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A NEW LEAF, *GLOSSOPTERIS DUOCAUDATA* SP. NOV., FROM THE LATE PERMIAN OF COOYAL, NEW SOUTH WALES

W. B. K. HOLMES*

"Noonee-Nyrang", Gulgong Road, Wellington, N.S.W., Australia-2820

ABSTRACT

A reticulate-veined leaf with conspicuous basal lobes and having a fructification consisting of an elliptic cluster of sessile naked seeds adnately attached to the petiole, is described as *Glossopteris duocaudata* sp. nov. The sterile leaves are somewhat similar to *Belemnopteris elongata* Lacey, van Dijk & Gordon-Gray from Natal but differ from the three Indian species of *Belemnopteris* by the manner in which the secondary venation in the basal lobes arises from the intramarginal vein on the inner sides of the lobes.

Key-words — Fructification, Naked seeds, *Glossopteris*, *Belemnopteris*, Late Permian, Australia.

सारांश

न्यू साउथ वेल्स में कूयाल के उत्तर पर्मियन से एक नवीन पत्ती, ग्लॉसॉप्टेरिस डुओकोडटा न० जा० – डब्ल्यू० बी० के० होल्म्स

जालिका रूपी शिराओं युक्त विशिष्ट आधारीय पालियों वाली एक पत्ति को जिसके वृंत से अवृंत-नग्न-बीजों से बना अन्डाकार गुच्छा रूपी फलन संलग्न है, ग्लॉसॉप्टेरिस डुओकोडेटा के नाम से वर्णित किया गया है। नैटाल के वंध्य पर्ण बैलिम्नॉप्टेरिस इलोंगेटा लैसी, वॉन डॅइक एवं गोर्डन-ग्रे से कुछ-कुछ मिलते जुलते हैं परन्तु आधारीय पालीयों में अन्दर की ओर वाली अंतरउपांतीय शिरा से द्वितीयक शिरान्यास के उत्पन्न होने के ढंग के आधार पर यह भारत की तीन बैलिम्नॉप्टेरिस जातियों से भिन्न है।

INTRODUCTION

AN abandoned quarry situated near the top of the Permian Illawarra Coal Measures sequence near Cooyal, 194 km north-west of Sydney, has yielded a rich flora which is beautifully preserved as impressions on grey mudstone. The geology of the quarry and an account of some glossopterid fructifications has been published previously (Holmes, 1974). At this locality the bulk of the *Glossopteris* leaves belong to two species; the leaf which sometimes has attached the *Cordaicarpus* seed-bearing fructification *Austroglossa walkomii* Holmes and a large, as yet undescribed leaf somewhat similar to a form from the Baralaba Coal Measures of Queensland referred to *G. damudica* by Rigby (1972, pl. 1, fig. 4, text-fig. c). The former leaf type is very common on most bedding planes of the fossiliferous sequence, but the latter leaf is only common in the upper section. Together, the leaves of these two species make up approximately 95% of the total leaves preserved. The next most numerous form is the distinctive leaf described below as *Glossopteris duocaudata* sp. nov. This species, comprising about 2% of the remaining 5% of plant material, occurs scattered throughout the lower bedding planes but becomes rarer in succeeding layers as the matrix becomes smaller grained and the layers more finely laminated. The balance of the assemblage is made up of several other species of *Glossopteris* leaves, equisetalean stems and leaves, fern fronds, ?conifer shoots and

*Hon. Research Fellow, Department of Geology, University of New England, Armidale, New South Wales, Australia 2351.

Noeggerathiopsis leaves. A detailed description of the *Glossopteris* and other plants is in preparation.

Genus — *Glossopteris* Brongniart

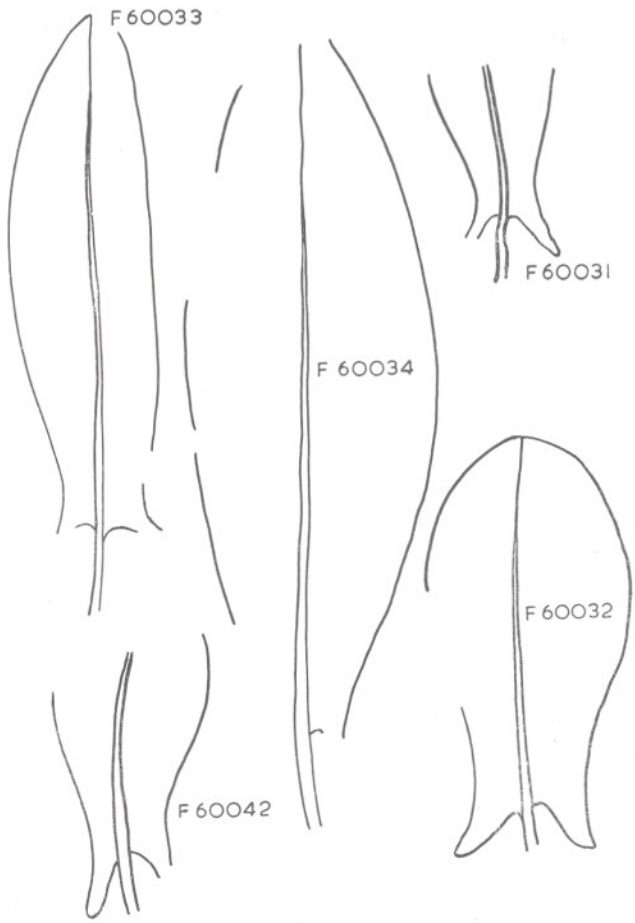
Glossopteris duocaudata sp. nov.

Pl. 1; Text-figs 1, 2

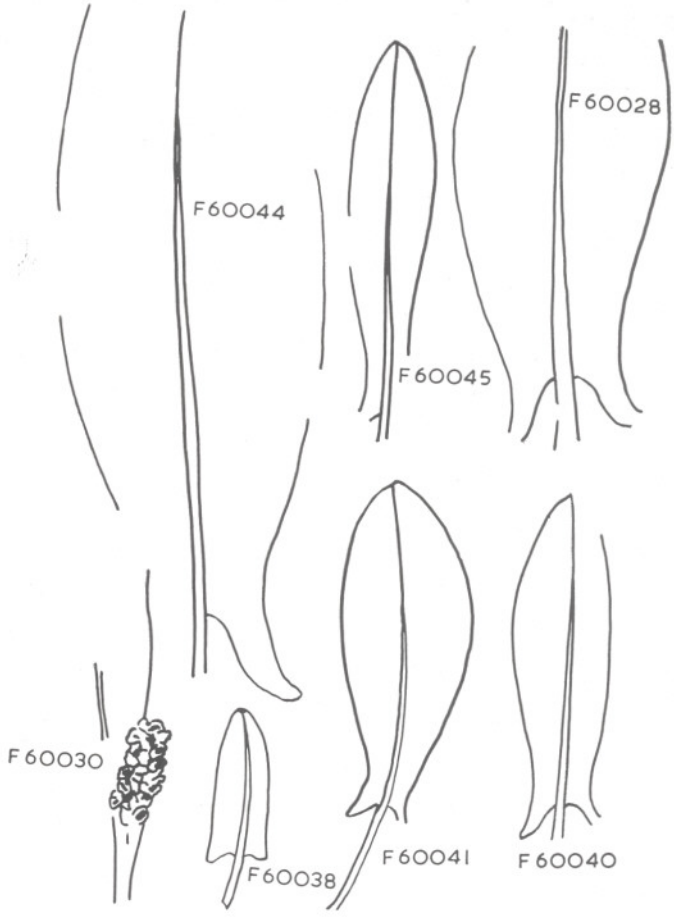
Diagnosis — Simple lanceolate or elliptic leaf with sagittate-hastate or variously lobed lamina base; lamina contracted above basal lobes; apex obtuse; midrib prominent, grooved or striated, tapering from a long petiole to the leaf apex. Secondary veins leaving midrib at an acute angle, then forking and joining with adjacent veins to form first a triangular or quadrilateral areole followed by longer and narrower transversely elongated rhombic meshes aligned at 75° to the midrib. Reticulate secondary veins in the basal lobes arising from an intramarginal vein running from the midrib around the inner edge of each lobe. Ovulate fructification consisting of approximately 30 ellipsoidal seeds forming an elliptic cluster on a peduncle attached adnately to the leaf petiole.

Holotype — AMF60028.

Paratypes — AMF60029 and AMF60030. part and counterpart with fructification;



TEXT-FIG. 1 — *Glossopteris duocaudata* sp. nov. Outline drawings to show range of variation of leaf form × 1 — (Specimens in the Fossil Plant Collection of the Australian Museum, Sydney, New South Wales).



TEXT-FIG. 2 — *Glossopteris duocaudata* sp. nov. Outline drawings to show range of variation of leaf form × 1. F60030 — attached ovulate fructification × 1 (Specimens in the Fossil Plant Collection of the Australian Museum, Sydney, New South Wales).

AMF60031 to AMF60052 sterile leaves showing range of variation. All types are housed in the fossil plant collection of the Palaeontology Department of the Australian Museum, Sydney, New South Wales.

Locality — Cooyal, New South Wales.

Horizon — Illawarra Coal Measures, Late Permian.

DESCRIPTION

Sterile Leaves — Leaves very variable in size and outline (Text-figs 1, 2), lanceolate-elliptic, from 3 to 20 cm in length (average 12 cm) and from 1·2 to 6 cm in width (average 4 cm). Margin entire, apex obtuse or occasionally slightly retuse. Base of lamina sagittate-hastate or variously lobed. The specific name alludes to the double-tailed appearance of most leaves. The basal lobes are bluntly pointed and usually form an angle of 45° with the petiole. On most leaves the basal lobes are from 1·5 to 3 cm in length and curve down and outwards from the lamina base, which is constricted above the lobes. On very small leaves the lamina base may be truncate. Petiole parallel-sided or expanding slightly to the leaf base; to 4 cm in length and from 2 to 5 mm in width. The midrib is conspicuously striated or grooved, 2 to 5 mm in width at the lamina base and decreasing in width to the leaf apex. Secondary veins leave the midrib at a very acute angle and

immediately fork and join with adjacent veins to form firstly a triangular or quadrilateral areole on either side of the midrib. The veins continue forking and anastomosing to form transversely elongated, rhombic areoles that become smaller towards the margin. The meshes are aligned at 75° to the midrib. In the portion of the lamina midway between the midrib and margin, the veins sometimes approach but do not join with adjacent veins, so that some areoles are extremely long. In the mid-portion of the leaf, the density of the secondary veins per cm leaving the midrib is approximately 9; halfway to the margin, from 14 to 20 (average 18) and at the margin, from 20 to 32 (average 26). The secondary veins in the basal lobes arise from a fine intramarginal vein that leaves the midrib and follows around the inner edge of each lobe. The mesh in the lobes is similar to that in the lamina.

Fertile Leaf — A large, incomplete leaf over 16 cm in length and 5 cm in width, has fractured so that the apex is missing and no basal lobes are preserved. The venation in the lamina is identical to that in sterile leaves of *G. duocaudata*. An elliptic seed cluster, 20×12 mm, is adnately attached by a peduncle 10 mm long and 2 mm wide to the 5 mm wide petiole. The cluster consists of approximately 30 seeds, apparently sessile and disposed at various angles. The seeds (or ovules) were probably ellipsoidal in shape and had a small slit-like micropyle at the apex. Laterally compressed seeds are circular, 3 mm in diameter and have a very narrow wing-like sarcotesta.

COMPARISONS

Sterile leaves, somewhat similar in outline, have been described from the Late Permian of Natal, R. S. A., by Lacey, van Dijk and Gordon-Gray (1975) as *Belemnopteris elongata*. These South African leaves differ from *Glossopteris duocaudata* by the form of their secondary venation, which has large, slightly elongated hexagonal or polygonal meshes that are inclined at an angle of 45° to the midrib; by more acute and usually smaller basal lobes and by not attaining the size of the larger specimens of *G. duocaudata*. *Belemnopteris* sp., a small leaf fragment illustrated but not described by Schopf (1970, text-fig. 1·5) is similar in form and venation to *B. elongata*. In this leaf and also those from South Africa the basal lobes have an intramarginal vein similar to that in the lobes of *G. duocaudata*. A basal fragment of a leaf from the Moranbah Coal Measures of Queensland, identified by Rigby (1978) as *Belemnopteris elongata*, shows tiny basal lobes formed by triangular projections at right angles to the midrib. A leaf with venation similar to *Glossopteris damudica* Feistmantel and having small basal "spurs" at right angles to the midrib has been recorded from Hammanskraal Transvaal by Kovacs-Endrödy (1976, pl. 4C, fig. 18). Her illustrations do not show any venation in the "spurs". From the same locality, she also mentions a part of a leaf with or hastate base similar to *Belemnopteris elongata* Lacey *et al.* (1975). *Glossopteris cordata sensu* Du Toit (1932) is a variable-shaped leaf with a bi-auriculate lamina base. The rounded basal lobes differ from the more elongated lobes of *G. duocaudata* and the lamina is not constricted above the lobes. However, in three illustrated figures (Du Toit, 1932, text-fig. 1A, B, D) the secondary venation in the lobes arises in a similar manner to that in *G. duocaudata*. The type species of *Belemnopteris*, *B. wood-masoniana* Feistmantel (1876) was illustrated as a tricostate leaf divided into three almost equal triangular lobes. The secondary venation formed a large, even polygonal mesh throughout the leaf. Pant and Choudhury (1977) have described two additional species from India, *B. sagittifolia* and *B. pellucida*, both with smaller basal lobes and less conspicuous lateral costae than the type species. A distinguishing feature of the Indian leaves placed in *Belemnopteris* is the secondary venation that arises from both sides of the lateral costae in contrast to *B. elongata* and *G. duocaudata* in which the secondary veins arise from one side only of a vein following around the inside margin of each basal lobe. Pant and Choudhury (1977) have noted that the petioles of *B. sagittifolia* and *B. pellucida* are inserted at an angle to the plane of the sagittate lamina. In *Glossopteris duocaudata* the petiole continues in the same plane from the leaf base into the lamina.

The fructification attached to a *Glossopteris duocaudata* leaf is very similar in organisation and method of attachment, to the immature cluster of the fructification *Austroglossa walkomii* Holmes as illustrated by Holmes (1974, pl. 7, fig. 3). *Plumsteadia ampla* (White) Rigby (White, 1963; Rigby, 1978) may be a similar type of organ but is circular in shape and is three times as large. As in *Jambadostrobus* Chandra and Surange (1977) and *Austroglossa* Holmes (1974) there is no protective bract attached to the seed cluster. The seeds or ovules are closely spaced and do not show a spiral arrangement, so it is not known whether the fructification is a strobilus or a dorsiventral organ.

DISCUSSION

The form and method of attachment of the ovulate fructification of this new leaf closely resembles other fructifications attached to typical *Glossopteris* leaves. Unfortunately it is not well enough understood at present to place it in either an existing or a new natural genus. The venation of the leaf is typically *Glossopteris* except for the intramarginal vein along the inside edges of the basal lobes. Schopf (1976) and Gould and Delevoryas (1977) have demonstrated from petrified material that the so-called "midrib" of a *Glossopteris* leaf consists of a closely-spaced reticulum of vascular bundles, therefore the intramarginal vein merely represents a change in direction of some of these bundles. Kovács-Endrödy (1979) has suggested the term "*fascis*" for the *Glossopteris* "midrib". Several species of *Glossopteris* leaves have basal lobes of varying form, e.g. *G. cordata* Dana (Rigby, 1964), *G. feistmantelii* Rigby (Feistmantel, 1882; Rigby, 1964), *G. cordiformis* Pant & Singh (1971) and *Glossopteris* sp. (Holmes, 1974, pl. 7, fig. 7). *G. cordata* sensu Du Toit (1932), a leaf with bi-auriculate base and venation in the lobes similar to *G. duocaudata* has been noted in the comparisons.

The lobed leaves placed in *Belemnopteris elongata* by Lacey *et al.* (1975) perhaps represent a portion of the range of variation of a single species which includes the unlobed leaves, referred to *Glossopteris elongata*, which have identical venation and occur in association with *Belemnopteris elongata*.

Pant and Choudhury (1977) have shown that *Belemnopteris sagittifolia* and *B. pellucida* have a resistant cuticle similar to *Glossopteris* in that their laminae are hypostomatic and the stomata are haplocheilic. However, because of the tricostate nature of the venation, the inclination of the plane of the lamina to the plane of the petiole, and the fructification being entirely unknown, the Indian species of *Belemnopteris* are, at present, justified in being separated from *Glossopteris*.

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EXPLANATION OF PLATE

PLATE 1

Glossopteris duocaudata sp. nov.

1. AMF60033. × 1.
2. AMF60028. × 1.
3. AMF60032. × 1.
4. AMF60030. Attached ovulate fructification. × 1.
5. AMF60030. × 2.
6. AMF60029. Counterpart of fig. 4. × 2.
7. AMF60052. × 1.
8. AMF60043. Basal portion of leaf to show form of venation in the lobes. × 2.
9. AMF60028. Basal portion of leaf to show form of venation in the lobes. × 2.

Specimens are housed in the Fossil Plant Collection of the Australian Museum, Sydney, New South Wales.

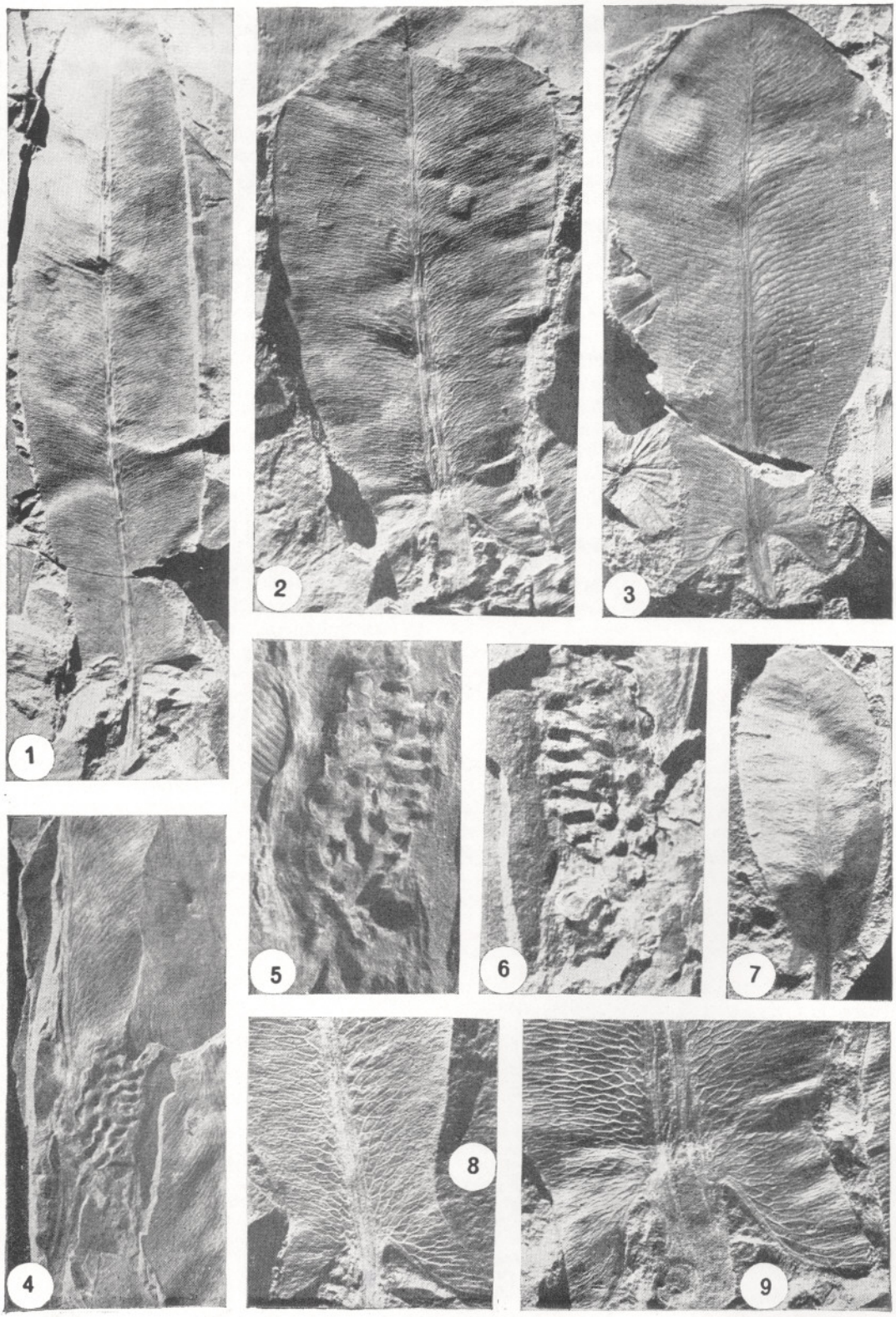

PLATE 1