1954/29
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COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS.

Record No. 1954/29

THE RANGES OF GLOSSOPTERIS, TAENIOPTERIS, AND THINNFELDIA IN AUSTRALIA

by

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Abstract

A critical study of the relevant literature reveals that the Australian records, which claim the intermingling of the *Glossopteris* flora (Permian) with the *Thinnfeldia-Taeniopteris* flora (Triassic), are either incorrect or unreliable. In Australia, the two floras are therefore still satisfactory guides for the separation of Palaeozoic from Mesozoic rocks.

Introduction.

It is commonly claimed that plant fossils are unsuitable or, at the least, unreliable for age determination and correlation of rock sequences in Australia. It cannot be denied, of course, that the rate of evolution in plants is considerably slower than in animals. Consequently, the ranges of individual plant genera and species over parts of the geological time scale are greater than of most animals. This does, however, not rule out the probability that within the confines of a small continent like Australia certain major steps in the evolution of past plant life can be relied upon as being homotaxial wherever we find their record in the rocks. The fact that in plants the spacing in time of characteristic evolutionary events is of the "order" of Periods of the geological time scale rather than Epochs or Ages does, in principle, not affect their usefulness.

Whether these events are found to coincide or not with particular events in the animal kingdom is a problem that belongs in another category of scientific analysis; but it can be said that, in one way or another, such correlation can commonly be carried out with a reasonable degree of accuracy. Among the incomparably more numerous characteristic steps of evolution in the animal kingdom there will always be one or some which come very close in time to the particular event in plant evolution which we desire to correlate.

In Australia it has long since been recognised that each of the floras of the late Devonian, the Carboniferous, the Permian, and the early Mesozoic has a remarkable individuality. The presence or absence of certain genera - in the case of the *Lycopodiales* even species - is a good indication of the age of the relevant beds. The doubts that have been raised were concerned chiefly with the degree of reliability of such age determinations. In many cases, however, students of the subject have been able to demonstrate that it was the apparently contrary evidence which was unreliable or incorrect. Nevertheless, the general attitude towards the reliability of plant fossils for age determination still seems to be one of slight distrust; ie., while recognition of the individuality of the above mentioned floras during the times of their acme is widespread and unchallenged, there remains among geologists and some palaeontologists the notion that there is no clean separation possible between these floras. The change from one to another is believed to be gradual, and this notion leads to the idea that anywhere, sooner or later, beds might be found in which the characteristic representatives of two successive floras occur intermingled.

This marginal case is, of course, theoretically conceivable and possible. To demonstrate and prove its actual existence in the rock-record is, however, quite another and often impossible task. The reason why it is so difficult to find beds which contain such a transitional flora lies in the fact that the probability for the preservation of a rock-record of the comparatively short time interval, which saw the transitional flora, is very much smaller than the probability of preservation of rock-records of the long time interval, during which the two successive floras displayed their individuality to the full.

The appreciation of the principles of probability calculus - which belong intrinsically to the concept of a geological time scale - should keep palaeontologists always on the alert against unqualified evidence referring to the discovery of alleged intermingling of successive floras or faunas which are elsewhere separate. A common source of error in that regard is the a priori uncritical acceptance of "Formations" as rock bodies of continuous sedimentation, from which all fossils collected are assumed to have lived contemporaneously, roughly speaking. However, contemporaneity is in no way proved by an unqualified statement such as "all these fossils occur in the Z-Formation". It is quite likely that, apart from different localities, some come from the bottom part, others from the top of what is believed to be "a Formation". In order to demonstrate how distorted that kind of stratigraphical record may become one has only to assume that the deposition (assuming continuous deposition) of the Z-Formation required the better part of two Epochs of the geological time scale - a case that is not at all rare. Strictly speaking, the one-time co-existence of the now petrified forms found in the Z-Formation can only be regarded as proved, if the fossils are found to occur indiscriminately throughout the formation.

With these general remarks as a background it will be realised from the following examination of the relevant literature why the existence of beds, in which the Permian Glossopteris flora is allegedly intermingling with the early Mesozoic Thinnfeldia-Taeniopteris flora, cannot be regarded as proved. It will, in any case, be demonstrated that any acceptable evidence, if it exists at all, has not yet made its way into the geological literature. It is therefore, in Australia, still convenient and practicable to separate Mesozoic from Palaeozoic rocks, in the absence of other evidence, by means of the plant genera Thinnfeldia, Taeniopteris, and Glossopteris.

Glossopteris and Taeniopteris

Discarding as unreliable some records from the times when Australian stratigraphy was in its infancy there are, as far as I can ascertain, only three localities in Australia from which the intermingling of Glossopteris with Taeniopteris has ever been recorded. These localities are (a) Betts's Creek and (b) Galah Gorge in the Hughenden district of Queensland, and (c) the shaft of the Sydney Harbour Colliery in New South Wales. This scarcity of records is not surprising, it bears out what was said above about the probability of preservation of the rock-record.

(a) Betts's Creek, Queensland - One of the three records, Betts's Creek, can be disposed of at once. It arose in 1944 from a misreading.

Betts's Creek is the famous locality of which Rands (1891) and Jack & Etheridge (1892) had claimed that Glossopteris occurs in the Upper Cretaceous (their "Desert Sandstone"). It took some time until this error was rectified. Maitland (1898) was the first to show that Rands' Glossopteris beds could not by Upper Cretaceous, although he still considered them to be of Mesozoic age. The problem was eventually solved when Reid (1916) published the results of his special investigation. He showed that tectonically undisturbed sandstone and shale formations containing Taeniopteris ("Desert Sandstone") unconformably overly folded and faulted beds with Glossopteris (his Betts's Creek Series). Reid correlated the former with the Jurassic Walloon Series and proved conclusively that the Glossopteris beds are Palaeozoic ("Permo-Carboniferous").

Bryan and Jones (1944, p.9) appear to have misread Reid

(1916) when they describe, referring to him, the Betts's Creek Series as "fresh-water conglomerates, sandstones and white shales containing Taeniopteris, Glossopteris, etc. ...", because both on p.11 and on p.16 of his paper Reid states quite clearly that Taeniopteris was found above the unconformity, i.e. in the "Desert Sandstone", not in the Betts's Creek Series with Glossopteris, Vertebraria, Phyllotheca, and Alethopteris. Whitehouse (1940, p.61), referred to by Bryan and Jones, did not mention Taeniopteris when he discussed the Betts's Creek Series. Unfortunately, in Bryan and Jones (1946, p.43) the error is repeated, and it has meanwhile been carried on (by quotation) by Fairbridge (1953, p.VII/60). David (1950), on the other hand, correctly avoids mentioning Taeniopteris in connexion with Glossopteris when discussing the Betts's Creek Series (on p.358).

(b) Galah Gorge, Queensland - This record must be regarded as unreliable. Whitehouse (1933, p.38) writes "Mr. C. Ogilvie recently has sent me a specimen of Taeniopteris sp. from the Glossopteris beds of Galah Gorge, near Hughenden. This is a new record for Queensland".

The separation of Mesozoic and Palaeozoic formations is so notoriously difficult in this area, that experienced geologists (Rands 1891, Jack and Etheridge 1892) were lead astray. Since this Taeniopteris specimen was evidently not found on one and the same slab with Glossopteris (or Whitehouse would have recorded it), and in view of the evidence from the nearby locality Betts's Creek (Reid 1916), it seems rather doubtful that the bed, in which Mr. Ogilvie found Taeniopteris belongs to the formation that contains Glossopteris. It should be kept in mind that, even if the two beds are only one foot apart, there could still be the unconformity between them.

It is therefore better to discard also this record of a Taeniopteris-Glossopteris association. It is mentioned in one other paper (Whitehouse 1940, p.59), but has not been entered in Bryan and Jones (1944, 1946), David (1950), or Fairbridge (1953).

(c) Sydney Harbour Colliery, New South Wales - The character of this record is similar to that of Betts's Creek; misreading takes part in it. An intermingling of Glossopteris with Taeniopteris in the "roof shales" of the coal seam has, as the original literature shows, never been claimed by those who were directly concerned with the description and interpretation of shaft section.

Dun (1911) described a specimen of Taeniopteris, tentatively referring it to T. mcclellandi Oldham and Morris, as coming from what he called "the flora of the shales overlying the coal seam". Other species of this flora are said to be Cladophlebis roylei Arber, Schizoneura gondwanensis Feistmantel, and Rhipidopsis gingkoides Schmalhausen ? var. süssmilchi Dun.

One will at once notice that Glossopteris is not mentioned. This is born out by the text in Dun (1910, p.616) which makes it sufficiently clear that the last record of Glossopteris was found below, not within, the Schizoneura-Cladophlebis beds. Dun writes "the first appearance of Schizoneura was at about ten feet above the coal seam, and Glossopteris browniana was associated with it about five feet above the seam". The wording of this sentence is, unfortunately, somewhat misleading if one does not analyse it closely. From the mentioned figures "five feet" and "ten feet" we realise, however, that it is the statement "associated with it" which confuses the issue and which should have been omitted.

Another, and equally important, aspect of the Taeniopteris record from these "roof shales" is the fact, that the exact stratigraphical provenance of the specimen is unknown. This fact alone is sufficient to render the record unacceptable as evidence of an intermingling of Glossopteris with Taeniopteris.

From all evidence available it is therefore clear that statements such as "Taeniopteris has been recorded from the top of the Permo-Carboniferous in New South Wales" (Whitehouse 1933, p.38) are premature. It is equally inexact to list Glossopteris and Taeniopteris as occurring together (Jones and de Jersey 1947, P.80). David (1950), in one instance (p.413), correctly refers to this Taeniopteris record as being only "in close proximity to Glossopteris" and ascribe the relevant beds - which are not known with certainty - to the Triassic. On the other hand, there is a reference to the same Taeniopteris occurrence in his chapter on the Permian (p.376). This reference should be disposed of in a future edition .

It may also be mentioned here that the record of an insect wing, belonging to a species of the Orthoptera, should no longer be placed in the Permian (David 1950, p.375). It is preferable to regard it as Triassic because the specimen was found on the same slab of shale with the above discussed Taeniopteris cf. T.mcclellandi (Dun 1911).

Glossopteris and Thinnfeldia

The one and only Australian record of an intermingling of Glossopteris and Thinnfeldia appears to be that in Whitehouse (1933, p.38), and it does not stand up to critical examination. Whitehouse writes "the Glossopteris beds of Jericho occur in a striking, white, sandy mudstone. Very similar beds from the same region recently have yielded a mass of Thinnfeldia feistmanteli", and later he goes on to say "thus, although no glossopterids are present with them, I am inclined, from the huge size of the pinnules and from the similarities of matrix, to believe that these forms are of Permo-Carboniferous age....".

Similarity of matrix is not an acceptable criterion considering the importance of the question whether Glossopteris and Thinnfeldia are, in Australia, separated or not. The particularly large size of the pinnules of one of the mentioned Thinnfeldia species may perhaps (not necessarily) indicate a slightly older age than the similar, but somewhat smaller, forms which are known from the Triassic Esk and Ipswich series. There is, however, no reason to assign a Permian age to them, particularly in view of the fact that nowhere else in Australia one has ever found Thinnfeldia in rocks (of) the Permian age of which was confirmed by other evidence.

Thus, as with Taeniopteris, there is no satisfactory evidence in Australia of Thinnfeldia intermingling with Glossopteris, and the relevant references in Whitehouse (1932; antedating the factual record of 1933), Bryan and Jones (1946, p.43), Jones and de Jersey (1947, p.74), and Fairbridge (1953, p.VII/60) should be treated with great reserve as, indeed, they have been in David (1950).

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APPENDIX I

COMMENTS ON "THE RANGES OF GLOSSOPTERIS, TAENIOPTERIS, AND THINNFELDIA IN AUSTRALIA" BY R.O. BRUNNSCHWEILER. (RECORDS 1954/29)

by

Mary E. White

In Mitchell River flora (see Records 1961/16) two species of *Taeniopteris* are associated with *Glossopteris*. The association is in no way surprising as *Taeniopteris* is probably an offshoot of *Glossopteris* and the distinction of *Palaeovittaria*, *Glossopteris* and *Taeniopteris* is in some cases fairly arbitrary.

In as far as the intermingling of *Glossopteris* and the Triassic flora with *Dicroidium* (incorrectly referred to as *Thinnfeldia*), similar difficulties are present. *Linguifolium*, *Sagenopteris* and *Phyllopteris* (and possibly even some "Thinnfeldia hughesi") have evolved from Glossopterids and there is no sharp distinction. "Glossopteris browniana" is known to range to Middle Triassic in India and South Africa. Only in well-preserved examples could a clear separation be made from "Sagenopteris sp". If one has a Glossopteris-like leaf from an horizon which is known to be Mesozoic, one would refer it to "Sagenopteris" or similar form genus on account of its age. The limitations of classification based on vegetative morphology are only too apparent. When a natural classification is possible on the basis of reproductive structures (if ever they are found for all leaf types) clarification of the situation will be possible. Until then, the use of form genera such as *Glossopteris* & *Taeniopteris*, and even *Dicroidium*, as a basis for far-reaching conclusions is unwise. If one has large, comprehensive collections comprising many different species, the "Floras" are distinct, but where the "flora" is an association of two or three form species, it is necessary to review the situation in the light of evolutionary changes.

The plant fossil record is invariably so fragmentary that it is equally unwise to over-emphasise the absence of species of a form genus. Brunnschweiler refers to the absence of *Glossopteris* with *Cladophlebis* and *Schizoneura*. *Glossopteris* regularly occurs with *Cladophlebis roylei* and frequently with *Schizoneura gondwanensis*. Absence of *Glossopteris* might be attributed to chance or to habitat.

The only valid age distinction which can be made at our present stage of knowledge is a separation of Lower Permian from Upper Permian (?/L. Triassic) on the presence or absence of *Taeniopterids* and *Ginkgoales* which are the forerunners (in Upper Permian) of groups which assume dominance during the Triassic and Jurassic.

Systematic recording of all facts, liberal illustration of all satisfactorily preserved specimens to enable close comparisons, and the collection of sufficient data to enable statistical analysis will eventually make it possible to determine age on the basis of plant fossils with far more certainty.