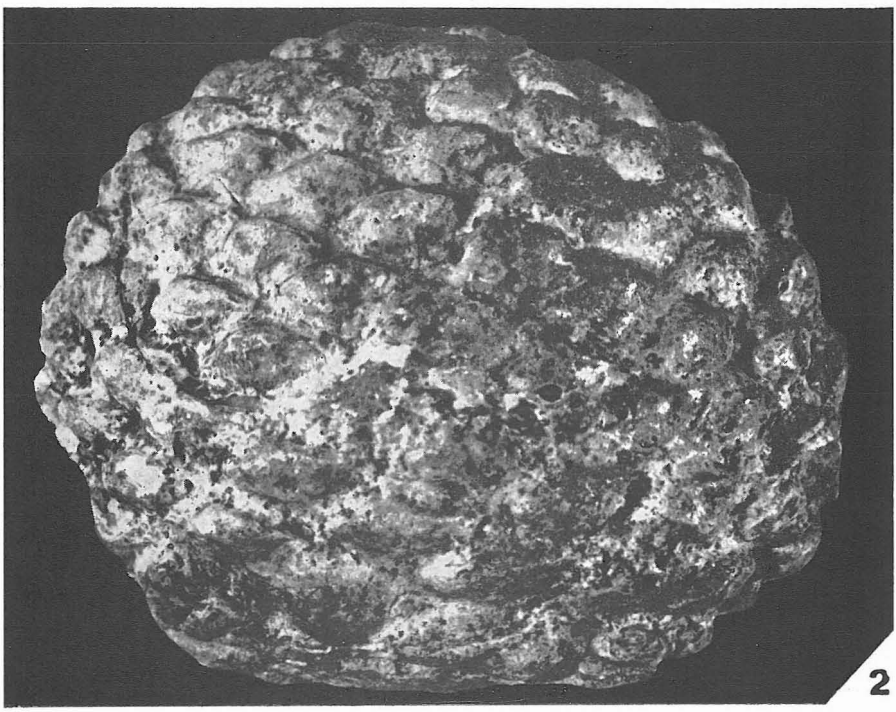

6


7

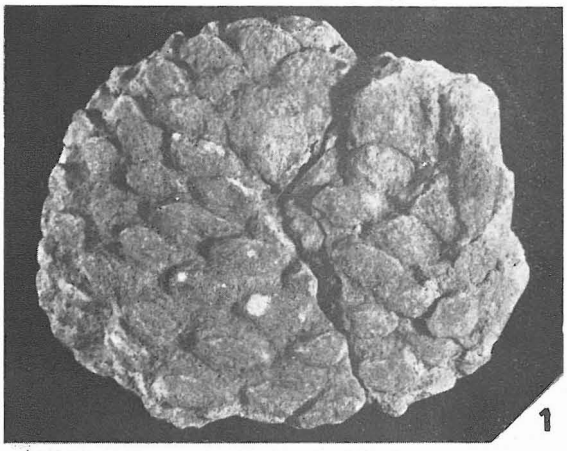
Pl. II.

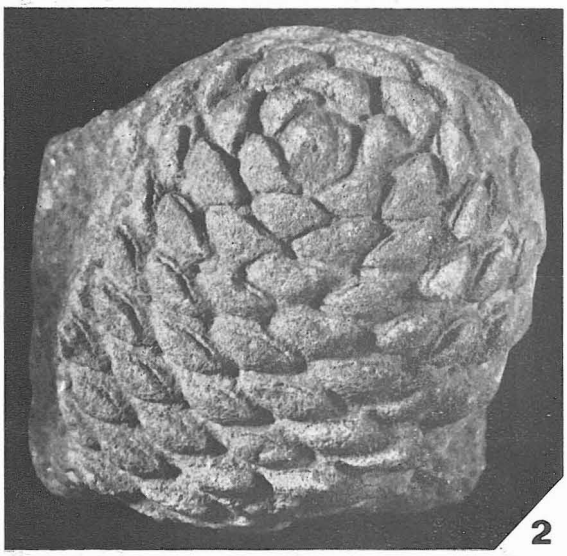


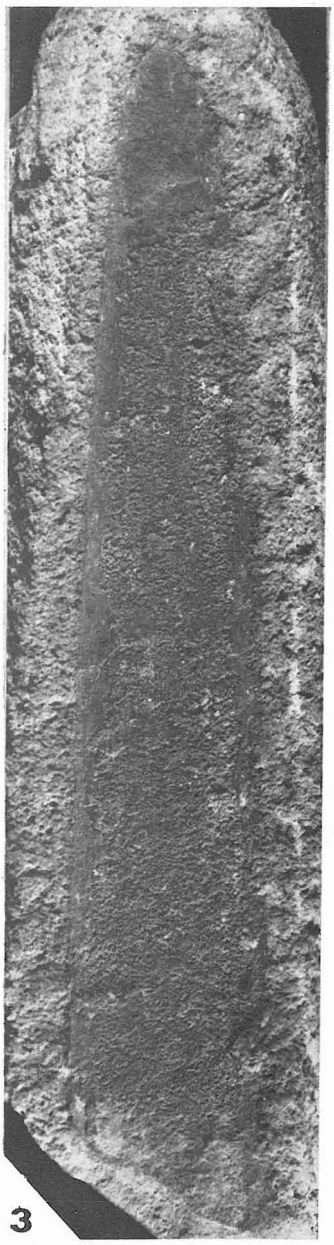
1

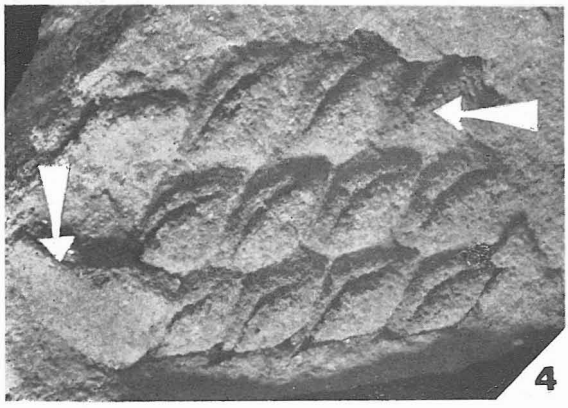


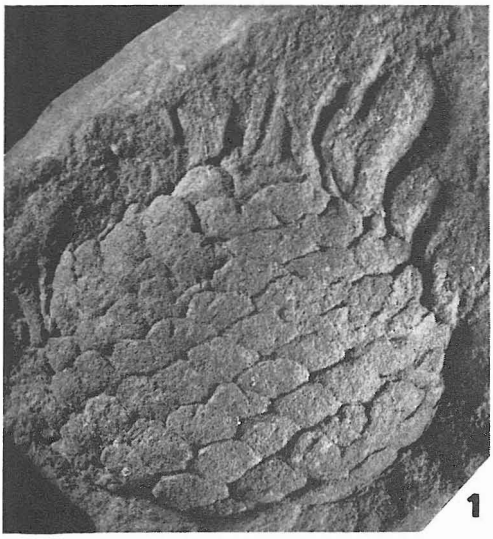
2

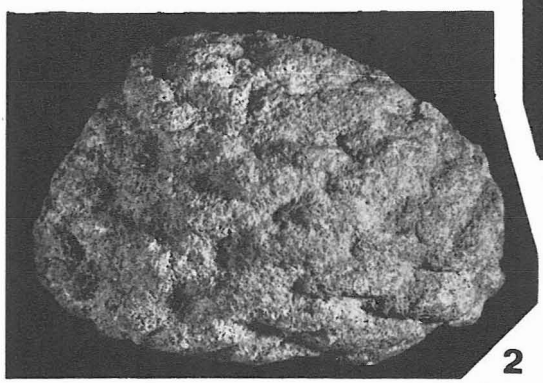


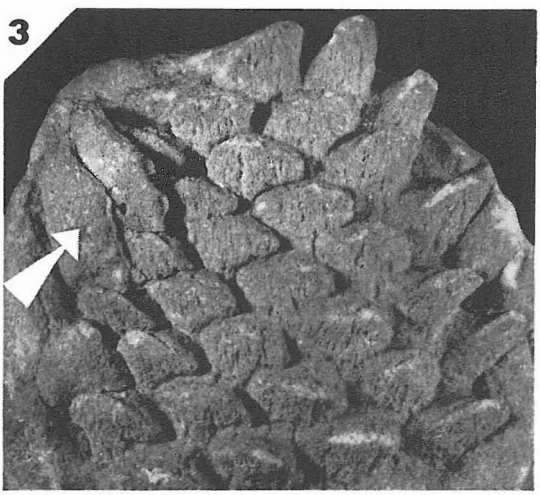


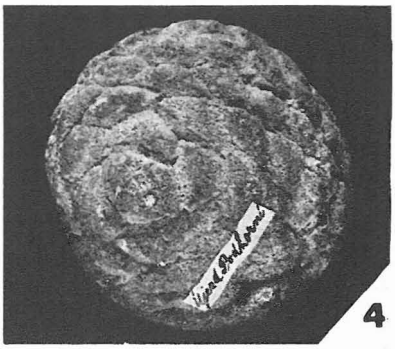




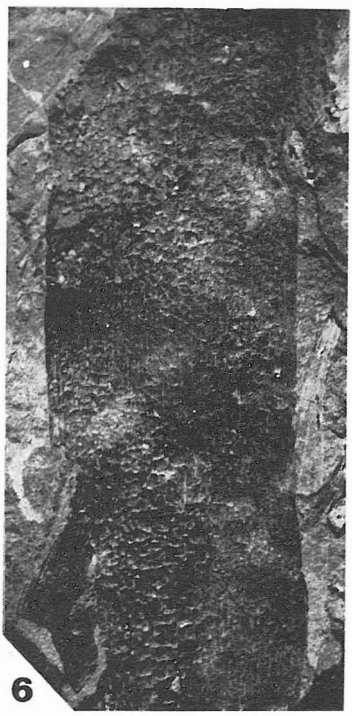

1

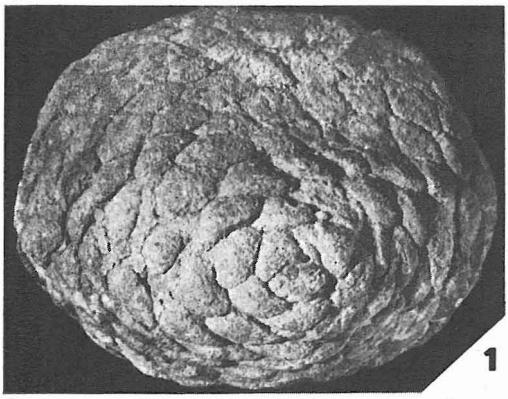

2

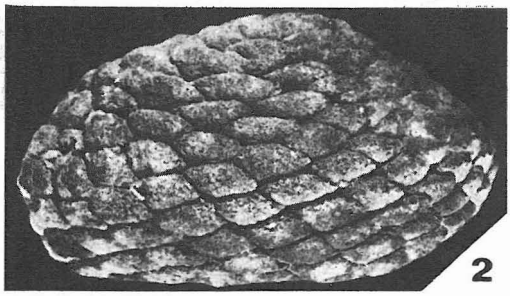

3

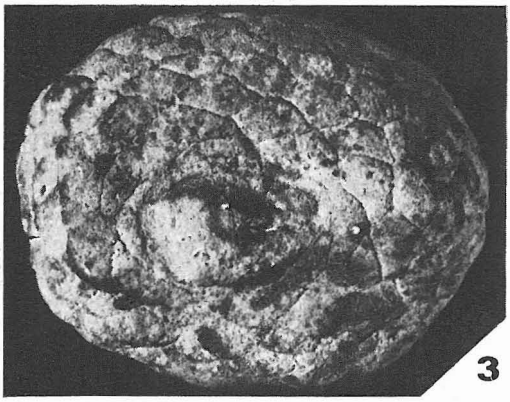

4


5

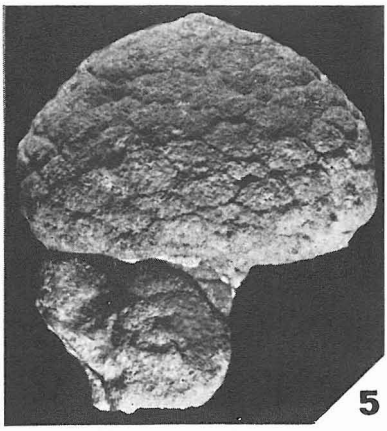

6

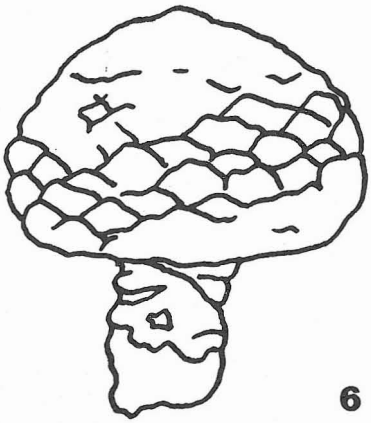

1

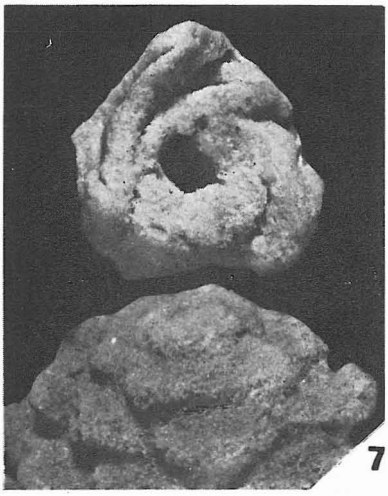

2

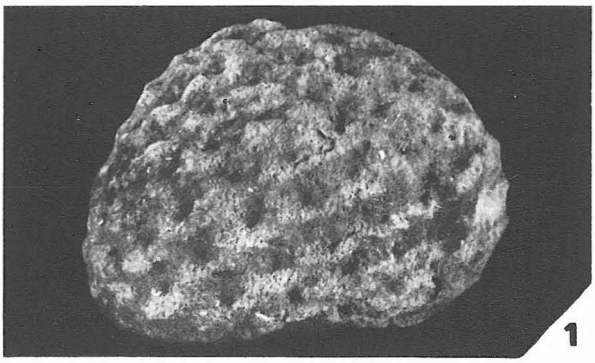

3


4

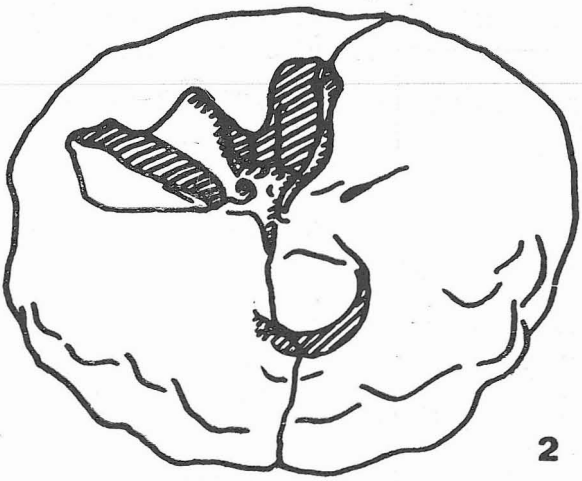

5


6

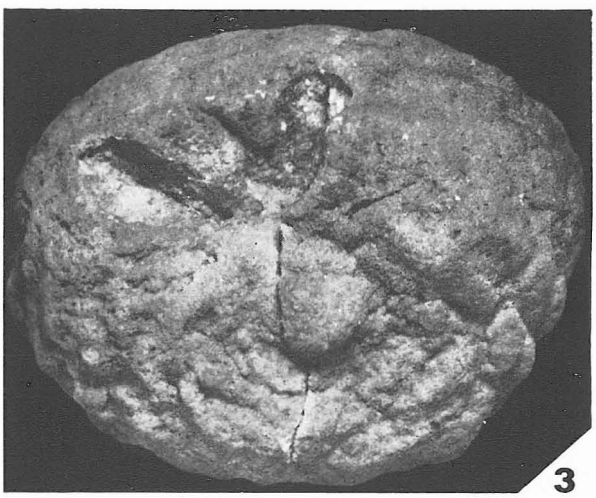

7



1



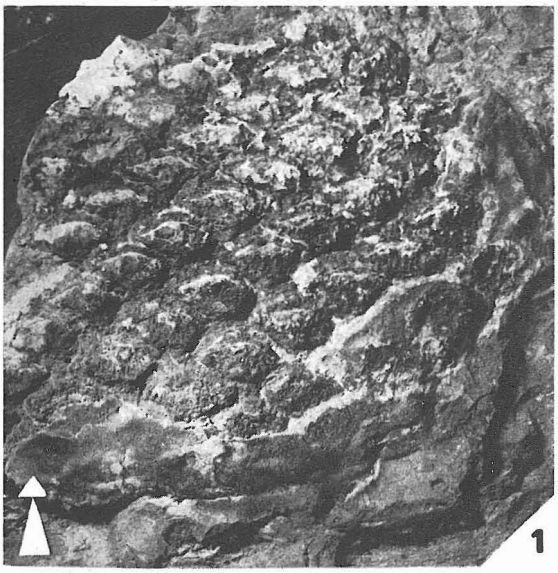
2



3

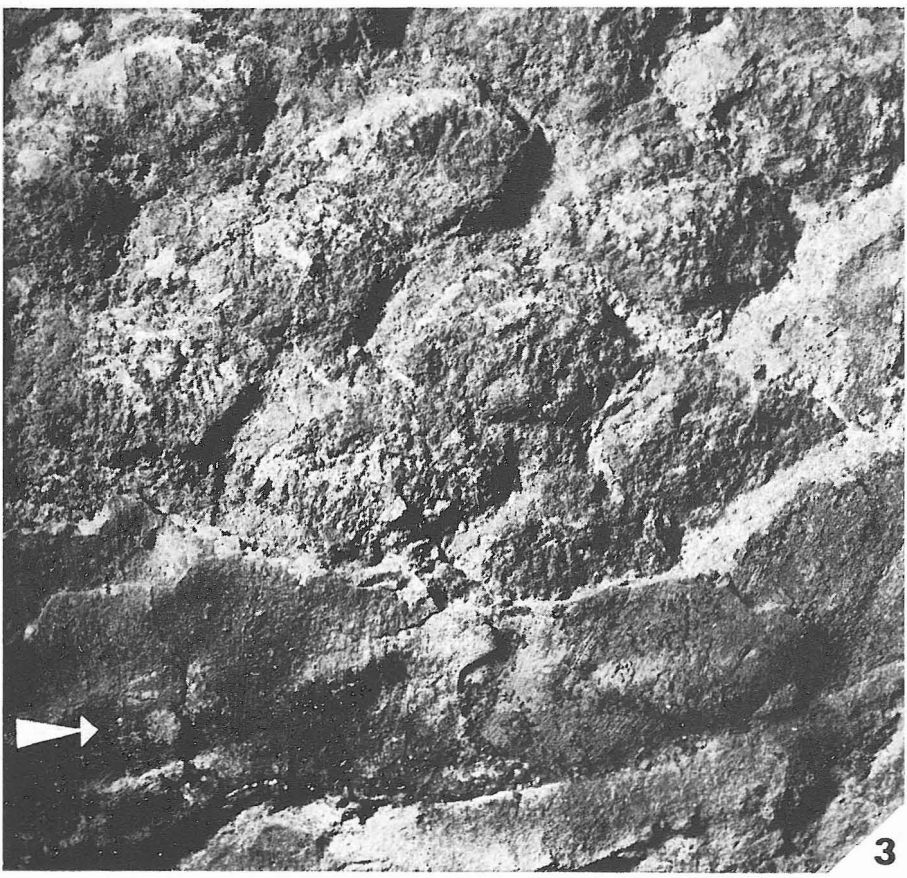
4

5



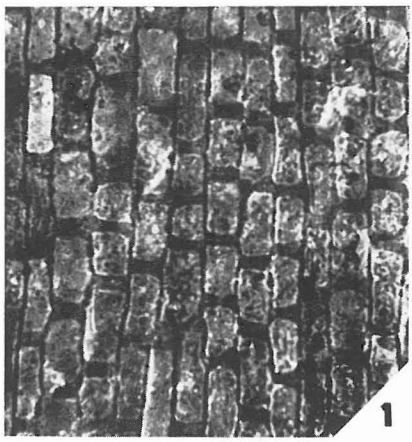
1

2

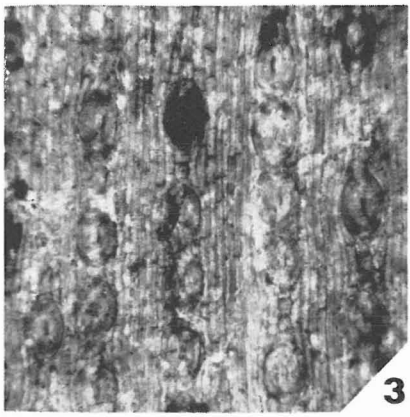


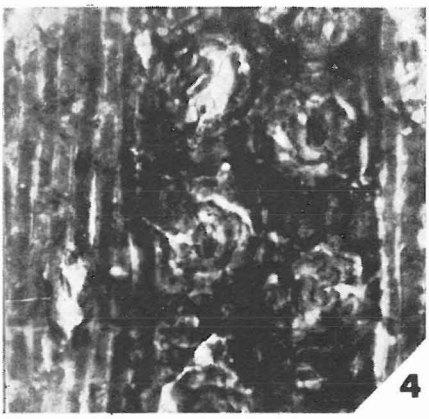
3

Pl. VIII.

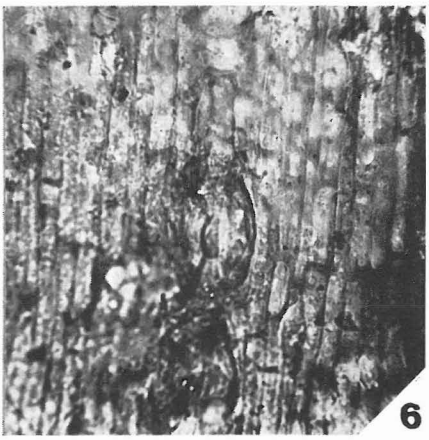

1


2


3


4


5


6

ANTONÍN HLUŠTÍK

PŘÍSPĚVEK K SYSTEMATICE A ANATOMII LISTŮ RODU *DAMMARITES* PRESL IN STERNBERG.

V práci jsou shrnuty dosavadní názory na původ šiškovitých útvarů, nalézaných jako volná jádra nebo otisky v pískovcích českého cenomanu (perucké vrstvy). Fosilie jsou zcela určitě rostlinného původu. Jejich povrch je tvořen šupinovitými výstupky, sestavenými ve spirále. Výstupky jsou buď pevně přitisknuté k povrchu více méně kulovitého tělesa, nebo výrazně vystupují v podobě mírně oddálených pahýlů (Pl. 1, figs. 1—3). Nad každým výstupkem lze na některých kusech pozorovat nehluboký dolíček. Na abaxiální straně odstávajících „šupin" se nachází zcela pravidelná příčná rýha a na adaxiální straně svislé vráskování.

J. B. Presl (in Sternberg 1838) poprvé popsal podobný útvar z cenomanských pískovců u Nového Bydžova. Volné, silně sploštělé diskovité jádro je pokryto přitisklými „šupinami" a nápadně připomíná samičí šištici konifer (Pl. 1, figs. 1, 2). Presl se domnívá, že jde o šišku z příbuznosti rodu *Agathis* a zvolil nové druhové jméno *Dammarites albens*. Šupinovité výstupky na povrchu „šišky" považoval za skutečné semenné šupiny. Podobná „šiška" byla později popsána jako *Dammarites crassipes* ze Slezska (Goeppert 1840). Renger (1866) zveřejnil český překlad Cordova nepublikovaného rukopisu, ve kterem je popsána podobná šiškovitá zkamenělina jako *Krannera mirabilis* (Pl. 1, fig. 3). Při této příležitosti Renger reviduje dosavadní názor na původ těchto zajímavých „šišek" a navrhuje nový rod *Palaeostrobus* s druhy *P. mirabilis* a *P. crassipes*. Na základě čistě morfologických úvah a srovnání s některými dalšími nálezy se domnívá, že „šišky" náležejí do příbuzenstva araukariových rostlin. Poprvé si také všiml, že na některých otiscích jsou zachovány zbytky listovitých útvarů v přímém pokračování „šupin". Odvozuje z toho svou teorii o „palistech", vyrůstajících v určitém stadiu vývoje „šišky" ze spodní části každé „šupiny" (Fig. 2, 3). Po odpadnutí palistů šiška dozrála a „šupiny" se rozevřely. Přitom se objevilo místo inserce „palistu" v podobě malého dolíčku a příčného žlábku na adaxiální straně „šupiny".

Renger zařadil do druhu *Palaeostrobus mirabilis* pouze kus, popsaný Cordou v nepublikovaném rukopise (Pl. 1, fig. 3). Do druhu *Palaeostrobus crassipes* pak zařadil Preslův holotyp *Dammarites albens*, Goeppertův *Dammarites crassipes*, některé další kusy z českého cenomanu a otisk vnějšího povrchu „šišky" uvedený Cordou ve vzpomínaném rukopise jako *Pinus papyracea* (Pl. 1, fig. 1—4, Pl. 2, Pl. 3, fig. 1, 2). V tomto druhovém rozdělení lze vystopovat jistou autorovu nedůslednost. Do druhu *P. mirabilis* je vřazen kus, který nese výrazně odstávající „šupiny", podobně jako je tomu v „dospělém stadiu" *P. crassipes* na kterém svou interpretaci Renger vysvětluje. Zdá se, že určité morfologické nepravidelnosti Cordova kusu (jako např. oddálenější rozestavení „šupin") vedly autora k tomuto druhovému rozlišení. Podle zkoumání všech dosažitelných exemplářů z paleobotanických sbírek Národního musea v Praze i z jiných institucí lze však říci, že existuje celá řada tvarových přechodů mezi typy s přitisklými a odstávajícími „šupinami".

Později sám Corda (in Reuss 1846) přijímá Preslovu interpretaci a cituje popisovaný druh jako *Dammara albens* (PRESL) CORDA.

Nověji se problémy dammaritových „šišek" zabýval J. Velenovský (1885). Cituje původní Cordův binom jako *Krannera mirabilis* CORDA in lit. Na bohatším sbírkovém materiálu a nálezech ojedinělých široce pentlicovitých listů typu *Cordaites* buduje vlastní interpretaci původu „šišek". Šišticovité útvary považuje za jakési zduřelé části větví nebo kmenů (podobně jako u recentních cykasovitých). Zduřeliny jsou podle Velenovského tvořeny vystouplými a stěsnanými dřevnatými násadci, na nichž vyrůstaly zmíněné široké listy (Fig. 4, 5, Pl. 3, fig. 3). Autor, zkušený morfolog, odmítá Preslův i Rengerův názor o šiškové povaze zkameněliny.

Výzkumy, které prováděl autor této práce, potvrzují domněnku Velenovského. Šišky *Araucaria* i *Agathis* se po dozrání rozpadají na jednotlivé šupiny, nesoucí buď ponořené semeno (*Araucaria*) nebo volné jednokřídlé semeno (*Agathis*). Jsou sice známy nálezy celých mineralizovaných araukariových šišek, ale jsou podle mého názoru vzácnější než nálezy nejrůznějších volných šupin řazených do blízkosti čeledi *Araucariceae* (např. *Dammara borealis, Aachenia debeyi, Araucaria bohemica aj.*). Nejinak je tomu i v čes-

kém cenomanu. Tím zajímavější je proto fakt, že „šišky" rodu *Dammarites* jsou známy v drtivé většině buď jako celistvá kulovitá nebo různě zploštělá tělesa, nebo jako otisky části jejich povrchu (Pl. 1—7). Na jediném exemplář jsem sice pozoroval jakési dutiny, naznačující vnitřní paprsčitou stavbu jak u šišek, ale tento jev může zároveň potvrzovat interpretaci Velenovského (Pl. 6, fig. 2, 3). V blízkosti „šišek" nebyly pozorovány doposud žádné zbytky skutečných šupin, které by nějak souvisely s vnější morfologií útvarů. Na příčných i podélných řezech „šiškami" jsem nepozoroval žádné náznaky vnitřní stavby nebo struktury odpovídající postavení případných semen.

Naopak je známo mnoho otisků „šišek" se zachovanými zbytky rovnoběžných žilkovaných širokých listů. Jejich pozice naznačuje, že se zachovaly v původním postavení na listových jizvách („šupinách") — tj. na násadcích ve smyslu Velenovského. Rekonstrukcí na mnoha exemplářích a z nábrusů na jílovcovém zbytku z Hloubětína (Pl. 7) lze zjistit, že listy přisedaly masívní trunkátní bází na adaxiální straně „šupin"; dolíčky nad „šupinami" velmi pravděpodobně představují vyústění stopy listové. Potvrzení této teorie by ovšem vyžadovalo podrobnější anatomické studium na nějakém mineralizovaném (silicifikovaném) kusu. Doposud však takový nález neznáme. Již dnes je však možno odvrhnout Rengerovu teorii o „palistech". Jak správně Velenovský, podotýká, Renger měl patrně na mysli braktee, které skutečně u jehličnanů známe. U araukariových šišek jsou mimoto známy zobanovité výrůstky na štítcích šupin. Tyto výrůstky nejsou však identické se zřetelně žilkovanými listy *Dammarites*, podobně jako podpůrné šupiny jiných konifer. Mimoto si lze těžko představit brakteu, která by odpadla ještě před úplným dozráním šišky a zanechala po sobě listovou stopu.

Na základě podrobného rozboru morfologie popisovaných útvarů autor této práce navrhuje synonymiku, jak je uvedena na str. 53. Jméno *Krannera mirabilis* CORDA in RENGER je nutno považovat za později publikované, jakkoli se již v paleobotanické literatuře vžilo. Rukopis J. A. Cordy se zatím nepodařilo najít a může nám tedy sloužit pouze jeho český překlad K. Rengera (1866, p. 133—135). Na základě morfologické totožnosti druhů *Dammarites albens* PRESL a *D. crassipes* Goeppert je nutno zvýhodnit druh *Dammarites albens PRESL*, které má prioritu a bylo platně publikováno. Druhový znak *D. crassipes* uváděný Goeppertem (1840, 1850) lze považovat za následek přirozené variability tvaru nebo změn při fosilizaci. Ve sbírkách Národního muzea je uloženo mnoho exemplářů, jejichž „stopky" mají nejrůznější délku a průměr. Jsou to vlastně části tenší větve nebo kmínku, nesoucího zduřelý osní útvar. Ve způsobu jeho zachování a odlomení neexistuje žádná pravidelnost, jak by tomu muselo být u pravé šišky. Autor této práce se tedy v podstatě ztotožňuje s interpretací J. Velenovského.

Tomu odpovídá i epidermální stavba *Dammarites albens* PRESL, jak ji bylo možno zjistit na zuhelnatělých zbytcích listů. Zbytky širokých souběžně žilkovaných listů se zašpičatělou špicí byly již dlouho známy nejen z pískovců, jak popisuje Velenovský (1885). V odkryvu cihelny v Praze-Hloubětíně i na jiných lokalitách sladkovodního cenamonu (např. Vyšerovice) autor této práce sbíral hojné úlomky se zachovanou kutikulou. Teprve nález kolegy dr. K. Drábka však umožnil spojit tyto roztroušené listy s určitou částí některé známé křídové rostliny. Jedná se totiž o úplnou „šišku" *Dammarites albens,* která na svých výstupcích nese zachované kutikuly širokých pentlicových listů v přirozené pozici (Pl. 6). I přes nepříznivé zachování kutinové blanky bylo možno alespoň zhruba popsat epidermis těchto listů. Charakteristckým znakem listů jsou hypostomatické čepele, na jejichž spodní straně jsou hojné průduchy sestaveny v podélných isolovaných řadách. Průduchové štěrbiny jsou orientovány podélně; průduchy mají charakter typický pro nahosemenné a jehličnaté rostliny (Pl. 8, fig. 2—6). Přesto však jsou zde znaky, upomínající na paleozoické kordaity (řada průduchů, tvar čepele, husté žilkování aj.). Průduchy jsou nezvykle velké, často dicyklické, jen málo výrazněji kutinizované než ostatní epidermální buňky. Zajímavým znakem obdélníkovitých epidermálních buněk jsou ztlustlé příčné stěny (Pl. 8, fig. 1). Zhodnocení těchto znaků však bude ještě vyžadovat další podrobné analýzy na lépe zachovaném materiálu. S určitostí se ukázalo, že kutikula listů z hloubětínského nálezu souhlasí s kutikulami jednotlivě nacházených listů s podobnou morfologií.

Z druhohor Evropy a Sovětského svazu jsou známy podobné nálezy listů, popisovaných pod nejrůznějšími rodovým názvy. Jejich kutikuly jsou však buď zcela neznámy, nebo nedostatečně prozkoumány. I v tomto případě bude zapotřebí rozsáhlejší srovnávací studie.

Závěry z předložené studie lze shrnout přibližně do těchto několika bodů:

1. *Dammarites albens* PRESL zcela určitě náleží k rostlinám nahosemenným.
2. Na základě kutikulární analýzy lze zjistit určité vztahy k jehličnanům, jakkoli morfologie a anatomie listů připomíná paleozoické kordaity.
3. Šiškovitá jádra nenáležejí rozpadavým šiškám z čeledi *Araucariaceae*. Nejpravděpodobněji představují zkamenělé části zduřelých kmínků nebo větví, nesoucích pentlicovité listy na šupinovitých listových jizvách (ve smyslu Velenovského).
4. Listy *Dammarites albens* PRESL byly hypostomatické, pravděpodobně kožovité, tuhé a opadavé.
5. O celkovém vzhledu nemáme přesných informací, pročež je nutno se přidržet zajímavé interpretace Velenovského (1. c.). Tento autor předpokládá, že šlo o rostlinu nízkého vzrůstu, nesoucí na tenkém krátkém kmínku kulovitý osní útvar s chocholem listů. Je ostatně pravděpodobné, že dlouhá tenká větev by těžko byla schopna nést tak masivní útvar vysoko nad zemí.
6. Dolíčky nad jizvami nejsou doposud uspokojivě vysvětleny. Mohou však představovat dutiny po odolnějších svazcích cévních, vstupujících do listů.
7. Ve svém celku byly šiškovitě vypadající zduřeniny alespoň částečně dřevnaté, už vzhledem k lépe zachovaným povrchovým podrobnostem. Vnitřní stavbu zatím naprosto neznáme.
8. Vzhledem k morfologické podrobnosti druhů *Dammarites albens* PRESL a *D. crassipes* GOEPPERT lze oba druhy sloučit do jediného druhu *D. albens* PRESL. Je to však závěr čistě formální, tj. vzhledem k platným pravidlům botanické nomenklatury.

EXPLANATIONS OF PLATES

Original specimens and preparations figured in this paper are deposited in the palaeobotanical collection of the Department of Palaeontology, National Museum, Prague, Václavské náměstí 68, Czechoslovakia. Collection signature is indicated here under the numbers of Inv. Cat. F.

PLATE I.

1, 2. *Dammarites albens* PRESL. The holotype figured in Sternberg 1838, Pl. 52, figs. 11, 12, in Reuss 1846, Pl. 49, figs. 6—8 as *Dammara albens* (PRESL) CORDA, in Renger 1866, Pl. 1, fig. 2 as *Palaeostrobus crassipes* (GOEPPERT) RENGER and in Velenovský 1885, Pl. 4, fig. 2 as *Krannera mirabilis* CORDA in lit. The flattened disk-shaped candstone cast with clinging leaf scars. Locality Nový Bydžov near Hradec Králové, eastern Bohemia, Peruc Formation, Cenomanian. F 82, nat. size, views of both sides of the cast.
Photo M. Páralová.

3. *Dammarites albens* PRESL. The type specimen of *Krannera mirabilis* CORDA in RENGER (Corda's manuscript Pl. 13, fig. 1) figured in Renger 1866, Pl. 1, fig. 1 as *Palaestrobus mirabilis* (CORDA) RENGER, in Velenovský 1885, Pl. 4, fig. 7 as *Krannera mirabilis* CORDA in lit. The oval cone-like part of the stem with protruding leaf scars, transversal grooves and pits above the scars are visible as well as perpendicular wrinkles on adaxial sidej of the scars. Locality Nehvizdy, east of Prague, central Bohemia, Peruc Formation, Cenomanian. F 134, nat. size.
Photo M. Páralová.

4. *Dammarites albens* PRESL. The type specimen of *Pinus papyracea* CORDA ex RENGER, mentioned by Renger 1866, p. 137. Outer impresion of the cone-like stem with preserved leaves (at the left margin of the fossil). Renger assigned it to *Palaeostrobus mirabilis* (CORDA) RENGER. Locality Nehvizdy, east of Prague, sandstones of the Peruc Formation, Cenomanian. F 135, nat. size.
Photo M. Páralová.

5. *Krannera mirabilis* CORDA in lit. sensu Velenovský 1885, p. 1—6, Pl. 1, fig. 10. "Fruit-like" sandstone cast. Locality Nehvizdy, Peruc Formation, Cenomanian. F 151, nat. size.
Photo M. Páralová.

6, 7. *Krannera mirabilis* CORDA in lit. sensu Velenovský 1885, p. 1—6, Pl. 1, fig. 18. The sandstone cast with "stalk" remain and corroded surface — see fig. 7 detail. Locality Nehvizdy, Peruc Formation, Cenomanian. F 152, nat. size (fig. 7 ca 1,5 ×).
Photo M. Páralová.

PLATE II.

1, 2. *Dammarites albens* PRESL. The holotype figured in Goeppert 1841, Pl. 53, fig. 3 as *Dammarites crassipes* GOEPPERT. The plastic cast copy deposited in the Muzeum Paleobotaniczne Uniwersytetu Wrocławskiego. Locality probably Chelmsko Śl. (Schömberg) south of Kamienna Gora, Poland, Cenomanian. Ca 1,5 ×.
Photo Mgr. V. Micek.

PLATE III.

1. *Dammarites albens* PRESL. The specimen figured in Renger 1866, Pl. 1, fig. 3, as *Palaeostrobus crassipes* (GOEPPERT) RENGER and in Velenovský 1885, Pl. 4, fig. 4 as *Krannera mirabilis* CORDA in lit. The sandstone cast with leaf impressions (at the right margin) of the fossil). Locality Nehvizdy, east of Prague, central Bohemia, Peruc Formation, Cenomanian. F 138, nat size. Photo M. Páralová.

2. *Dammarites albens* PRESL. The specimen figured in Renger 1866, Pl. 1, fig. 4 as *Palaeostrobus crassipes* (GOEPPERT) RENGER and figured in Velenovský 1885, Pl. 4, fig. 1 as *Krannera mirabilis* CORDA in lit. In the specimen slightly protruding leaf scars with transversal grooves are visible. Locality Nehvizdy, Peruc Formation, Cenomanian. F 140, nat. size. Photo M. Páralová.

3. *Dammarites albens* PRESL. The leaf impression figured in Velenovský 1885, Pl. 1, fig. 5 as *Krannera mirabilis* CORDA in lit. The upper part of the leaf blade with pointed apex. Covered by limonite. Locality Nehvizdy, Peruc Formation, Cenomanian. F 153, nat. size. Photo M. Páralová.

4. *Damarites albens* PRESL. Part of the stem surface. The vertical arrow indicates the leaf impression in natural position, the horizontal one shows transversal groove on the scar. Locality Nehvizdy, Peruc Formation, Cenomanian. F 150, ca 1,5 X. Photo M. Páralová.

5. *Dammarites albens* PRESL. Part of the stem figured in Pl. IV, fig. 3, showing the shape of protruding leaf scars. Locality Nehvizdy, Peruc Formation, Cenomanian. F 147, nat. size. Photo M. Páralová.

PLATE IV.

1. *Dammarites albens* PRESL. The cone-like stem with distinct impressions of the leaves in natural position at the clinging leaf scars (compare the specimen with the Presl's holotype in Pl. 1, figs. 1, 2!). Locality Vojice near Jičín, eastern Bohemia, Peruc Formation, the Cenomanian sandstone. F 146, nat. size. Photo M. Páralová.

2. *Dammarites albens* PRESL. A sandstone cast with poorly preserved surface. Locality Nehvizdy, east of Prague, central Bohemia, Peruc Formation, Cenomanian. F 174, nat. size. Photo M. Páralová.

3. *Dammarites albens* PRESL. A part of the stem surface with evidently woody protruding leaf scars. The arrow indicates leaf remains in natural position. See also distinct vertical wrinkles on adaxial side of the scars. Locality Nehvizdy, Peruc Formation, Cenomanian. F 147, nat. size. Photo M. Páralová.

4, 5. *Dammarites albens* PRESL. Both apical and basal views of a free sandstone cast with clinging leaf scars and stalk-like remain of shoot. Locality Podhorní Újezd near Hořice, eastern Bohemia, Peruc Formation, Cenomanian. F 149, nat. size. Photo M. Páralová.

6. *Dammarites albens* PRESL. A part of carbonized leaf. Locality Hloubětín brick-kiln, Prague, central Bohemia, freshwater claystones of the Peruc Formation, Cenomanian. F 144, ca 1,5 X. Photo M. Páralová.

PLATE V.

1—4. *Dammarites albens* PRESL. Free sandstone cast with preserved stalk-like part of the shoot. Four different views of the same specimen: 1 — apical, 2 — lateral, 3 — basal and 4 — opposite lateral view. Locality Nehvizdy, Peruc Formation, Cenomanian. F 148, ca. nat. size. Photo M. Páralová.

5, 6. *Dammarites albens* PRESL. The specimen figured in Velenovský 1885, Pl. 4, fig. 9 as *Krannera mirabilis* CORDA in lit. About 2 cm long remain of the shoot preserved. Traces of leaf scars are observable on the surface of the shoot (fig. 6). Locality Jičín, eastern Bohemia, Peruc Formation, Cenomanian. F 139, nat. size. Photo M. Páralová, sketch the author.

7. *Dammarites albens PRESL.* Apical part of poorly preserved sandstone cast of cone-like stem (lower part of the figure) and outer impression belonging to it (upper part of the figure). Spiral arrangement of the leaves can be seen. Locality Nehvizdy, Peruc Formation, Cenomanian. F 170, nat. size. Photo M. Páralová.

PLATE VI.

1. *Dammarites albens* PRESL. A sandstone cast with destroyed surface. Only the pits between the scars are preserved. Locality Nehvizdy, Peruc Formation, Cenomanian. F 171, nat. size. Photo M. Páralová.

2, 3. *Dammarites albens* PRESL. Basal view of free sandstone cast. Radially oriented pyramidal cavities are visible as well as the remain of the shoot. The shape and position of the cavities correspond with the surrounding leaf scars on the surface. The cavities towards the axis of cone-like stem resembling the structure of coniferous cones (see also Description and Discussion). Locality Nehvizdy, Peruc Formation, Cenomanian. F 169, nat. size. Photo M. Páralová, sketched by the author (fig. 2).

4. *Dammarites albens* PRESL. Part of carbonized leaf. Locality Hloubětín brickkiln, Prague, central Bohemia, freshwater claystones of the Peruc Formation, Cenomanian. F 143, nat. size. Photo M. Páralová.

5. *Dammarites albens* PRESL. Part of carbonized wide ribbon-shaped leaf. Locality Hloubětín brickkiln, Prague, central Bohemia, freshwater claystones of the Peruc Formation, Cenomanian. F 142, nat. size. Photo M. Páralová.

PLATE VII.

1—3. *Dammarites albens* PRESL. The claystone impression of the cone-like stem. At the base of it remains of the leaves are visible in natural position, bearing particules of the coal matter with cuticles. The arrows show the place from which the sample for cuticular analysis was gained. (See also Pl. 8, figs. 1—6). The leaves cover the underlying leaf scars and copy their shape (3). Locality Hloubětín brickkiln, Prague, central Bohemia, freshwater claystones of the Peruc Formation, Cenomanian. F 141, nat. size (1) and ca. 3,5 × (2,3). Photo M. Páralová.

PLATE VIII.

1, 2. *Dammarites albens* PRESL. Upper (1) and lower (2) epidermis of the leaf. From the specimen F 141 (see Pl. VII, figs. 1—3). Stronger cutinization of transversal walls of epidermal cells (1) and part of stomatal row (2). Locality Hloubětín, Prague, Cenomanian. Preparations F 155 a, b, ca. 200×. Photo the author.

3. *Dammarites albens* PRESL. Lower epidermis with distinctive single rows of stomata. Locality Hloubětín, Prague, Cenomanian. From the specimen F 000. Preparation F 000, co 63 ×. Photo the author.

4. *Dammarites albens* PRESL. Lower epidermis of undermacerated leaf. Locality Hloubětín, Prague, Cenomanian. From the specimen F 167. Preparation F 168, ca. 160 ×. Photo the author.

5, 6. *Dammarites albens* PRESL. Two details of stomata on the lower epidermis of the specimen F 158. Locality Vyšehořovice, east of Progue, freshwater claystones of the Peruc Formation, Cenomanian. Preparation F 157, ca. 200 ×. Photo the author.