ARMIDALE AND DISTRICT HISTORICAL SOCIETY

JOURNAL AND PROCEEDINGS

No. 21, January 1978.

Editor: J.S. Ryan

This *Journal* has been published
with the assistance of a grant from the
Royal Australian Historical Society, Sydney.

International Standard Serial Number
AT ISSN 0084 - 6732

Articles appearing in this journal are abstracted and indexed in
Historial Abstracts: and/or *America: History and Life.*

Printed by T.G. Brown, Pty., Ltd., Armidale, N.S.W., and
Published by the Armidale and District Historical Society.

THE NYMBOIDA VALLEY – 200 MILLION YEARS AGO

Few people driving from Armidale to Grafton notice the small village of Nymboida. It consists of only a few houses, a police station and a post office scattered along four kilometers of a road passing over undulating farmlands. The low hills around the village are still clothed in virgin forest, so it is not difficult to imagine this peaceful timbered valley two hundred years ago. But what was the valley like two hundred million years ago? Compared to this inconceivably long period of time, a mere two hundred years is like one second in about eight months. Great changes would be expected over such a long period of time. Surprisingly, geological interpretation of the rocks and fossils of this age around Nymboida suggests that the environment of two hundred million years ago was in many ways similar to that of the present.

How do we know how old these rocks are? For over a century now, geologists have synthesized sequences of fossils from all over the world into a standard succession of named geological ages. Fossil plants found near Nymboida are most similar to those found in the Late Anisian to Ladinian Stages of the Triassic Period. Such an age determination gives an idea of the position of the Nymboida fossils in geological time relative to other fossilferous sequences of the world. More recently methods of estimating the age of some rock types in millions of years have also been devised. Fortunately, such a dateable rock, a basalt flow, is interbedded with Triassic sediments west of Nymboida. Calculations based on the radioactive decay of isotopes (potassium 40 to argon 40) in feldspars of this basalt indicate an isotopic age of 211 ± 5 million years. This radiometric date is in good agreement with radiometric dating of Triassic rocks in other parts of the world.

A tuff horizon within the Triassic sequence near Nymboida is the key to reconstructing the Triassic geography of the area. Unlike conglomerate, sandstone and shale beds of the Triassic sequence, which were resorted and incremented by slowly shifting depositional environments, the tuff was erupted during a relatively short episode of volcanic activity. Its lower surface is a model of the landscape at a particular time during the Triassic. The thickening and thinning of a unit of conglomerate underlying this tuff, suggests that it filled broad valleys cut into deformed older rocks. The detailed structure and texture of this conglomerate unit is similar to a modern braided stream deposit. Like the modern Nymboida River, these Triassic streams were confined by valley walls and probably had both braided and meandering reaches.

Although a tuff and a basalt are found in the rock sequence near Nymboida, the Triassic landscape to the west probably did not include active volcanoes. From radiometric dating of rocks throughout the New England region, it seems that there may have been volcanoes at this time to the north, south and east of Nymboida, but volcanic activity to the west had ceased tens of millions of years before. So Triassic streams near Nymboida drained a vast tableland of older volcanic strata, and dissected down into the underlying folded rocks. Thus Triassic conglomerates are quite distinctive from later Triassic, Jurassic and modern stream conglomerates in this area, because they have more pebbles of light-coloured extrusive rocks than of deformed metamorphic rocks which became more widely exposed as erosion continued.

Fossils are seldom well-preserved in conglomeratic stream deposits, but thick shale

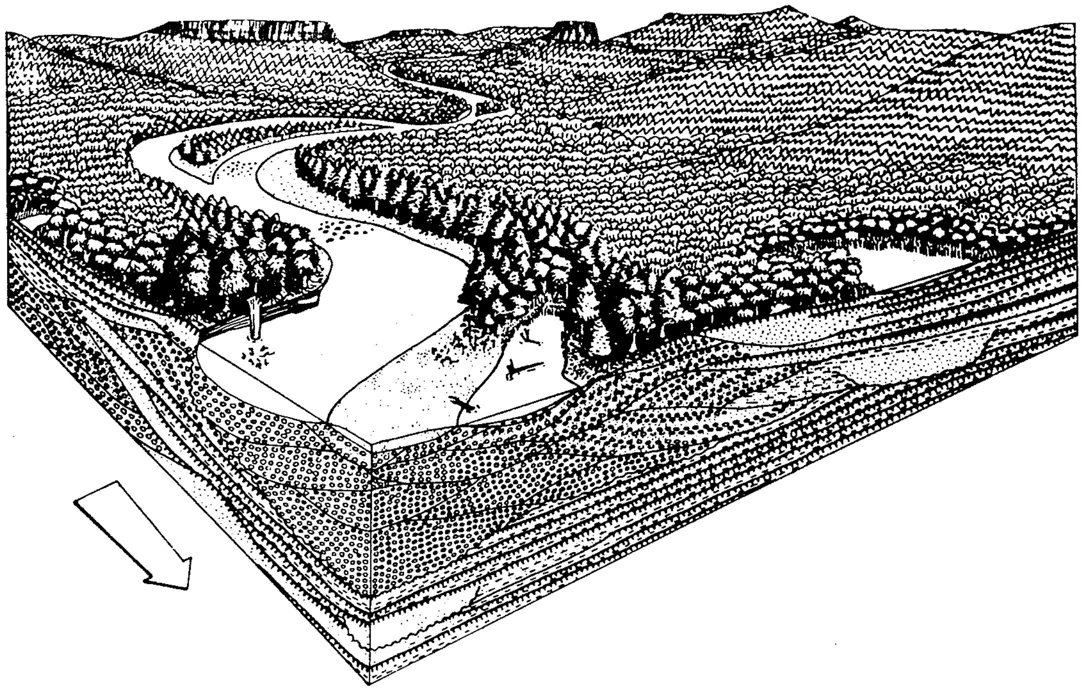

Figure 1. A reconstruction of the Triassic valley near Nymboida, north-eastern New South Wales, showing *'Phoenicopsis'*-dominated scrub on sandy levees (conical trees and dashed shading), *Dicroidium*-dominated floodplain forests (rounded trees and undulose pattern) and *Johnstonia*-dominated mallee-like woodland on hillsides (serrated pattern). Rock types are conglomerate (open circles), sandstone (stipple), siltstone (dashes) and fossil soils (heavy spiked lines). Arrow indicates present north. (From *Alcheringa* with permission.)

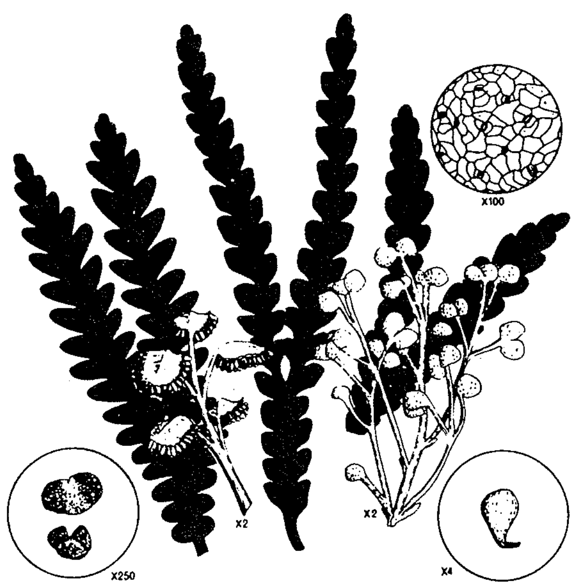

Figure 2. The various plant parts of a Triassic pteridosperm: leaves, *Dicroidium odontopteroides* (black), showing variation in outline accepted for the species; microsporophyll, *Pteruchus johnstonii* (left); megasporophyll, *Pilophorosperma costulatum s.l.* (right); pollen grains, *Alisporites* spp., (lower left inset); seed (lower right inset); impressions of epidermal cells and stomates on the cuticle (upper right inset). (From *Alcheringa* with permission.)

and coal sequences deposited alongside these streams contain abundant evidence of Triassic vegetation. Beautifully preserved plant fossils are abundant in Nymboida Colliery open cut, 3 km east of the Grafton road. The variety of plant fossils, the logs, stumps and the thin, clayey fossil soils in this quarry suggest that ancient forests once clothed the Triassic valley near Nymboida. The variety of fossils, each usually reconstructed as different sizes and shapes of plants by palaeobotanists, and the localized abundance of specific plants, suggest that this forest had a relatively complex structure composed of several different sub-assemblages of herbs, bushes and trees.

Indisputable angiosperm fossils are first found in rocks some 70 million years younger than those deposited around Nymboida. So no flowers bloomed in these monotonous green Triassic forests. No grasses carpeted the forest floor. But just as in much modern vegetation, the Triassic forests were dominated by a group of plants with the most sophisticated reproductive system of their time. These were the pteridosperms or seed ferns, which have been extinct now for about 100 million years. Although these plants had fern-like leaves, they differed from modern ferns in several important respects. They reproduced by means of seeds and pollen, each produced in specialised fructifications. For this reason they are classified as gymnosperms, rather than pteridophytes, such as modern ferns, which reproduce by spores.

Unfortunately seed and pollen organs and leaves of various types of gymnosperms are usually found randomly mixed in fossiliferous deposits, so that it is often difficult to establish which organs were originally derived from the same species. Association of leaves and plant organs is not always a reliable guide, because plants may form fruit and drop leaves at different times of the year, and because fructifications and leaves respond differently to transport by wind and water. A more reliable method of matching various plant parts is by their detailed anatomical structure. Pteridosperm leaves differ from modern fern leaves in having a tough waxy outer coating – a cuticle. When compressed fossil leaves are chemically treated with a strong oxidizing agent and then mounted on a microscope slide, the impressions of epidermal cells and stomates can often be seen in the cuticle. These details of structure may be diagnostic for certain groups of plants. Since most pteridosperm fructifications also have cuticles, the various organs of a single extinct species can be matched in this way. However, palaeobotanists still like to play safe by giving all the different organs separate names, even after it is suspected that they came from the same species of plant. *Dicroidium odontopteroides*, a common pteridosperm leaf at Nymboida, is a good example of these difficulties. Its likely megasporophyll (seed bearing organ) is called *Pilophorosperma costulatum s.l.*, its microsporophyll (pollen organ) is called *Pteruchus johnstonii* and its dispersed pollen have been classified as various species of *Alisporites* (Fig. 2).

Various species of *Dicroidium* are the most common fossil plants at Nymboida, but there are also other pteridosperms (*Tetraptilon*, *Lepidopteris*), equisetaleans (*Phyllotheca*, *Neocalamites*), marattialean ferns (*Asterotheca*), dipteridacean ferns (*Dictyophyllum*), several types of fern-like foliage whose botanical affinities are uncertain (*Cladophlebis*, *Lobifolia*), some enigmatic but possibly pteridophytic plants (*Chiropteris*), cycad-like plants (*Taeniopteris*), ginkgo-like plants (*Sphenobaiera*, *Ginkgoites*) and a podocarp conifer (*Rissikia*).

Two additional plants deserve special comment. One is a long parallel-sided leaf up to 166 by 16 mm in size called '*Phoenicopsis*'. The particular species found at Nymboida is common in Triassic deposits of all the southern continents. Palaeobotanists are still undecided whether it is a ginkgoalean or conifer. It is found occasionally in all the different rock types of the Nymboida Colliery open cut, but at the base of white sandstone beds intercalated within the shaly sequence it is easily the most abundant leaf, forming eighty to ninety percent of the leaf remains. These sandstone beds may thin from several metres to nothing over the 300 m length of the quarry wall. They also contain lenticular, channel deposits of cross-bedded sandstone. These features suggest that they are crevasse splay deposits, formed where a crevasse in a levee has allowed floodwaters to rush out onto the floodplain, leaving miniature deltaic deposits as they slow down and disperse. The way in which the '*Phoenicopsis*' leaves have been entrained in these crevasse splay deposits suggests that '*Phoenicopsis*' formed a monodominant levee vegetation, much like the modern sheoak (*Casuarina*) of river banks in New South Wales.

The other plant of interest is *Johnstonia*, a type of pteridosperm leaf closely related to Dicroidium, but whose lateral pinnae are reduced to a straight or slightly wavy margin. Such leaves are only rarely encountered in groups of five or six in the shales at Nymboida. Several hundred kilometres to the west, near Delungra, they appear to have formed a semi-arid mallee-like woodland association. Perhaps such an association colonized the hills around Nymboida and was only rarely preserved in the floodplain shales.

So what was the Nymboida Valley like 200 million years ago? Not so much different. Instead of folded rocks forming the present New England Tableland, the Triasic Nymboida River dissected an extensively eroded older volcanic terrain. More consolidated flows and ash beds probably formed long palisade-like scarps, small buttes and glistening blocky screes. The streams winding through this terrain were choked with pebbles of these light-coloured volcanics and flanked by sandy levees. Only '*Phoenicopsis*' thrived on the dry sandy levees. The adjacent clayey floodplain supported a well-structured pteridosperm forest largely of *Dicroidium*. Drier, light-coloured soils of the nearby hills were only sparsely clothed by a mallee-like pteridosperm woodland.

G.J. RETALLACK

References

Flint, J.C.E., & Gould, R.E., 1975, 'A note on the fossil megafloras of the Nymboida and Red Cliff Coal Measures, southern Clarence-Moreton Basin, *J. Proc. R. Soc. N.S.W.*, *108*, pp. 70-74.

McElroy, C.T., 1963, 'The geology of the Clarence-Moreton Basin', *Mem. geol. Surv. N.S.W.*, *9*, 172 pp.

Retallack, G.J., 1977, 'Reconstructing Triassic vegetation of eastern Australasia: a new approach for the biostratigraphy of Gondwanaland, *Alcheringa 1*, pp. 253-283.

Retallack, G.J., Gould, R.E., & Runnegar, B., 1977, 'Isotopic dating of a Middle Triassic megafossil flora from near Nymboida, northeastern New South Wales', *Proc. Linn. Soc. N.S.W.*, *101*, pp. 77-113.