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NOTES ON TASMANIAN PINES
II. ATHROTAXIS FROM THE LOWER TERTIARY

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(With 2 text figures)

ABSTRACT

A species of *Athrotaxis* is described from the Lower Tertiary of the Buckland basin. With hesitation it is identified with *A. ungeri* (Halle) Florin from the Lower Cretaceous of Patagonia. The ecology of *Athrotaxis* is discussed.

INTRODUCTION

In the first of these notes some podocarps from a Lower Tertiary locality near Buckland were described. The same locality has yielded a species of *Athrotaxis*. *Athrotaxis* in the past was widespread in the Southern Hemisphere, though it is now endemic to Tasmania; its fossil record in Tasmania, however, is very uncertain.

I am indebted for help and criticism to Dr. W. M. Curtis and Dr. W. D. Jackson, University of Tasmania.

DESCRIPTION OF THE MATERIAL

Family TAXODIACEAE.

Genus **ATHROTAXIS** D. Don.

Athrotaxis ungeri (Halle) Florin.

Figs. 1 and 2.

1913 *Athrotaxites ungeri* Halle, pp. 40-44; pl. 2 figs. 11-17, pl. 3 figs. 13-20 ? 21, pl. 4 fig. 22, pl. 5 figs. 10-13, Lower Cretaceous, Patagonia.

1940 *Athrotaxis ungeri Halle;* Florin, p. 35. Change of name.

1963 *Athrotaxis ungeri* Halle; Florin, p. 202. Note only.

Locality: Tea Tree Rivulet, Buckland, Tasmania.

Diagnosis, emended. Shoots 2-4 mm. in diameter, with rounded apex, showing closely packed, spirally arranged scale leaves; usually one complete leaf and parts of two others seen on one side of the (now flattened) shoot. Leaves about 3 mm. long and 2.5 mm. wide (extremes, 4 x 2.75 mm. and 2.0 x 1.5 mm., at apex). Widest part about 0.75 mm. from leaf base, leaf contracted slightly towards leaf base and contracting above to a more or less acute apex. Compressed sideways, leaves about 1.0 mm. thick. Lower (abaxial) surface rounded, not keeled. Upper (adaxial) surface flat, consisting of a portion over the midrib about 0.75 mm. long and two narrow parts tapering from apex towards widest part of the leaf.

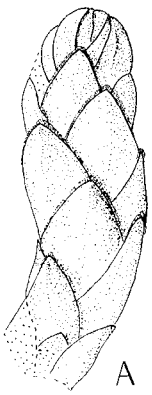
Cuticle on lower surface 5μ or more thick, on upper about 1.5μ. Leaf amphistomatic, stomata lying in two zones of indefinite outline on the lower leaf surface, and in two zones set close to leaf edge on the upper leaf surface; zones separated by triangular area over midrib, not reaching leaf apex. Stomata mostly orientated more or less longitudinally but no regularity of arrangement apparent. Epidermal cells away from stomata in indistinct longitudinal rows. Leaf margin ornamented along its whole length with a wing of long finger-like cells, joined lateraly over most of their length; wing up to 0.1 mm. wide at leaf apex.

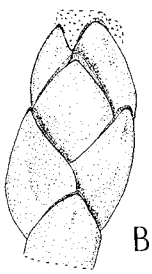
Epidermal cells on lower leaf surface more or less equidemsional, or slightly wider than long, about 40μ x 35μ, outlines thick, up to 7μ, straight, with rather indistinct edges, penetrating far down anticlinal cell walls, outlines sometimes pierced by holes. On upper leaf surface cells more or less rectangular, 38μ x 20μ outlines thin. No epidermal papillae or other ornament present. Stomata normally monocyclic, rarely incompletely dicyclic, subsidiary cells more or less equidimensional, 4-8, mostly 5 or 6 round each stomatal pit, set in a circle, scarcely or not divisible into lateral and terminal members. Stomatal pit overhung by collar of cutin arising from periclinal surface of subsidiary cells (not wall of stomatal pit), collar up to 7μ wide. Stomatal pit more or less round or slightly elongated parallel with the long axis of the pore, guard cells feebly cutinised, even around pore.

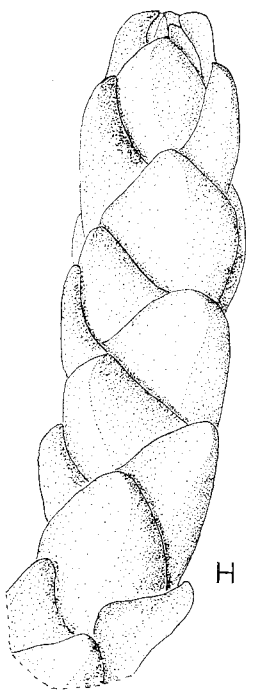
Marginal wing composed of single layer of cells, uniting proximally with both upper and lower leaf surfaces, composed of often transversly divided cells having finger-like ends.

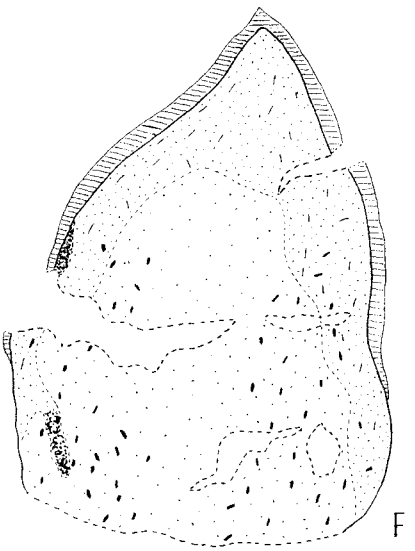
DESCRIPTION AND CLASSIFICATION

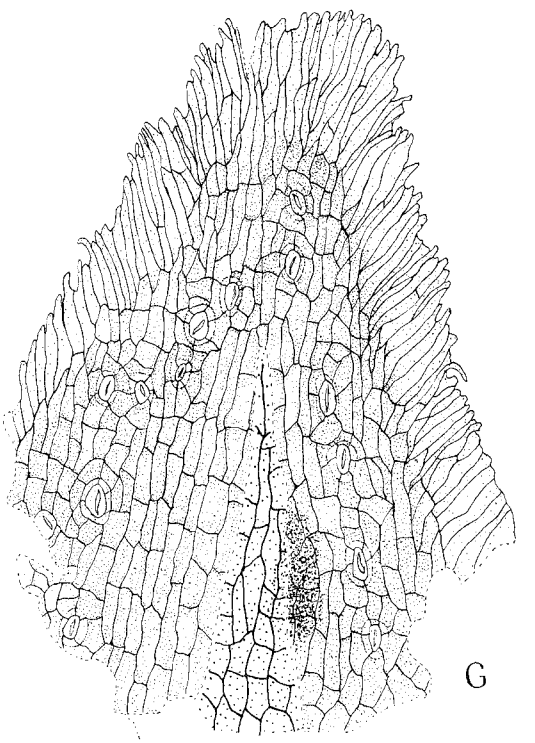
The material consists of short lengths of leafy shoots and is somewhat local in the Tea Tree material. None of the shoots show branching, but all show the leaf arrangement, and one, an apex (Figs. 1A, B, C-E). The leaf length was, however, obtained from isolated leaves, since on the shoots the leaf bases are covered up; the extent of the upper leaf surface was obtained from the cuticle (Fig. 1F). No veins were visible. The leaf showed no sign of a definite keel, in this resembling *living A. cupressoides* (Fig. 1H) the marked keel seen in some figures (e.g. Florin 1931, pl. 11 fig. 8) appears as the specimen is dried and is thus an artefact.

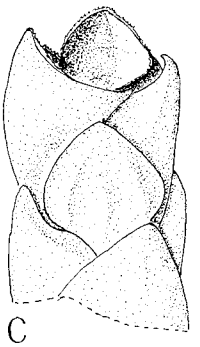


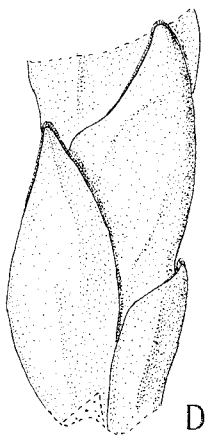












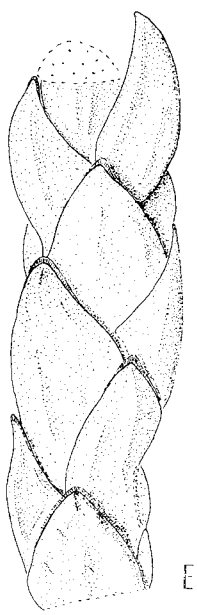
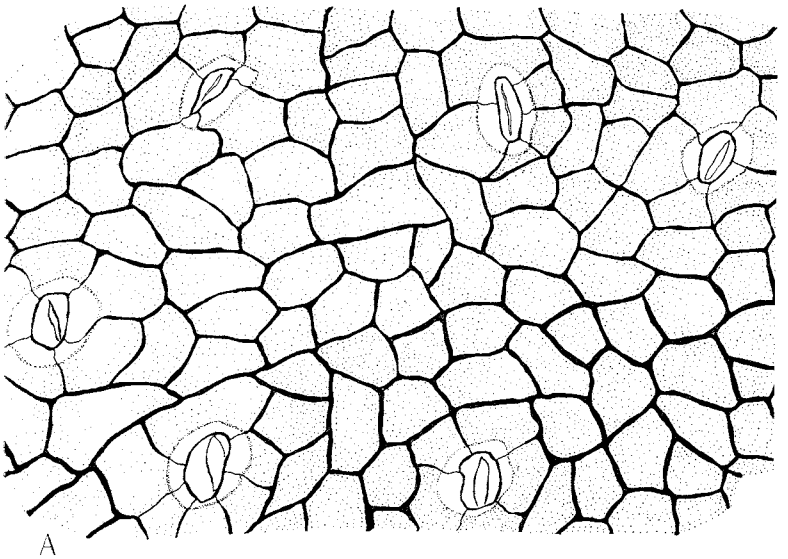
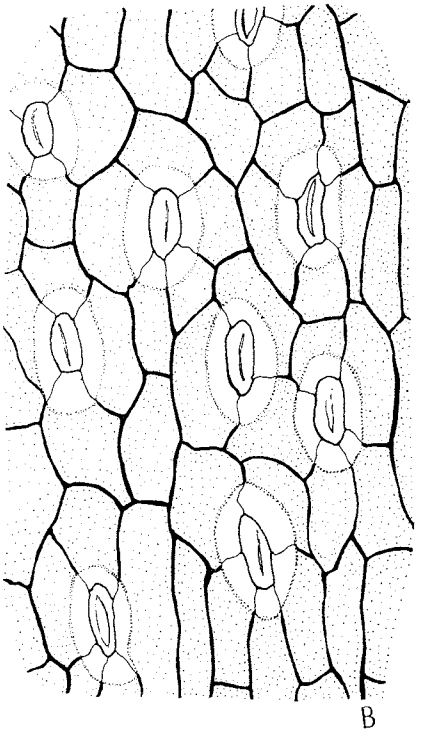
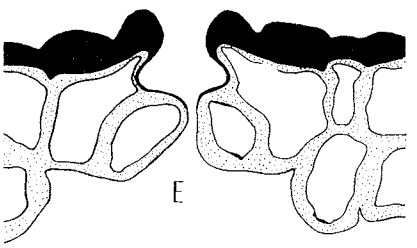
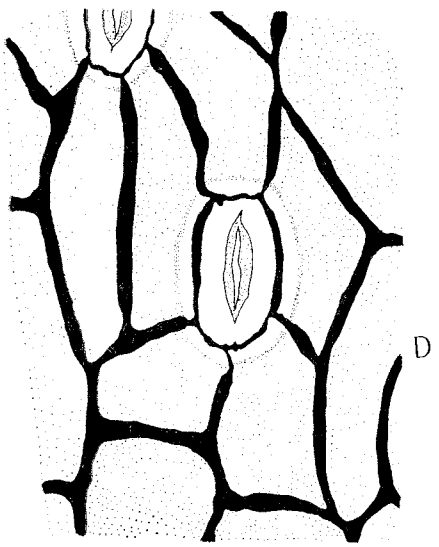


FIG. 1.—A-G: *Athrotaxis nugeri* and H, *A. cupressoides*. A-E: Fragments of shoots, showing leaf form and appearance of marginal wing. x 10. 81893-81895. F: A leaf macerated whole. Area of upper cuticle close stipple; stomata on upper surface fine lines, on lower heavy lines; marginal wing cross-lined. x 26. 81897. G: Leaf apex macerated, showing cells of marginal wing, cells and stomata of upper leaf surface, and some cells of lower leaf surface (heavy lines to centre). x 135. 81897. H: A shoot, to show leaf form. Draw from living material, *note* absence of a distinct keel. x 10.









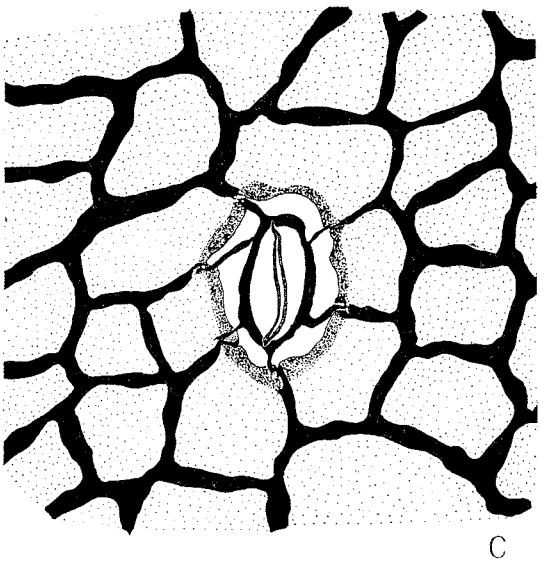


FIG. 2.—A-C: *Athrotaxis ungeri* and D, E, *A. laxifolia*. A, B: Cuticle from lower and upper leaf surfaces respectively, to show stomatal arrangement and cell outlines. x 350. 81896. C: A stoma, lower leaf surface, showing collar round stomatal pit, and subsidiary cells. x 600. 81896. D: A stoma, lower leaf surface, in surface view. x 600. E: A transverse section through a stoma, showing collar round stomatal pit, and subsidiary cells. x 600.

The cuticle was rather brittle, despite its thickness. Its chief features, and the marginal wing, are shown in Figs. 1G, 2A-C. A very important feature is the collar round the stomatal pit. This appears as a nearly colourless rim, often in the fossil caved into the stomatal pit, but showing the outlines of the subsidiary cells (Fig. 2C). Sections of living species show that this rim is composed of a set of papillae on the subsidiary cells, fused to form a collar (Fig. 2E and see Florin 1931: 365-369 for full description of the genus). The rim, i.e. collar, is larger in the fossil than in the living species, however.

The combination of features points towards *Athrotaxis*, and (it appears) no other genus: of special importance is the leaf arrangement, the lack of regular orientation of the stomata, and irregular arrangement of the subsidiary cells, the (mostly) monocyclic stomatal apparatus, and the collar round the stomatal pit, an especially useful feature (Florin 1931, 1958).

In the gross form the fossil is most like *A cupressoides*, being distinguished from the other two by its small leaves, closely appressed to the stem (e.g. Fig. 1A, B). It is also distinguished from *A. selaginoides* by being amphi—not epistomatic. The cuticle is, however, nearest to that of *A. laxifolia* from which it is distinguished by (1) showing, proportionately, more stomata on the lower surface, and (2) the large marginal wing. *A. ungeri* is distinguished from *A. cupressoides* on its cuticle, as follows: it has a much wider collar round the stomatal pit, a larger marginal fringe to the leaf, no papillae, even at the leaf base, and very narrow non-stomatiferous margins on the upper leaf surface.

Curtis (1956, p. 6) points out that *A. laxifolia* is in many ways intermediate between the other two species, and discusses the possibility that it may be a hybrid. This idea she finally rejects. The recognition of *A. ungeri* supports her view. In stomatal details *A. laxifolia* is not intermediate between *A. selaginoides* and *A. cupressoides*, but points towards an extinct species, different from all the living species.

Florin (1960) discusses the fossil record of *Athrotaxis* and concludes that all Northern Hemishpere records are suspect or wrong. Following this view, only the southern records of shoots are here compared: these are as follows:—

(1) *Athrotaxis ungeri* (Halle) Florin (see Halle 1913, pp. 40-44). The shoots of this species showed closely appressed leaves, rhombic in outline, about 3 mm. long and 2 mm. wide. The leaves appear to have been thick, their edges are described as straight (see especially pl. 2 figs. 15, 17). In this they are most like *A. cupressoides*, as Halle points out. I can point to no definite difference between Halle's specimens and mine. It may be that the leaves of Halle's specimens are slightly smaller than those of mine; it looks also as if their margins are straighter. Unluckily, however, Halle's material showed no cuticle, and the figures show no sign of a marginal fringe. Halle's specimens come from the Lower Cretaceous of Patagonia (Rio Fossiles).

With much hesitation I identify the Tasmanian specimens as conspecific with the Patagonian ones. In absence of cuticle comparision is extremely incomplete. Gross form alone (as noted) will not satisfactorily separate the Tasmanian *A. ungeri* and *A. cupressoides*: but the cuticle does at once. The difference in age is also a reason for hesitation, but is not of itself ground for making a new species.

(2) *A. australis* Bose (1955: pp. 385-386). This species consists of poorly preserved shoot impressions, probably differing from *A. ungeri* in having larger, more acute and less closely appressed leaves. However the specimen shown in pl. 2 figs. 16 and 17, also text-fig. 1a is decidedly like my material.

(3) *A. novae-zealandiae* (Ettingshausen) Florin (see Ettingshausen 1891: p. 254). Two small shoots of this species are figured both showing longer, less appressed and more acute leaves than *A. ungeri*.

(4) The only Tasmanian fossil records of *Athrotaxis* are given by Johnston (1888). *A. ? tamarensis* could be a shoot of *A. ungeri* but is regarded as inderminable. A cone *Sequoia* (later *Athrotaxis*) *tasmanica* (Johnston) Florin is also mentioned. I prefer to regard this specimen as indeterminable.

DISCUSSION

Athrotaxis has been recorded from the Lower Cretaceous of Patagonia, and at various levels in the lower Tertiary from New Zealand, Queensland and New South Wales. Assuming (as seems probable) that *Athrotaxis* has existed more or less continuously in Tasmania since the Lower Tertiary (for the last 50 to 60 million years) its present restriction to Tasmania represents a contraction into a part of its earlier range, not a spread into a new area. It recalls *Microcachrys*, which seems to have behaved in a similar way (Couper 1960).

There is, however, a strong suggestion that the ecology of at least the Tasmanian Tertiary species (and I suspect those from elsewhere also) was different from that of the living species. The Tertiary *A. ungeri* is found along with tropical or sub-tropical pines, such as *Podocarpus* sects. Polypodiopsis, Dacrycarpus and Stachycarpus. Further, in the early Tertiary Tasmania, with Eastern Australia in general was a low-lying peneplain with a warm moist climate (Gill in Spry and Banks 1962). It looks as if the *Athrotaxis* was then a warm temperature rain forest tree. It is, of course, possible that *Athrotaxis* then, like *Phyllocladus* now, had both highland and lowland species: but there is no evidence of this yet. The living species of *Athrotaxis* are highland trees, though still, it is to be noted, confined to high rainfall areas.

Athrotaxis is, probably, not unique in showing an apparent change of ecology as between the Tertiary and the present, *Microcachrys* is most likely similar. There is, therefore, at least the hope that if we could discover the factors that have confined *Athrotaxis* to the Tasmanian austral montane flora, we could apply the same arguments to other groups in that flora.

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