

ON *PACHYPTERIS PINNATA* (WALKOM) FROM TASMANIA

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(With three text figures)

ABSTRACT

Material from the Rhaetian of Tasmania referred to *Thinnfeldia pinnata* Walkom is described. The leaf is of thick substance, once pinnate, and probably abscised. It shows a moderately thick cuticle with most stomata on the lower leaf surface, papillae over the stomatal pit, an unmodified leaf margin, and irregular subsidiary cells. With this information the leaf fits better in *Pachypteris* Brongniart than *Thinnfeldia* Ettingshausen, and is transferred to *Pachypteris*. It is readily distinguishable from other adequately known species of the genus.

INTRODUCTION

Although the great majority of fern-like but cutinised leaves from the Triassic floras of the Southern Hemisphere are forked, a few are known that are simple. Another instance is described herein, *Pachypteris pinnata* (Walkom) com. nov., a leaf that has been known for many years but not in detail.

Nothing is known of the reproductive structures of *P. pinnata*, but as with some other leaves, there are rather close similarities with unforked leaves to which are ascribed reproductive structures indicating that they belong to the *Corystospermaceae* (e.g., Harris 1964, Townrow 1963). Probably therefore *P. pinnata* belongs to this family also. It is not very easy to decide which genus of isolated leaf *P. pinnata* should go into, emphasising again the similarities between some of the pteridospermous leaves of the early Mesozoic, a similarity apparently extending to elements of the floras of both hemispheres.

The material was collected by one of us (J.A.T.) at the Valley Coal Mine, Fingal (now closed), a locality dated as Rhaetian on its megaspore content (Dettman 1961).

DESCRIPTION

?CORYSTOSPERMACEAE

PACHYPTERIS Brongniart*Pachypteris pinnata* (Walkom) com. nov.

Figs. 1-3

- ?1888 *Pecopteris caudata* Johnston, pl. 26 fig. 6 only. Triassic of Longford, Tasmania.
1919 *Microphyllopteris pectinata* Walkom non Hector, pp. 186-187, pl. 8 figs 1, 4. Jurassic at Bexhill, New South Wales.

- 1921 *Thinnfeldia pinnata* Walkom, pp. 10-11, pl. 2 figs 1-4. Lower Jurassic at Talbragar, New South Wales.
1944 *Thinnfeldia praecordillerae* Frenguelli in part, pp. 511-519, pl. 1 fig. 1; pl. 3 fig. 1; pl. 4 fig. 3 (lower specimens, ?upper). Norinian, Cacheuta, the Argentine. (Excluded specimens having long pinnae, auricled at base.)
1967 *Thinnfeldia praecordillerae* Frenguelli: Jain and Delevoryas, p. 570, pl. 90, figs. 7, 8. Norinian, Cacheuta, the Argentine.
Excluded: 1950 *Thinnfeldia pinnata* Browne non Walkom. Pl. 40 c. Larger bipinnate leaf.
Holotype: Walkom 1921, pl. 2 fig. 1. Talbragar Fish Bed, Lower Jurassic.

Diagnosis emended. Once pinnate leaf, 6-12 cms long, 1-2 cms wide, narrow lanceolate in overall shape. Pinnae rounded, with very obtuse apex, entire margins and contracted at the base, or uncontracted, decurrent down the rachis to form a narrow laminae 1-2 mm wide flanking the rachis. Pinnae not displaced towards either surface of the rachis and only slightly, or not at all rotated to stand at an angle to the rachis.

Substance of pinnae thick, venation very obscurely shown on hand specimen, consisting of a midrib forking about half way along the pinnae, giving off simple, once or rarely twice forked laterals at about 30°. About 1 vein per 1 mm of margin.

Rachis not clearly marked off from the pinnae (probably) showing abscission scar at the base, channelled down the centre on both surfaces, as now compressed.

Cuticle about 2-3 μ thick on upper (presumed adaxial) leaf surface, about half that thickness on under surface, showing slightly elongated or equidimensional polygonal cells lacking preferred orientation over lamina. At lamina edge cells elongated (about 25 x 40 μ) forming 2 or 3 rows, but margin otherwise unspecialised, neither thickened nor scarious. Larger veins visible as rows of somewhat elongated cells on lower leaf surface only. Leaf amphistomatic, but most stomata lying on lower leaf surface (proportions about 30:1), between the veins, and without preferred orientation.

Cell outlines straight, or with only minute sinuositities, not pierced by holes, about 3 μ wide. Stomata sunken in a pit formed by 5-8 subsidiary cells mostly lacking particular arrangements, but

a few (about 1 in 30) showing a more or less clear ring of small subsidiary cells; encircling cells absent or occasionally irregularly present. Stomata on lower leaf surface overhung by prominent hollow papillae borne on subsidiary cells, probably in life projecting upwards at a low angle, but on upper leaf surface papillae on subsidiary cells smaller or absent, being replaced by a collar of thick cutin. Cell surface with papillae or solid mounds of cutin about 5μ in diameter, such papillae occurring mainly on the upper leaf surface.

Rachis cuticle showing more or less rectangular or polygonal cells in vague longitudinal rows, and stomata like those on upper leaf surface. Stomata mainly on upper rachis surface (proportion about 4:3).

Locality of material studied: Valley Coal Mine, Fingal, Tasmania: Rhaetian.

Description: There are ten fragments available, none entirely complete but some (figs 1, 2) probably nearly so, all being very well preserved. The orientation of the specimens is not easy to decide. There are plainly two sorts of cuticle on the two surfaces, and it is assumed, by analogy with many living and fossil plants, that the stomatiferous one is the lower (abaxial). Of the hand specimens, one (fig. 2B) shows an incomplete leaf base, viewed from the lower surface, that is, not showing the abscission surface; and this leaf shows the veins fairly clearly. Other specimens (fig. 2A) do not show the veins (or only exceedingly obscurely), but do show in places slightly rotated pinnae, with the acroscopic edge of the leaf lying slightly lower than the basicopic one. On the analogy of living plants with rotated pinnae, this means that we are looking at the upper (adaxial) leaf surface, and the failure to see the veins suggests the same.

Accepting this orientation, *both* surfaces of the rachis, as now compressed, are channelled, and where plant material is absent, show as a shallow trench (fig. 2A). The impression left by the pinnae is only a little less deep than that of the rachis. Presumably, therefore, the rachis was elliptical in section, scarcely thicker than the pinnae, and bore the pinnae laterally, and not displaced towards

either surface. The circumstance that rachis and pinnae are only slightly different thicknesses, together with the obscurity of the veins suggests that the leaf was of thick substance, quite different, for example from *Dicroidium odontopteroides* (Morris) Gothan.

The existence of a leaf-base scar, noted also by Walkom (1921, p. 10) indicates, as he points out, that the leaf, like many leaves known to be corystocpermaceous, was shed entire. The single base is shown in figure 2c, and is incomplete, but seems to show a double scar, indicating that two traces entered the leaf (cf. Harris 1964, Townrow 1965). It is not possible to make out whether or where any such two traces joined, and it is possible that they continued independently far up the leaf, the channel down the centre of the rachis representing more compressible tissue between two traces. However, this is unknown, and the appearances can be explained other ways.

The veins were most easily seen by detaching pinnae, and macerating them in acid but not alkali, when they appear as dark strands, sometimes interrupted (fig. 2B). Apart from the elongated cells, the margin is seen to be unmodified both on the hand specimens, and cuticle preparations. However, a few pinnae are slightly convex downwards (i.e., the lower leaf surface concave as in *Gleichenia microphylla* for example).

The cuticle is readily prepared, and its features given in the diagnosis and in figures 3A-9. The papillae over the stomatal pit are borne more or less on the edge of the pit, and, as noted, vary in form, but always show an interior of lighter shade (fig. 3A) indicating that they are hollow; a feature also seen in some of the papillae on the epidermal cell surface (fig. 3D). In a number of instances, the tip of a papillae is at a slightly different plane of focus from its root, suggesting that before fossilisation the papillae may have pointed partly upwards. The guard cells are only thinly cutinised, and there is no sign of any cutin lining to the stomatal aperture.

Comparisons. Comparison of the present material is not easy because none of the other once pinnate leaves comparable with it have a cuticle, and all

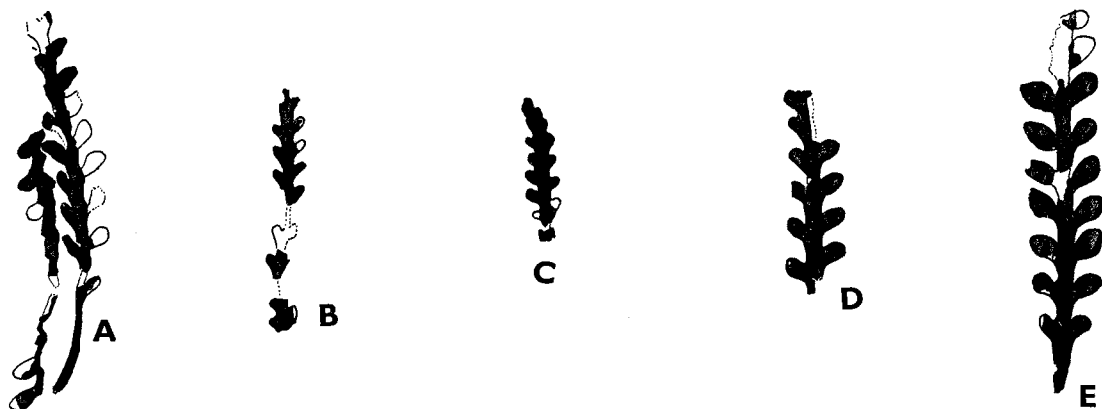


FIG. 1.—*Pachypteris pinnata*, A-E: Portions of leaves, A showing abscised base, C an apex. $\times 1$. University of Tasmania, Geology Department. 89775a,b; 89774; 89776d; 89776a; 89775c.

differ in gross form. The differences are, however, small, and in characters known to be inconstant where large populations of similar leaves are available. Under these circumstances it seems better to take a rather wide view, and place together for the time being leaves which may ultimately prove to be different. A group of badly known and scarcely distinguishable leaves is not convenient.

Thinnfeldia pinnata Walkom (1921) is a rather larger leaf than ours, with a rather more divided venation (these two features usually go together), but going on the figures, an equal vein density at the margin. The leaf bases are not contracted, but this feature varies in our material (figs 1b, e) and some of the leaves cited below come between. While noting the difference, we combine our material with Walkom's whose name takes priority. *T. pinnata* of Browne (1950) is a bipinnate and now referred to *Pachypteris crassa* (Halle) Townrow (1965).

Microphyllopteris pectinata of Walkom (1919) comes from Bexhill, N.S.W., and is from the Walloon Coal Measures of the Clarence Basin, approximately Middle Jurassic in age (McElroy 1962). Details of venation and cuticle are

unavailable; in gross form this leaf does show slightly contracted pinnae, comparable with figure 2a and Walkom was almost certainly correct to identify it (1921) with *P. pinnata*.

Thinnfeldia praecordillerae Frenguelli in part (1944, see also Jain and Delevoryas 1967) is a leaf of size closely comparable to our material, of similar venation, and with slightly contracted pinna bases sometimes. Further detail is unavailable. It may differ in having slightly longer pinnae, but the difference is slight, and we believe inadequate for specific separation without more evidence.

Pecopteris caudata Johnson (1888 pl. 26 fig. 6 only) is doubtfully identical. The rather crude drawing does not give information enough for a definite opinion. The age is the same as our material.

At present *P. pinnata* ranges from the Norinian (Triassic) until approximately the Middle Jurassic, but in view of the uncertainties of all the identifications, this rather long range should not be given much weight.

Thinnfeldia dutoitii Jain and Delevoryas (1967) is definitely different however, showing odontopteroid venation, much like *Dicroidium feistmanteli*.

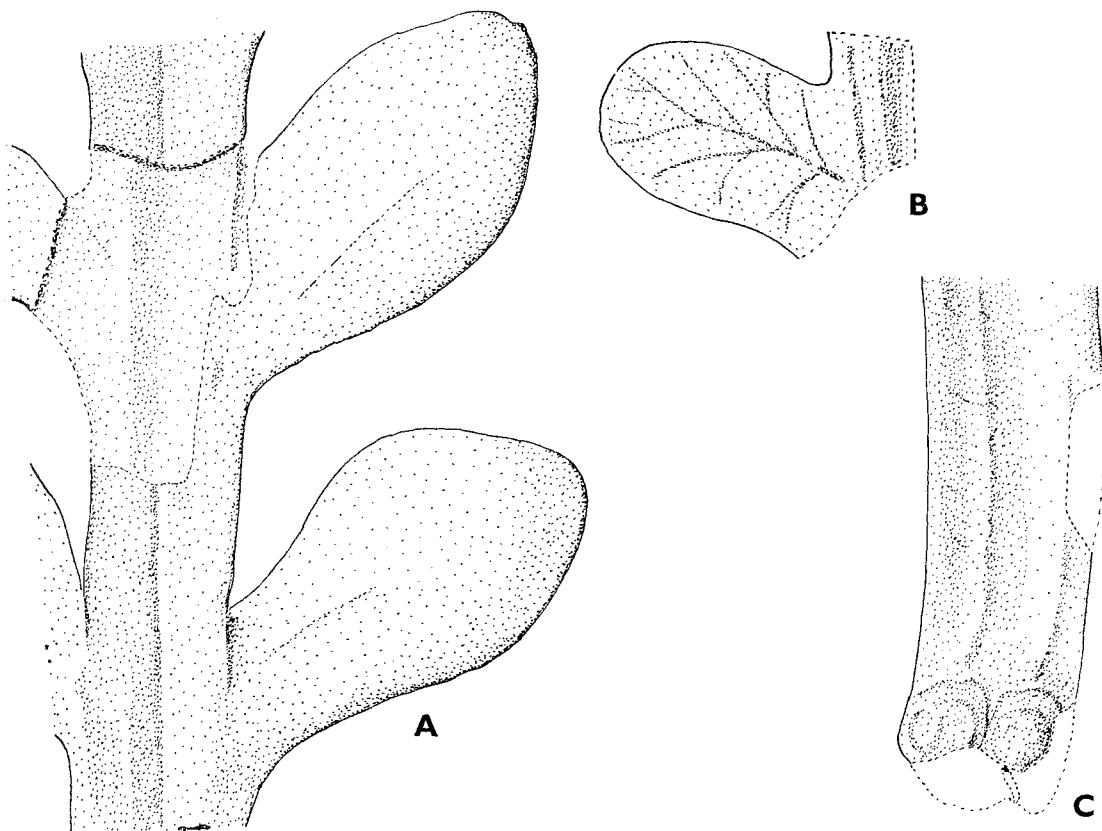


FIG. 2.—*Pachypteris pinnata*, A: Part of a leaf showing rachis as a trench both in the plant material and on the impression, slightly concave pinnae and obscure midrib. $\times 7$. B: Pinna and veins. $\times 7$. C: Leaf base with double abscission scar. $\times 11$. University of Tasmania, Geology Department. A, 89775c; B, 89776a; C, 98775b.

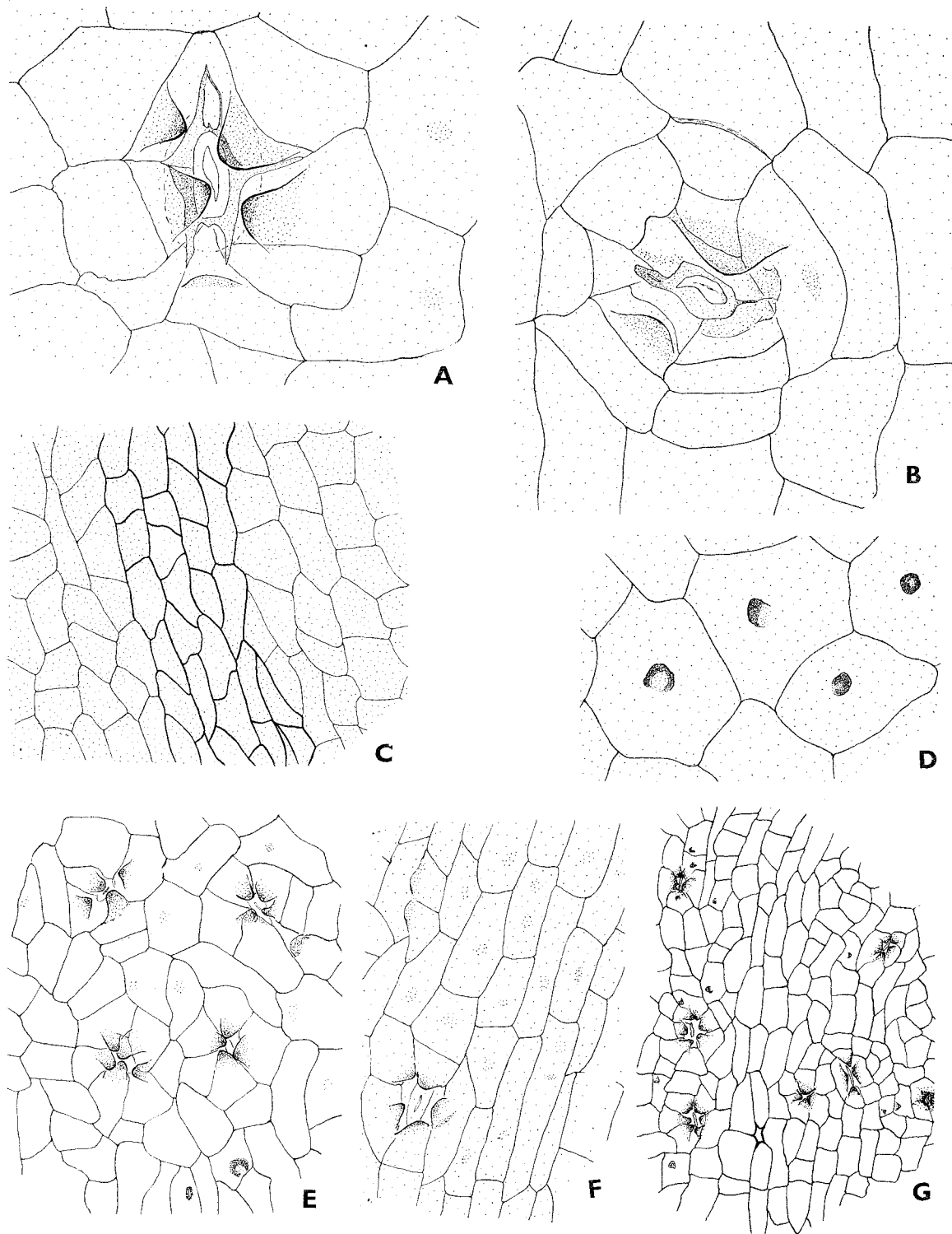


FIG. 3.—*Pachypteris pinnata*. A: Stoma with somewhat irregular monocylic subsidiary cells. B: Stoma with rather regular dicyclic subsidiary cells. Both $\times 600$. C: Cuticle along the margin (centre), $\times 200$. D: Cells with small hollow papillae $\times 600$. E: Cuticle from lower surface, away from a vein. $\times 200$. F: Rachis cuticle. $\times 200$. G: Cuticle over a vein (centre) and stomata. $\times 100$. University of Tasmania, Geology Department. A,C,E, 89775a; B,D, 89775c; F, 89775c; G, 89774.

Fragments of *D. odontopteroides* could be confused with *P. pinnata*, but have a thin leaf substance and no papillae over their stomata, while *D. obtusifolium* has a thick leaf but scarcely sunken stomata in a rectangular pit, devoid of papillae (Townrow 1966). Other leaves probably would not cause serious confusion.

Generic Ascription. *P. pinnata* is excluded from *Dicroidium* (including *Xylopteris* Frenquelli and *Hoegia* Townrow) by being unforked (see Townrow 1957, and Bonetti 1966), from *Stenopteris* Saporta by having more than one vein per pinna, from *Lepidopteris* Schimper in lacking blisters on the rachis and in being once pinnate, and from *Cycadopteris* Zigno (including *Lomatopteris* Saporta) in lacking a thickened margin to the leaf (see Harris 1964 also Townrow and Hancock 1962). Of genera with a distinct midrib (that is excluding *Ctenozamites* Nathorst and *Dichopteris* Zigno) this leaves *Pachypteris* and *Thinnfeldia*.

The distinction between these two is not at all easy to draw (Harris 1964, Daber 1962, Barnard 1965). In general, however, species of *Thinnfeldia* have, or tend to have, distinct veins and a more or less regular circle of subsidiary cells, whereas *Pachypteris* has a thick to very thick leaf substance obscuring the veins, and rather irregular subsidiary cells. On this basis *P. pinnata* fits more easily into *Pachypteris*, agreeing with *P. papillosa* Thomas and Bos (Harris 1964) in being once pinnate, unlike the type species *P. lanceolata* Brongniart (Gomolitskiy, et al. 1962, Harris 1964). Like *P. papillosa*, *P. pinnata* also has papillae (mostly) over the stomatal pit but a much thinner cuticle. *P. pinnata* is also distinguishable from *P. crassa* (Halle) Townrow (1965) in being once pinnate, which also distinguishes it from the less well known *P. shemshakensis* Barnard (1965). Harris (*loc. cit.*) also discussed a number of poorly known leaves; or leaves of doubtful ascription to *Pachypteris*, which it is probably not worth discussing again at length here, except that we entirely agree with him that the forking specimens of du Toit should be excluded from *Pachypteris*.

At present, accepting the identification offered here, there are in the later Triassic and Jurassic gondwanan floras two reasonably well known unforked corystosperm (or probably corystosperm) leaves: *Pachypteris pinnata* and *P. crassa*. Both are more delicate leaves than the two somewhat younger well known European species, *P. lanceolata*

and *P. papillosa*. In the case of *P. papillosa* and *P. crassa* the pollen organ is known, and though the pollen is similar, the organisation of the organs is rather different (Harris 1964, Townrow 1965), suggesting that though in the later Triassic and Jurassic the Corystospermaceae existed in both hemispheres, the component members remained somewhat different.

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