

A REVIEW OF THE UPPER PERMIAN *GLOSSOPTERIS* FLORA IN WESTERN NATAL

WILLIAM S. LACEY

School of Plant Biology, University College of North Wales, Bangor,
Gwynedd, LL57 2UW, U.K.

ABSTRACT

The Upper Permian *Glossopteris* flora known from Lower Beaufort outcrops in the Bulwer-Mooi River-Bergville area of Western Natal, South Africa, is reviewed. Characteristic taxa (not all present at every locality) include *Phyllothea australis*, *Sphenophyllum speciosum*, coarse-meshed *Glossopteris* species, *Belemnopteris elongata*, *Eretmonia natalensis*, *Lidgettonia africana*, (?) *Plumsteadia natalensis*, and *Rigbya arberioides*. Comparisons are made with similar floras in India, Australia and Antarctica. The importance of consultation and collaboration between palaeobotanists studying Gondwana floras is emphasized.

INTRODUCTION

DURING the 25 years which have elapsed since the first number of *The Palaeobotanist*—the *Birbal Sahni Memorial Volume*—appeared great advances have been made in our knowledge of *Glossopteris* floras in all parts of Gondwanaland. The progress has been particularly rapid in the last dozen years, no doubt stimulated in part by the Symposium on the Floristics and Stratigraphy of Gondwanaland which took place in Lucknow in 1964 during the International Geological Congress in India in that year and by the four subsequent International Gondwana Symposia held in Argentina in 1967, South Africa in 1970, Australia in 1973 and India in 1977.

I have been concerned with studies in *Glossopteris* and *Dicroidium* floras of various parts of Southern Africa since 1958; and since 1973 more particularly with *Glossopteris* floras in Natal, collaborating with South African colleagues in the University of Natal at Pietermaritzburg. My study of Natal floras was considerably advanced by personal contact with Indian and Australian palaeobotanists at the Canberra Symposium in 1973, enabling comparison of materials and exchanges of opinion to be made at first hand, and later by exchange of letters with palaeobotanists interested in Gondwana floras working in South Africa, India, Australia and the U.S.A. All the same, in recent Gondwana studies duplication of the descriptions of some taxa from different parts of Gondwanaland has

occurred, resulting in some taxonomic confusion. This has been due in part to studies being conducted independently and in part to differing morphological conceptions in the various countries concerned, before the exchange of 1973 referred to above.

In this paper I review the present state of our knowledge of the Upper Permian *Glossopteris* flora as found in the western part of Natal and compare it with floras in India, Australia and Antarctica mainly in the light of discussions at and subsequent to the 4th International Gondwana Symposium held in Calcutta in January, 1977.

COMPOSITION AND OCCURRENCE OF THE UPPER PERMIAN *GLOSSOPTERIS* FLORA IN WESTERN NATAL

Two years ago, in collaboration with South African colleagues, I published an account of a flora containing at least 35 taxa from the Lower Beaufort Subgroup in Natal, temporarily exposed near Mooi River (Lacey, van Dijk & Gordon-Gray, 1975). This flora includes four species of sphenopsids, one pteropsid, fifteen cycadopsids (mainly *Glossopteridales*), one coniferopsid, one possible bryopsid, several taxa incertae sedis, and several kinds of dispersed seeds and microsporangia. It is characterized by abundant *Phyllothea australis* Brongniart, *Sphenophyllum speciosum* (Royle) McClelland, *Glossopteris* spp. of the coarse-meshed type (such as *G. conspicua* Feistmantel and *G. elongata* Dana, syn. *G. retifera* Feist.), *Belemnopteris elongata* Lacey, van Dijk & Gordon-Gray, *Eretmonia*

natalensis (Du Toit) emend. Lacey, van Dijk & Gordon-Gray and several kinds of seed-bearing organs of which the best represented are *Lidgettonia africana* (Thomas) emend. Lacey, van Dijk & Gordon-Gray, (?) *Plumsteadia natalensis* Lacey, van Dijk & Gordon-Gray, and *Rigbya arberioides* Lacey, van Dijk & Gordon-Gray. Pteropsids, coniferopsids and the possible bryopsids are less common. *Gangamopteris* species are totally absent. The Upper Permian age of this flora, inferred from the presence of coarse-meshed *Glossopteris* species considered in conjunction with the absence of *Gangamopteris*, is well supported by the very rich insect fauna which occurs in the same beds with the plants (Riek, 1973, 1974).

Further fieldwork during and since 1974 has resulted in the discovery of essentially the same flora characterized by *Phyllothea australis*, *Sphenophyllum speciosum*, coarse-meshed *Glossopteris* species, *Belemnopteris elongata*, *Eretmonia natalensis* (or microsporangia suggesting the presence of this male fructification), *Lidgettonia africana*, (?) *Plumsteadia natalensis*, and *Rigbya arberioides* in three more localities, one of which is some 70 km south of the Mooi River locality (van Dijk, Lacey, Gordon-Gray & Reid, 1977, in press). Not all these taxa are represented in all three localities as the following distribution table indicates:

Taxon	Locality		
	Mount West	Mooi Quarry	Bulwer
<i>Phyllothea australis</i>	×	—	×
<i>Sphenophyllum speciosum</i>	×	×	×
<i>Glossopteris</i> (coarse-meshed)	×	×	×
<i>Belemnopteris elongata</i>	×	×	×
<i>Eretmonia natalensis</i> (<i>Arberiola</i>)	×	×	×
<i>Lidgettonia africana</i>	×	×	—
(?) <i>Plumsteadia natalensis</i>	×	×	—
<i>Rigbya arberioides</i>	—	×	×

Eretmonia natalensis has also been found in the original locality for *Lidgettonia africana* at Lidgetton (van Dijk, Lacey, Gordon-Gray & Reid, 1977, in press), and this locality is proving to be of exceptional interest in that it has yielded structurally-preserved sphenopsid axis and glossopterid leaf compression material locally petrified in pyrite (van Dijk, Gordon-Gray & Lacey, 1975).

In addition, Du Toit's original locality for *Eretmonia natalensis* near Bergville, some 70 km north of Mooi River, also yielded coarse-meshed *Glossopteris* species, and some auriculate leaves similar to some forms of *Belemnopteris*.

Thus, from a consideration of six localities known so far, extending over a distance of about 140 km, north to south in western Natal, it would appear that a flora containing combinations of the taxa *Sphenophyllum*, coarse-meshed *Glossopteris*, *Belemnopteris*, *Phyllothea*, *Eretmonia*, *Lidgettonia*, (?) *Plumsteadia* and *Rigbya* is likely to have stratigraphic value as an indicator of Lower Beaufort (Upper Permian) deposits, a point already suggested by Lacey, van Dijk & Gordon-Gray (1975).

COMPARISONS WITH SOME OTHER GONDWANA FLORAS

INDIA

The Mooi River flora in Natal has already been compared briefly with that of the Raniganj Stage (Upper Damuda Series) in India and shown to have nine taxa in common (Lacey, van Dijk & Gordon-Gray, 1975). Now, as a result of a personal exchange of views in Lucknow in February, 1977 after the Calcutta Symposium, Professor K. R. Surange, Dr S. Chandra and I are of the opinion that the Upper Permian flora of Natal, especially as best developed in the Mooi River locality, and the Indian Raniganj flora are virtually the same flora.

Our discussions also enabled us to suggest modifications to taxonomic treatment already published by us on both Indian and South African materials. The most important of these modifications are listed below.

1. *Lidgettonia mucronata* Surange & Chandra, 1974 is now regarded as being the same as *Lidgettonia africana* Thomas 1958, as revised by Lacey, van Dijk & Gordon-Gray (1975).

2. *Denkania indica* Surange & Chandra (1973) is closely comparable to *Lidgettonia africana* in Natal.

3. The genus *Partha* (Surange & Chandra, 1973a) including two species, one of which *P. indica*, was originally described as *Lidgettonia indica* by Surange & Maheshwari (1970), may indeed be congeneric with *Lidgettonia*.

4. *Eretmonia utkalensis*, *E. hinjridaensis* and *E. karanpurensis* (Surange & Maheshwari, 1970) are all closely similar to *E. natalensis* Du Toit. Indeed, if the broad conception of *E. natalensis* adopted by Lacey, van Dijk and Gordon-Gray (1975) is accepted, all three Indian species fall within the range of variation shown by the African species. Rigby (1977, in litt.) would prefer that they should be regarded as synonyms of *E. natalensis*.

5. *Glossotheca* (Surange & Maheshwari, 1970) and *Eretmonia* Du Toit are regarded as closely allied genera.

6. The "winged seeds" in the Natal flora (Lacey, van Dijk & Gordon-Gray, 1975, pp. 402-404) should be placed in *Indocarpus elongatus*, or at least in the genus *Indocarpus*, of Surange & Chandra (1974a).

7. The Natal fructification attached to a leaf recorded as *Glossopteris conspicua* Feist. and described as *Scutum conspicuum* comb. nov. (Lacey, van Dijk & Gordon-Gray, 1975, pp. 394-395) may be a specimen of *Venus-trostrobis diademus* gen. et sp. nov. (Chandra & Surange, 1977, in press). This new fructification is attached to coarse-meshed *Glossopteris* leaves which can be compared to *G. conspicua* Feist. on gross morphology but are actually identified with *G. ghusikensis* Pant & Gupta on the basis of both external morphology and preserved cuticle structure.

New information is now available also on the genus *Belemnopteris* Feistmantel, as emended by Lacey, van Dijk and Gordon-Gray (1975). From Indian Raniganj material Pant and Choudhury (1977) have described two new species, *B. sagittifolia* and *B. pellucida*, both superficially resembling the rather variable specimens of *B. elongata* known from Natal. Discussions with Professor D. D. Pant in Allahabad, also in February 1977, confirm the necessity of establishing two new species for the Indian material since they have structure preserved and two types of cuticle can be recognized. The Natal material of *B. elongata* has, so far, yielded no structural details so that it is not possible to state with which, if indeed either, of the two new Indian species it is conspecific. Nevertheless, the occurrence in the Raniganj of India of *Belemnopteris* leaves closely resembling those from Natal strengthens the comparison between the two floras.

AUSTRALIA

On the basis of seven taxa in common, including *Phyllothea australis*, coarse-meshed *Glossopteris* species and *Rigbya arberioides*, the Natal flora has been compared with the Upper Permian floras of the Upper Bowen Series in Queensland and the Newcastle Series in New South Wales (Lacey, van Dijk & Gordon-Gray, 1975). A paper by Holmes (1974), received after the 1975 Natal paper had gone to press, describes an interesting flora from Cooyal, New South Wales, which provides further support for these comparisons.

The Cooyal flora consists of *Phyllothea australis* Feist., *Stellothea robusta* (Feist.) Surange & Prakash, *Sphenopteris lobifolia* Morris and *S. polymorpha* Feist., six species of *Glossopteris*, including coarse-meshed specimens referred to *G. conspicua* Feist., the fructifications *Dictyopteridium sporiferum* Feist. ex Zeiller, *Isodictyopteridium costatum* Holmes, *Eretmonia cooyalensis* Holmes, and *Austroglossa walkomii* Holmes, and *Noeggerathioipsis* sp. Holmes states that the Cooyal locality is in the Illawarra Coal Measures, which are equivalent to at least the upper part of the Newcastle Coal Measures and Upper Permian in age. He adds that the flora can be correlated with that of the Baralaba Coal Measures and Blackwater Group of the Bowen Basin of Queensland and the Raniganj Stage of the Damuda Series in India. In this context, the presence of coarse-meshed *Glossopteris* leaves identified as *G. conspicua* Feist. and of a species of *Eretmonia* is of particular importance. The seed-bearing fructification, *Austroglossa walkomii*, attached to leaves referred to *G. conspicua* Feist., however, raises problems of two kinds. First, what is the true nature of the fructification itself? Schopf (1976) suggests that, while there is a basis for comparison between *Austroglossa* and other glossopterid fructifications, the difference would seem to indicate a family degree of taxonomic separation. Rigby (1977, in litt.) asks whether *Austroglossa* could be an inverted example of Plumstead's genus *Pluma*, or putting it another way, whether perhaps *Pluma*, which is not well-preserved, is a twisted *Austroglossa*?

Second, we now have a situation where four different kinds of seed-bearing fructification have been found attached to leaves

referred to or compared with *Glossopteris conspicua* Feist. (*Scutum draperium* by Plunstead, 1958; *Austroglossa walkomii* by Holmes, 1974; *Scutum conspicuum* by Lacey, van Dijk and Gordon-Gray, 1975; and *Venusstrobilus diademus* by Chandra and Surange, 1977).

Holmes himself (*loc. cit.*) has discussed this problem at some length. It is worth noting that he states that certain specimens referred to *Glossopteris conspicua* Feistmantel by Arber in 1905 and Du Toit in 1927 appear to be different from the Cooyal specimens. Clearly further work is needed to resolve this confusion; the matter waits for leaf cuticle evidence, not yet available in every case.

ANTARCTICA

In recent years *Glossopteris* floras in several localities in Antarctica have yielded *Belemnopteris* leaves and seed-bearing fructifications which Lacey, van Dijk and Gordon-Gray (1975) included in *Belemnopteris elongata* and *Rigbya arberioides* respectively. The *Belemnopteris* leaves came from Terrace Ridge, Ohio Range (Schopf, 1970) and Rigby, who has seen both Antarctic and Natal materials, confirms (1973, personal communication) that they are the same as *Belemnopteris elongata*.

More recently, Kyle (1976, personal communication) has recorded leaves from South Victoria Land which she also refers to *Belemnopteris elongata*.

The Antarctic fructifications now regarded as *Rigbya arberioides* were recorded by Schopf (1967, 1976) from Discovery Ridge, Mercer Ridge and South Ridge, Mount Glossopteris, Ohio Range and Leaia Ledge, Mount Schopf, Ohio Range. The assignment of these fructifications, unnamed by Schopf in 1967 but described as "antarcticoid capitulum and stalk" in 1976, to *Rigbya arberioides* Lacey, van Dijk and Gordon-Gray in 1975 has been accepted by Schopf (1977, personal communication) and also by Rigby (1977, personal communication).

In his 1976 paper, Schopf has also recorded an *Eretmonia* (not yet specifically named) from Leaia Ledge, Mount Schopf, Ohio Range.

Thus we now have *Belemnopteris elongata*, *Eretmonia* sp. and *Rigbya arberioides* asso-

ciated with *Glossopteris* species, occurring at a number of localities in the Ohio Range. By comparison with their occurrence in Natal, these taxa suggest the presence of Upper Permian strata in the Ohio Range region of Antarctica, although it should be noted that Schopf (1976) gives a Lower Permian age for one of the localities (Discovery Ridge), the others being given simply as Permian.

SUMMARY

Our knowledge of the Upper Permian *Glossopteris* flora in Western Natal has been extended and revised in the light of further field work and as a result of personal exchange of information with other palaeobotanists working on Gondwana floras.

Extended comparison of the Natal flora with Raniganj floras in India and similar floras in Australia and Antarctica has also been achieved by the same means.

The importance of consultation, exchange of materials (photographs, latex pulls of specimens, and, if possible, duplicate specimens), exchanges of opinion, and, indeed general collaboration on Gondwana problems prior to publication cannot be overemphasized, if satisfactory progress is to be made.

It is hoped that the new Gondwana Newsletter, proposed by a meeting of the Working Group no. 7 of the Subcommission on Gondwana Stratigraphy at the Calcutta Symposium, January 1977 will be fully supported so that it can make a valuable contribution to facilitating collaboration in Gondwana studies.

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