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ON *ARAUCARITES ROGERSII* SEWARD FROM THE LOWER CRETACEOUS KIRKWOOD FORMATION OF THE ALGOA BASIN, CAPE PROVINCE, SOUTH AFRICA

by

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ABSTRACT

Araucarites rogersii Seward from the Kirkwood Formation (Lower Cretaceous) of South Africa, is redescribed based on new fossil material including a single compressed cone. Some additional observations on the flora and environment of the Early Cretaceous in the Algoa Basin are made.

INTRODUCTION

Araucarites rogersii Seward is one of the most common fossil plant organs found in the Kirkwood Formation of South Africa. The genus *Araucarites* Presl is a widespread Mesozoic group of coniferous foliage and seed cone scales with affinities to those of the extant Araucariaceae.

Since Seward's (1903) description of the flora of the Uitenhage Series is the latest detailed work on the Lower Cretaceous fossil flora of South Africa, the present work will attempt to update Seward's description of *Araucarites rogersii* based on the increased number of specimens now available and particularly on a new find of a partially compressed cone assigned to this species.

SYSTEMATIC PALAEOBOTANY

Order: Coniferales
Family: Araucariaceae
Genus: *Araucarites* Presl
Araucarites rogersii Seward 1903

Araucarites rogersii Seward 1903: 37–38, Plate 6, Figures 4–7.

Diagnosis emended

Ovulate conifer cone, subcylindrical, compact, bearing helically inserted seed scales, fused to subtending bracts. Bract-scale complexes subcircular to deltoid, as long as broad, central 1/3 thick, fibrous, lateral extensions of scale thin, laminar, with fine elongate hexagonal reticulations; scale free near bract apex, semi-circular in outline, and scale with a single obovate seed, per scale.

Locality

Kirkwood Formation, Lower Cretaceous. 14 km east of Kirkwood 3/4 km south-west of Dunbrody Station. Along the west facing bluff on the east side of Bezuidenhout's River, Cape Province, South Africa.

Nomenclature

Seward's specific epithet *rogersi* is altered to *rogersii* according to the recommendations of the International Code of Botanical Nomenclature. This change requires no alteration in the species authorship.

Description

Seward's description and diagnosis are quite accurate except for his failure to note the "ligule" or free seed scale apex. Measurements of the specimens of isolated seed scales give an average median length of 2,5 to 3,0 cm with the width of the broadest portion of the scale measuring 2,0–3,0 cm. The very thin laminar wings of the seed scales are most often indifferently preserved but, when present, give a more nearly subcircular outline to the whole scale (figs. 4, 7, 8). The central one-third of the scale is a massive, very fibrous, narrowly deltoid area that widens smoothly from the base to the apex (figs. 1–8). Only rarely is there evidence of a continuation of the thin lateral wings across the distal portion of the apex. Usually the apex is truncate with the fibrous central portion extending to the distal edge (figs. 1–8).

Seward's (1903) Plate 6, Figure 4 and description includes a mucronate or narrowly prolonged apex for the bracts; these extensions of the apex have not been found in any of the recently collected material. Clearly defined seeds have not been found either, and the original description of these is accepted (Seward, 1903).

The abaxial surface of several scales shows, near the bract apex, the impression of a semicircular or acutely pointed free scale tip (figs. 3, 4, 5, 7). The shape and position of these structures is consistent with the position of free scale apices in extant araucarian scales. It is most probable that these are only visible in adaxial view since not all the scales show such impressions (fig. 6).

The cone here assigned to *Araucarites rogersii* is obliquely compressed but is 4,5 cm long and about 2,5 cm wide (figs. 1, 2). Because most of the cone-scale specimens of *Araucarites rogersii* are found detached, it seems likely that the cones shattered when mature to facilitate seed dispersal as in modern Araucariaceae (Dallimore and Jackson, 1966). The small size of the cone would then be consistent with

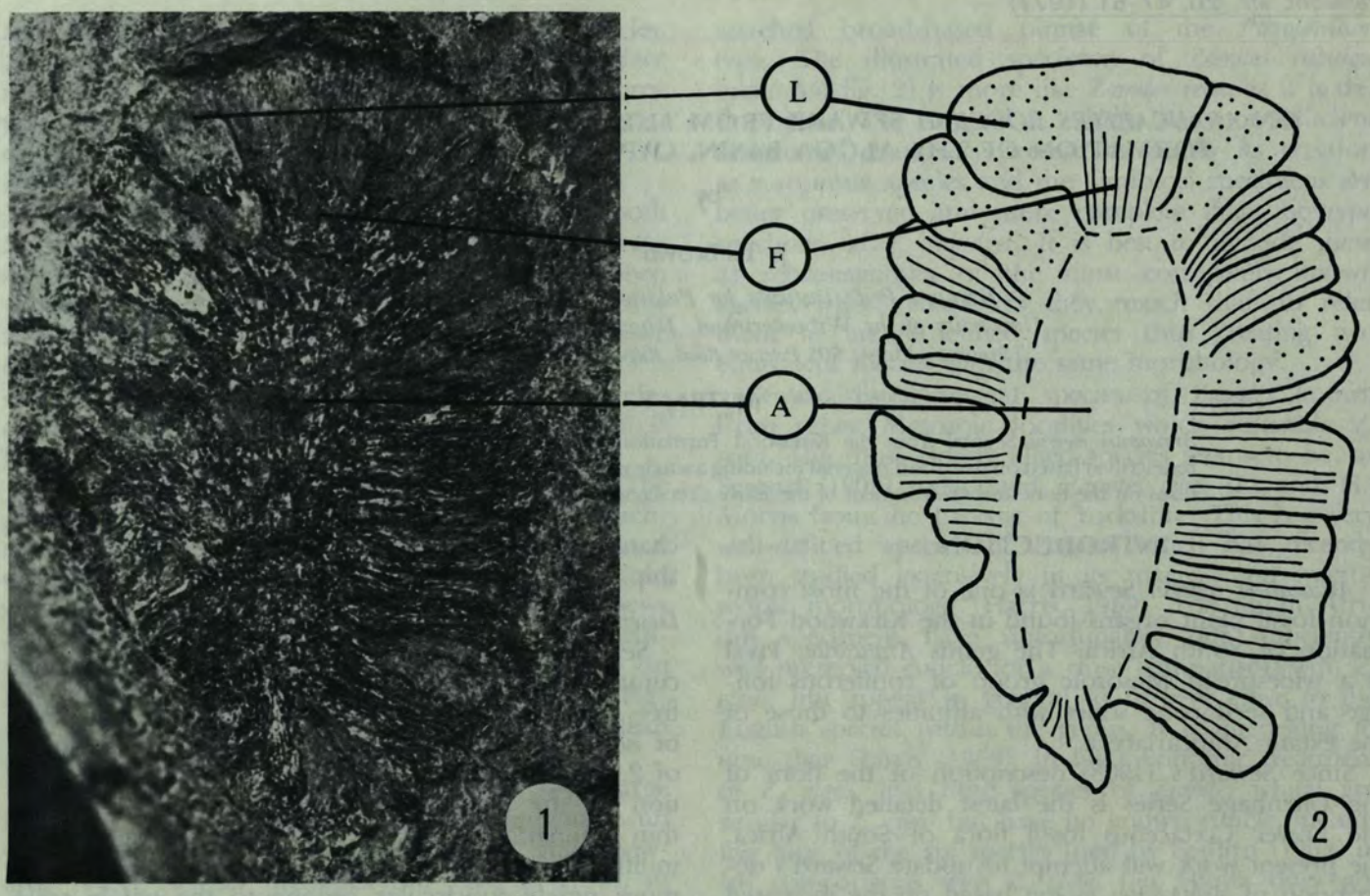


Figure 1. *Araucarites rogersii* BPI (Pal) PB 163. × 2. L. laminar wing of cone scale. F. fibrous centre of cone scale. A. fibrous axis of cone.

Figure 2. *Araucarites rogersii*. Interpretation of cone PB 163. As shown in Figure 1.

an assumption of immaturity. Scales of the cone measure 1,0 cm long, about 1/3 that of dispersed scales. The axis of the cone is about 0,5 cm in diameter (figs. 1, 2).

The best evidence for assigning the cone to this species lies in the massive fibrous nature of the central portion of the scales. These fibrous areas are easily seen on the fractured surfaces of the scales attached to the cone axis (fig. 1). They are also abundant in the exposed end of the cone axis itself (fig. 1). Where the matrix of the rock is evenly broken near the cone apex, the scales can be seen in cross section as flattened ellipsoidal bodies extending laterally into fine laminar extensions. This configuration too is consistent with the known structure of the isolated scales of *A. rogersii*.

Discussion

Morphologically *Araucarites rogersii* is rather securely established as a coniferous megasporangiate cone with affinities in its structure to the modern Araucariaceae. Structurally, *Araucarites rogersii* has many superficial similarities to the seed cone of the extent genus *Araucaria,* a genus which is known to extend from the Jurassic through to the present.

However, there are not enough detailed characters known for *Araucarites rogersii* to include it confidently in the modern genus *Araucaria*. We know at present nothing of the vegetative leaves, stem anatomy, or even the cone anatomy, all of which should be available before a fossil cone is definitely assigned to a genus with living representatives. It seems more precise to indicate this lack of knowledge by using a fossil organ genus with less demanding characters than to create a possibly mistaken correlation based on insufficient evidence.

Seward (1903, 1919) mentions the close resemblance of this South African species to *Araucarites* species recorded from India and the Lower Cretaceous of North America.

One species, *A. cutchensis* Feistmantel, has been reported from both the Lower Cretaceous of India and the Grahamland flora of Antarctica (Halle, 1913). *Araucarites cutchensis* chiefly differs from *A. rogersii* in the shape and size of the free scale apex. Halle (1913, fig. 16) clearly illustrates the elongate attenuate free scale apex of *A. cutchensis*. This is quite distinct from the semicircular acute free scale apex of *A. rogersii*. *Araucarites wyomingensis* Fontaine is a second species compared by Seward to *A. rogersii*; it is, however, consistently smaller than *A. rogersii*, measuring 1,2 cm in length by 0,9 cm in width.

There are two well-defined species of *Araucarites* from the Lower Cretaceous Ticó flora of Argentina

(Archangelsky, 1966). *Araucarites bagueroensis* Archangelsky is smaller than *A. rogersii* and has a very different shaped free scale which is separated from the bract laterally by a prominent ridge. The second species from Ticó, *Araucarites minimus* Archangelsky, is as the name implies very small, only 0,8 cm wide by 0,7 cm long, far smaller than *A. rogersii*.

Other Indian species of *Araucarites* also differ in detail from *A. rogersii*. *Araucarites fibrosa* Sukh-Dev and Bose is larger than *A. rogersii*, measuring up to 6 cm long by 4,4 cm wide and has an obviously mucronate tip which has seldom been encountered in *A. rogersii*. *Araucarites macropterus* Feistmantel is deltoid in shape with a less pronounced laminar wing (Sukh-Dev and Bose, 1972). Two Jurassic *Araucarites* from India, *A. bindrabunensis* Vishnu-Mittre and *A. nipaniensis* Singh, are also quite distinct. *Araucarites bindrabunensis* is known from a petrification but its scales are less than one-third the size of those of *A. rogersii* and wedge-shaped with a 3 to 5 mm long tip (Vishnu-Mittre, 1954). *Araucarites nipaniensis* has a very extensive wing, a much less fibrous central area, and has no free scale (Singh, 1956). Seemingly, *A. rogersii* is a morphologically distinct form when compared to these other species of *Araucarites* from similar age strata.

Araucarites rogersii is not a distinct indicator of an Early Cretaceous age for the flora. Species of *Araucarites* have been reported from the Jurassic and Cretaceous (Seward, 1919). The best evidence from megafossil remains comes from the abundant occurrence of *Onychiopsis psilotoides* (Stokes and Webb) Ward (=*O. mantelli* Seward), a widespread species of fern usually assigned to the Wealden or its equiva-

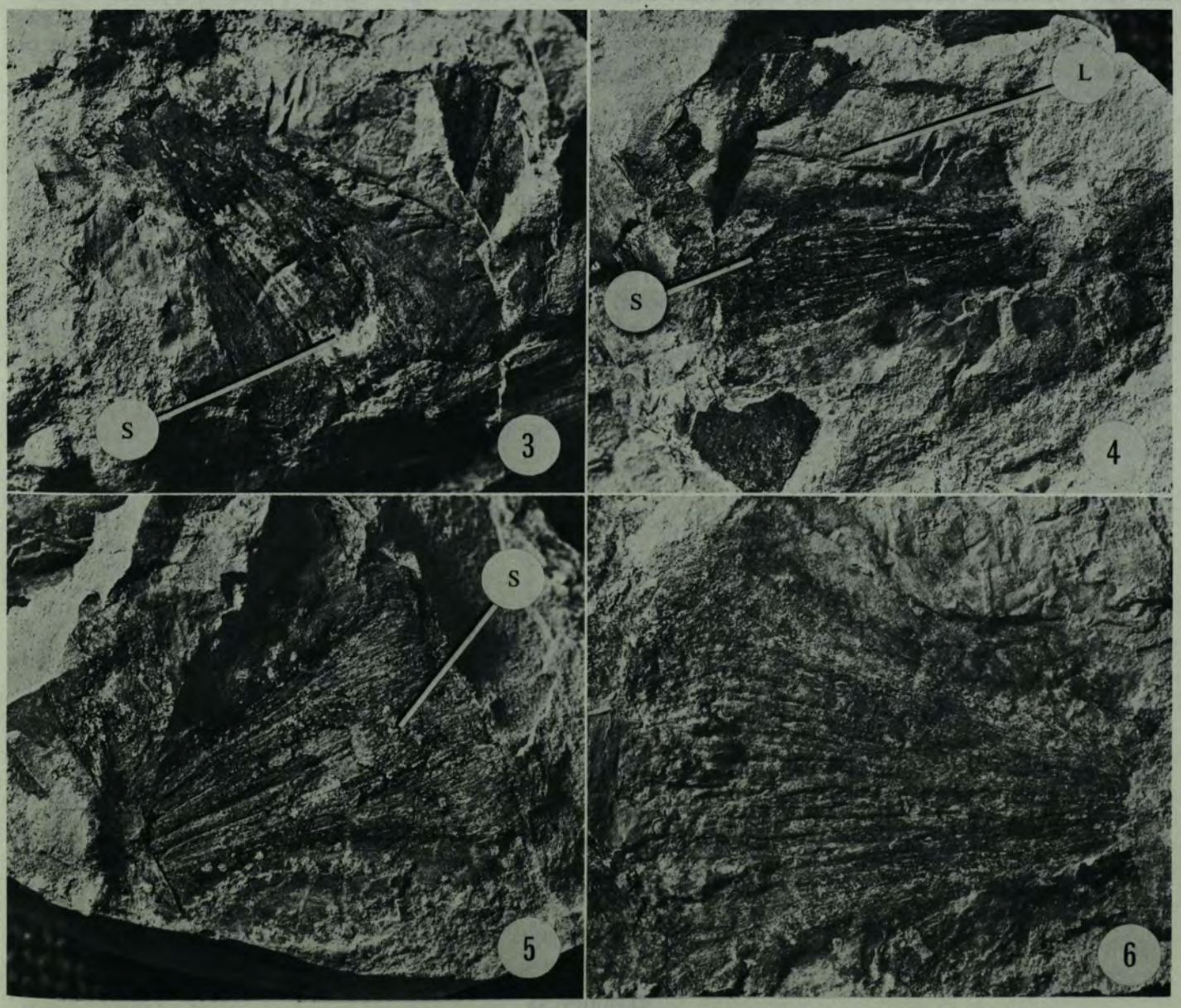


Figure 3. *Araucarites rogersii* BPI (Pal) PB 164. × 2. Single detached cone scale with a free scale apex shown S.
Figure 4. *Araucarites rogersii* BPI (Pal) PB 165. × 2. Cone scale with broad laminary wing L.
Figure 5. *Araucarites rogersii* BPI (Pal) PB 166. × 2. Cone scale with free scale apex S.
Figure 6. *Araucarites rogersii* BPI (Pal) PB 167. × 2,5. Detached cone scale.

lent (Barnard, 1973). This fern occurs almost alone at the nearby Sunday's River locality, and several smaller fronds have been found with *Araucarites rogersii* at the Bezuidenhout's River locality.

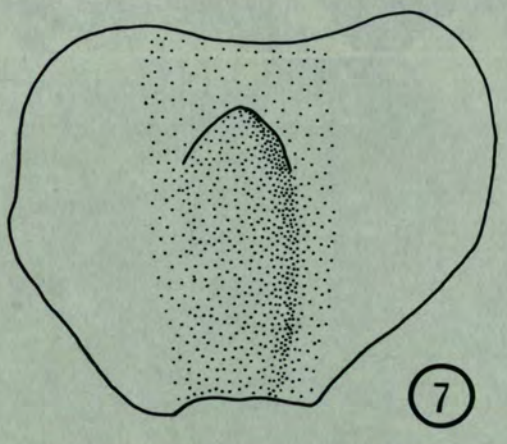
An interesting feature of the deposits in which *A. rogersii* is found is the relative lack of vegetative remains of conifers. Seward (1903) reported only two forms, *Brachyphyllum* and a single specimen he referred to *Taxites*. The collections available here have only a very few, small, poorly preserved fragments of a *Brachyphyllum* sp. and these do not occur at the same level as the cone scales. The *Taxites* type of conifer is unknown from the Bezuidenhout's River locality. It must be assumed that in the light of our present knowledge the cones of *Araucarites rogersii* were borne on the same tree that bore the *Brachyphyllum* foliage. Because some species of *Brachyphyllum* have cuticular characters which align them with the Araucariaceae, this seems to support the alliance based on cone-scale morphology (Kendall, 1947).

Little can be said to further our knowledge of the habit or surrounding environment based on the occurrence or morphology of *A. rogersii*. It has been noted that in Lower Cretaceous times conifers occupied a much broader geographic and physiographic range than at present (Hughes, 1973). The Kirkwood Formation is believed to have been laid down rapidly in the Algoa Bay-Kirkwood area and represents the continental-lacustrine facies of the series of strata of Early Cretaceous age in this area (Shone, 1976). An earlier paper pointed out one aspect of the rate of sedimentation during this time based on other plant fossils and their preservation (Brown and Gow, 1976). *Araucarites rogersii* was probably attached to a tree of considerable size, if its assignment to the family Araucariaceae is correct, which grew very near an area where rapid deposition took place due to periodic inundation with complete burial of the smaller plants which grew along the margins of the watercourses (Brown and Gow, 1976).

Since *A. rogersii* is assumed to have been attached to a large tree, the scattered organs which are found today must have been present on the soil when burial took place. Perhaps a seasonal variation in the shedding of the plant organs could account for the greater number of cone scales preserved relative to the vegetative leaves, if burial took place shortly after a large drop of cones and scales. This could account for the relative scarcity of vegetative parts compared to cone scales. The trees themselves may have been unaffected by the flooding which buried the isolated organs. Large pieces of silicified coniferous wood are found at different levels of the Kirkwood Formation; these may represent the trunks of *Araucarites rogersii*.

We may assume that there was a significant area of land which was covered with large coniferous trees close enough to the area for their scattered seed scales to be buried with the ferns which grew along the margins of the streams.

The picture of the flora in Early Cretaceous times of the area now surrounding the present Bezuidenhout's River near its entry into the Sunday's River is that of low-lying, well-watered land with bryophytes, ferns and cycads occupying the watercourse margins, while large coniferous trees bearing *Brachyphyllum* type foliage and *Araucarites* cones occupied the higher ground.



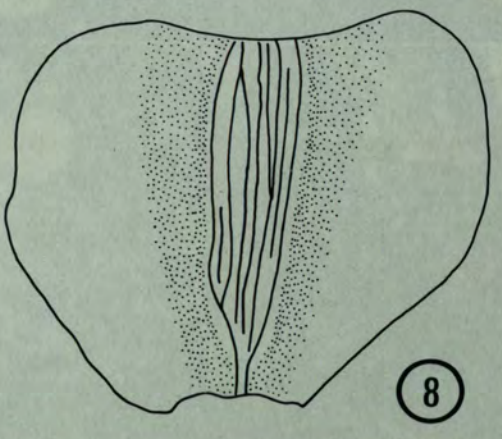


Figure 7. *Araucarites rogersii*. Diagrammatic reconstruction of the adaxial view showing free ovuliferous scale. Stipple represents thicker area of central bract and scale. × 2.

Figure 8. *Araucarites rogersii*. Diagrammatic view of abaxial surface showing central fibrous area of bract. × 2.

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