

ON SOME "NORTHERN" ELEMENTS IN THE LOWER GONDWANA FLORA OF VEREENIGING, TRANSVAAL

by

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ABSTRACT

A small assemblage of plant elements from the Lower Permian of Vereeniging, in the southern Transvaal, is described here. The assemblage is constituted of form-genera normally only found in the palaeofloristic regions of the northern hemisphere. The genera concerned are: *Pecopteris* (*Asterotheca*), *Cladophlebis*, *Sphenophyllum* and *Psymphyllum*. The intermingling of these "Northern" elements with the *Glossopteris* flora of Vereeniging serves to illustrate the mixed nature of this flora. Reference is made to similar mixed Gondwana floras elsewhere in Africa and also in South America.

INTRODUCTION

The specimens described in this paper represent plants belonging to genera of the northern hemisphere. Hence they are frequently referred to as "Northern" elements. Their occurrence at Vereeniging is of special interest since such elements are not characteristic of the Lower Gondwana flora of this locality. The genera concerned are: *Pecopteris* (*Asterotheca*), *Cladophlebis*, *Sphenophyllum* and *Psymphyllum*.

The type material consists of impressions in a fine-grained matrix and no organic matter remains. Identification is consequently based on external morphology only. The plant remains come from a rich fossiliferous horizon in the Lower Permian Coal-measures of Vereeniging. The stratum concerned is composed of a soft laminated clay which is exposed at Leeuwkuil, a famous site situated about 6 km south of the town. The specimens concerned come from a zone known as Layer A, Quarry No. 2, Leeuwkuil (Le Roux, 1963). The material is now housed in the museum of the Bernard Price Institute for Palaeontological Research at the University of the Witwatersrand, Johannesburg.

DESCRIPTION OF MATERIAL

PTEROPSIDA OF UNCERTAIN SYSTEMATIC POSITION

Genus *Pecopteris* Brongniart

This genus includes plants with fern-like foliage which may show similarity in gross morphological features in sterile fronds. In the absence of reproductive organs it is impossible to establish the natural affinities of such plants, however. Some pecopterids are known to have borne seeds and were therefore probably pteridospermous plants. On the other hand some species bore marattiaceous sporangia and are referred to the genus *Asterotheca*. Where both sterile and fertile

fronds are known to occur on the same plant the two genera are combined in the name *Pecopteris* (*Asterotheca*), with the genus *Pecopteris* taking priority according to the rules of nomenclature.

Pecopteris (*Asterotheca*) *singeri* Archangelsky

Plate I, Figures 1, 2 and 3

This species was originally described from the Lower Permian of Argentina by Archangelsky (1958). A more detailed description was subsequently given by Archangelsky and De la Sota (1960). More recently a plant from Wankie, Rhodesia, was referred to this species by Huard-Moine (1964) and Lacey and Huard-Moine (1966).

Material

The specimens available for study are marked: PAS/1–3 (Figures 1, 2 and 3), PAS/4, 5 (not figured).

Description (Figures 1–3)

The pinna is acuminate pointed and terminates in an elongated wedge-shaped lobe. The pinnules are obtusely pointed and are attached by the whole broad base to the rachis of the pinna. The pinnules are alternately placed and inserted at an angle of approximately 70 degrees to the rachis, which has a width of 1.5 mm at its maximum. Opposite rows of pinnules are sometimes of unequal length. The maximum length of a pinnule is 13 mm and the width at the base is 5 mm. The pinnules are slightly decurrent. The margins are more or less parallel in the apical region, but slightly curved near the base. There is a strong median vein traversing the pinnule. Closely-spaced synangia are borne along the margins of the pinnules on either side of the median vein. The synangia are oval to sub-circular in shape, numbering 9–10 on either side; each synangium having a diameter of 1–2 mm. The nature of sterile pinnules is unknown at present.

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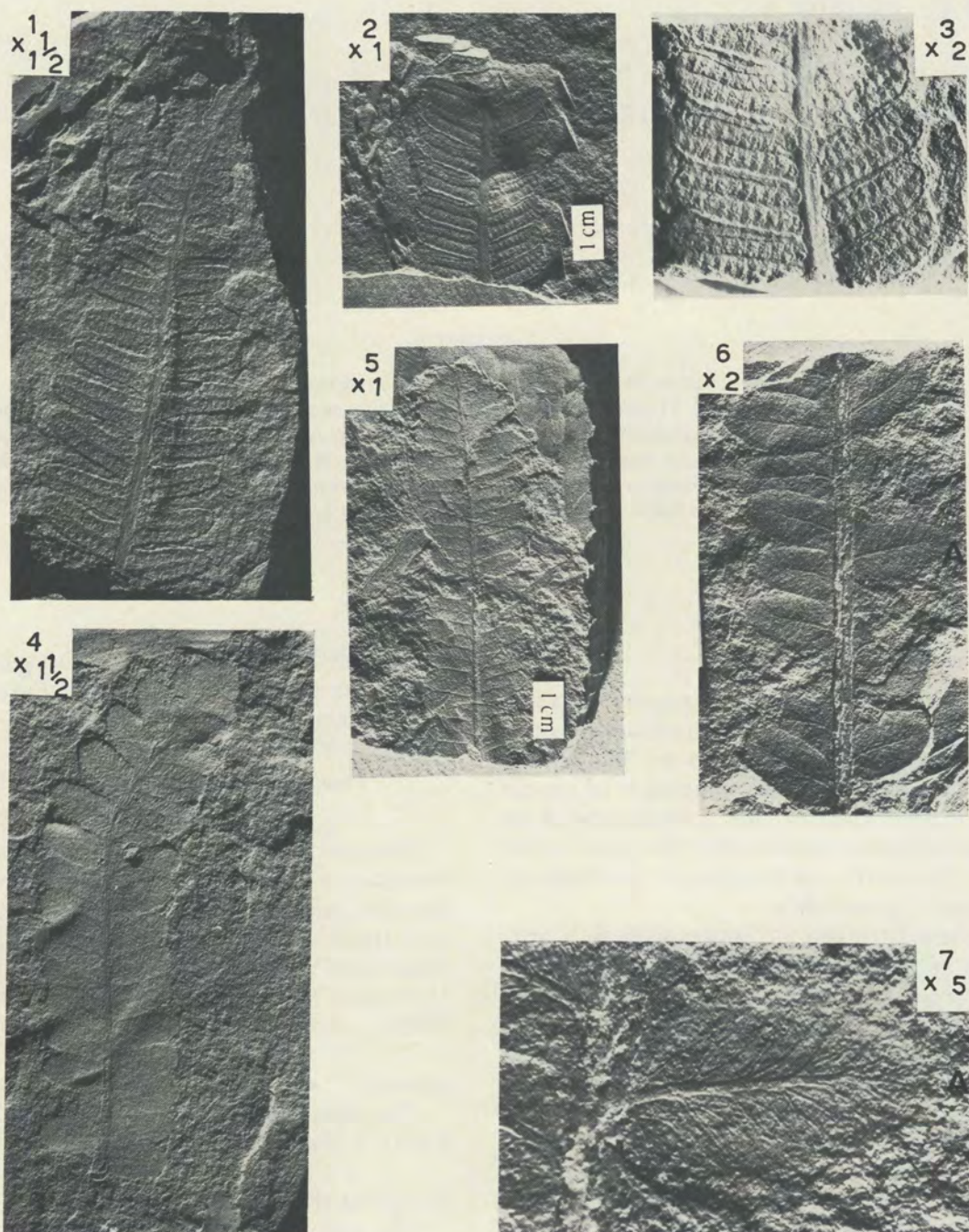


PLATE I

Pecopteris (Asterotheca) singeri Archangelsky.

Figure 1. Apical portion of a fertile pinna showing broad base of pinnules and prominent median vein. (Magnification $\times 1\frac{1}{2}$.)

Figure 2. Fragment of a fertile pinna showing the arrangement of the sori on the pinnules. (Natural size.)

Figure 3. The same specimen as shown in Figure 2 enlarged twice to show more detail of the sori.

Pecopteris (Asterotheca) cf. plumsteadiae Huard-Moine.

Figure 4. Apical portion of a sterile pinna showing flexuous nature of the pinna and obtusely pointed apex. (Magnification $\times 1\frac{1}{2}$.)

Figure 5. Portion of a sterile pinna showing slightly decurrent median veins, forked secondary veins and parallel sides of the pinnules. (Natural size.)

Cladophlebis cf. nebbensis Brongniart.

Figure 6. Portion of a sterile pinna showing shape and arrangement of the pinnules (Magnification $\times 2$.)

Figure 7. The pinnule at "A" in Figure 6 magnified 5 times to show the venation.

Comparisons and discussions

A close comparison is possible between the new plant and a fertile pecopterid from Wankie, referred to *Pecopteris* (*Asterotheca*) *singeri* Archangelsky by Huard-Moine (1964) and Lacey and Huard-Moine (1966). With the exception of a small difference in the size of the pinnae of the two plants, they seem to be identical in other respects. The same remarks seem valid when comparing the Vereeniging plant with the Argentinian type material described by Archangelsky (1958) and Archangelsky and De la Sota (1960). Unfortunately a comparison with regard to sterile pinnules has not been possible owing to the lack of such specimens in the case of the Vereeniging plant. In view of the strikingly close resemblance between the fertile pinnules of the latter and those of *Pecopteris* (*Asterotheca*) *singeri* there seems to be little doubt that the two plants are specifically identical.

Pecopteris (*Asterotheca*) *plumsteadiae* Huard-Moine

This species was first described from Wankie by Huard-Moine (1964).

Pecopteris (*Asterotheca*) cf. *plumsteadiae* Huard-Moine

Figures 4 and 5

Material

The specimens available for study are: PAP/1,2 (Figures 4 and 5), PAP/3 (not figured).

Description (Based on sterile pinnae only. See Plate I, Figures 4 and 5).

The pinna is flexuous and terminates rather abruptly in a bluntly-pointed lobe. The pinnules have rounded apices and parallel sides. The pinnules are alternately placed and attached nearly at right angles to the rachis. The maximum size of a pinnule is 10 mm long and 4 mm wide. The primary vein is slightly decurrent and the secondary veins are given off obliquely from it. The veins fork once and there are normally 5 secondary veins on either side of the median vein.

Comparisons and discussions

The superficial features of the plant described here seem to be very similar to those of a new pecopterid described from Wankie by Huard-Moine (1964). Since no fertile specimens are available of the Vereeniging plant, a closer comparison between the two plants concerned is not possible. Under the circumstances it is therefore proposed to refer the new plant provisionally to the Wankie species.

Genus *Cladophlebis* Brongniart

Some fragmentary remains of a fern-like plant, found in Lower Gondwana (Middle-Ecca) sandstone near Vereeniging, were first recorded by Seward and Leslie (1908), who identified the plant as *Callipteridium* sp. but at the same time remarked that it closely resembled *Cladophlebis roylei* Arber. Recently Plumstead (1961, 1966a, 1969) mentioned that the genus was represented in the Vereeniging flora. No examples of

such plants were figured or described, however, by the latter author.

Cladophlebis cf. *nebbensis* Brongniart

Figures 6 and 7

Material

The specimens available for study are marked: CLA/1 (Figure 6); CLA/2 (not figured).

Description (Figures 6 and 7)

The pinnules are obtusely pointed and placed alternately at a wide angle to the strong rachis of the pinna. The margins are entire and nearly parallel. The pinnules are 7–9 mm long and 3–5 mm wide, and are attached by the whole width of the base. The primary vein is slightly decurrent and terminates before reaching the extreme end of the pinnule. The secondary veins are given off obliquely and fork once.

Comparisons and discussions

The specimen figured here is a portion of a sterile pinna which shows a very strong resemblance to a plant recorded from Wankie, Rhodesia, and described by Walton (1929) as *Cladophlebis* sp. Supplementary material from the same locality was subsequently referred to *C.* cf. *nebbensis* Brongniart by Huard-Moine (1964) and Lacey and Huard-Moine (1966). The Vereeniging plant is found to be identical to the Wankie species with respect to gross morphology and it is therefore proposed to apply the same specific name to the former plant.

SPHENOPHYLLALES

Genus *Sphenophyllum* Brongniart

Plants belonging to this genus form a minor constituent in the Vereeniging fossil flora. The occurrence of such plants in this flora was mentioned by Plumstead (1961, 1966a, 1966b) but no actual specimens were described.

The scanty remains of a single species is described here for the first time.

Sphenophyllum cf. *thonii* Mahr

Plate II, Figures 8, 9, 10

Material

The following specimens are available for study: SPHY/1 (Figure 10), SPHY/2 and SPHY/2a (counterparts — Figures 8 and 9).

Description (Figures 8–10)

Specimen I (Figure 10)

This specimen shows a portion of a shoot with two incomplete whorls of leaves spread out in one plane and attached to a slender axis having a diameter of 2 mm. The leaves are triangular in shape with the lateral margins more or less straight and the distal margin slightly curved. The lateral margins are entire and the corners are rounded. The leaves are 15 mm wide at the

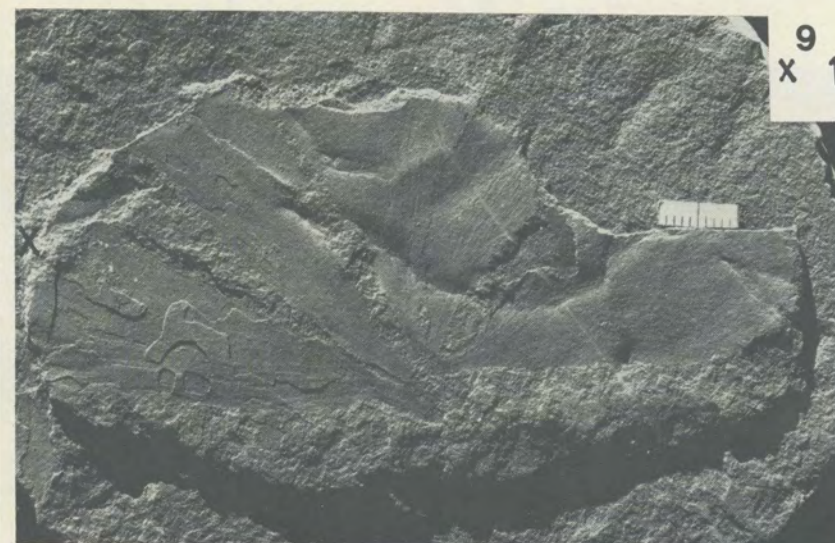


PLATE II

Sphenophyllum cf. *thouii* Mahr.

Figures 8 and 9. Counterparts showing a detached whorl of 5 leaves with indications of forked veins on some leaves. Note remnants of a sixth leaf superimposed on the leaf at "X". (Natural size.)

Figure 10. Two incomplete whorls of leaves on a portion of stem. Note the typical verticillate arrangement of the wedge-shaped leaves, and slender stem. (Natural size.)

apices and the overall length is 25 mm. The venation is obscure and cannot be made out.

Specimens 2 and 2a (Figures 8 and 9)

This fossil is preserved in two counterparts, showing a whorl of 5 leaves with indications of a possible sixth leaf overlying one of the outer leaves. The leaves are wedge-shaped and have a maximum width of 20 mm and a length of 50 mm. The nerves are very indistinct but two primary veins appear to enter the leaves at the base and by repeated forking produce many secondary veins spreading out fan-wise throughout the leaves.

Comparisons and discussions

The poor preservation of the specimen figured (Figure 10), does not permit a close comparison with any known species of *Sphenophyllum*. Considering the shape and size of the leaves there seems to be a resemblance to *S. thonii* var. *minor* Sterzel, a Cathaysian element recorded by Halle (1927) from the Shihotse flora of China. A similar comparison can be drawn between the Vereeniging plant and a similar species recorded from Wankie (Walton, 1929). Subsequent investigations of the Wankie flora by Huard-Moine (1965) and Lacey and Huard-Moine (1966) led these authors to the conclusion that there was little justification for Sterzel's institution of the varietal species *S. thonii* var. *minor*, and this name was consequently abandoned for the Wankie species in favour of *S. thonii* Mahr.

On the strength of the above conclusion the Vereeniging specimen is tentatively referred to *S. cf. thonii* Mahr.

The specimens in Figures 8 and 9 show some resemblance to *Benlightfootia mackii*, an element in the Wankie flora recorded by Lacey and Huard-Moine (1966). The characteristic notching of the leaves of that plant is completely absent in the Vereeniging specimen, however. The fossil is believed to represent a detached whorl of leaves which was possibly derived from a larger specimen of the same species of plant as that shown in Figure 10. It is, therefore, tentatively included in this description with some hesitation.

? GINKGOALES

Genus *Psygmyphyllum* Schimper

This genus was previously recorded from Vereeniging (Seward, 1903; Le Roux, 1970). Additional information concerning the genus was recently revealed by a new discovery. It is thought appropriate to include the description of this supplementary material in the present paper since *Psygmyphyllum* is essentially also a northern hemisphere genus.

Psygmyphyllum kidstoni Seward

Plate III, Figures 11 and 12

Material

The following specimens are available for study: PS/4 and PS/4a (counterparts — Figures 11 and 12).

Description (Figures 11 and 12)

The specimens described here represent counterparts showing a portion of a shoot bearing simple leaves on a very stout axis having a maximum width of 15 mm. The leaves are cuneate and the lamina is contracted into a long basal portion resembling a petiole. The leaves appear to be spirally arranged on the axis. The laminae are torn, making it difficult to determine the exact shape and degree of original lobing. The venation is badly preserved, but the veins can be seen to spread out from the base of the laminae and are repeatedly forked. No lateral anastomosis can be detected.

Discussion and comparisons

Compared with *P. kidstoni* the axis of the new specimen is much broader than that of Seward's type specimen. Furthermore the leaves of the latter are longer, more elongated and more distinctly lobed than those of the new specimen. It is believed that the difference between the two specimens could be due to the possibility that the type specimen was derived from the terminal end of a foliage shoot while the new specimen apparently represents a basal portion of a shoot of the same species of plant. An isolated, wedge-shaped leaf was previously recorded from Vereeniging (Le Roux, 1970) and at the time of its description was provisionally referred to *P. kidstoni*. The close resemblance of this leaf to those of the new specimen suggests a mutual parent plant and the latter is, therefore, referred to *P. kidstoni*.

CONCLUSIONS AND DISCUSSION

The intermingling of the *Glossopteris* flora of Vereeniging with northern elements has been known for some time (Le Roux, 1949). Recently Plumstead (1961, 1966a, 1969) discussed the significance of this fact in the light of recent discoveries at Vereeniging. Since she did not describe any of these elements the present description of an assemblage of such plants must be regarded as an attempt to fill this gap partly.

Similar examples of mixed floras are known to occur elsewhere in Africa and have been recorded by Walton (1929), Lacey and Huard-Moine (1966) and Teixeira (1950).

In South America Archangelsky (1958) and Archangelsky and De la Sota (1960) recorded northern elements intermingling with the Gondwana flora of Santa Cruz. Subsequently Arrondo (1972) gave a comprehensive list of plants recorded from the Golandrana formation of Santa Cruz, reflecting the large number of northern elements present in the Gondwana flora of Argentina.

The significance of northern elements in the Gondwana flora has been the subject of much discussion and has recently been summarised by Archangelsky (1967) in his discussion on the Permian flora of Argentina.

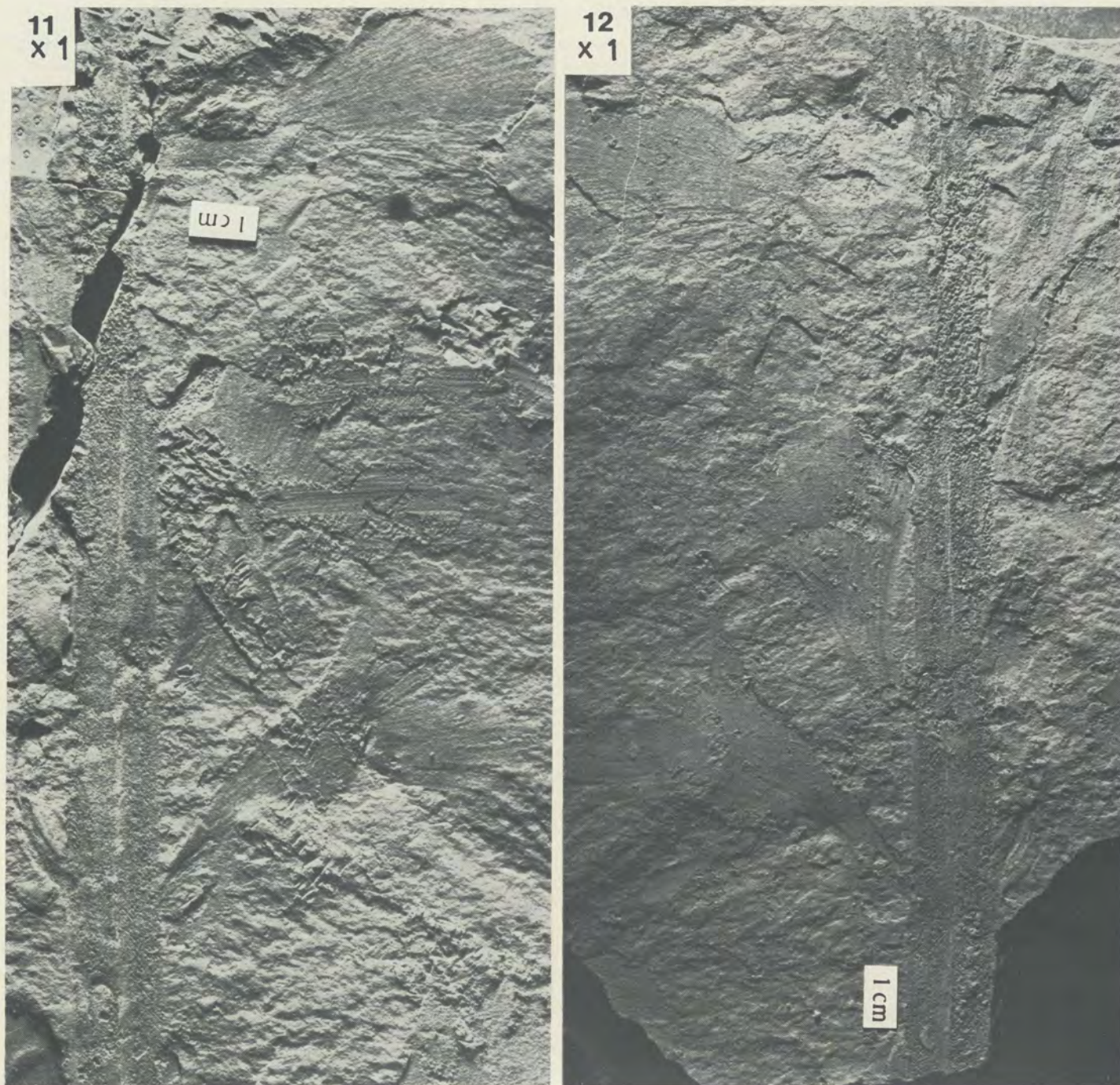


PLATE III

Psygmothylum kidstoni Seward.

Figures 11 and 12. Portion of a foliage shoot showing strong woody axis and cuneate leaves in counterparts. (Natural size.)

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