DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

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CARBONIFEROUS AND PERMIAN SEDIMENTS IN SOUTH AUSTRALIA AND THEIR CORRELATION

(Proposed Quarterly Note)

GEOLOGICAL SURVEY

by

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BIOSTRATIGRAPHY SECTION

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DEPARTMENT OF MINES AND ENERGY
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ABSTRACT

In the past 25 years, late Palaeozoic sediments in South Australia have generally been assigned entirely to the Permian. Recent investigations especially by Balme (1980) suggest that a significant part of this succession, including most of the glacial sediments, is probably Carboniferous. Until an accurate position for the Carboniferous/Permian boundary is determined, it is recommended that geologists refer these strata simply to the Permo-Carboniferous.

Precise correlation of the Late Palaeozoic succession in South Australia with an international stage scheme is virtually impossible at present. The local stages of Clarke and Farmer (1976) offer the best means of chronostratigraphic subdivision of South Australian Late Palaeozoic strata.

This note draws attention to investigations suggesting that the older part of the South Australian "Permian" is probably Carboniferous. It also considers correlation of South Australian Late Palaeozoic sections with the newly proposed Tasmanian stages and with a revised northern hemisphere standard.

Background

Late Palaeozoic sediments have been long known from the Adelaide region, at Hallett Cove, Cape Jervis and elsewhere on Fleurieu and Yorke Peninsulas, as a result of great interest in the associated glaciation (Howchin, 1895, 1926). In the past 25 years, thick, largely subsurface sedimentary successions of similar age have also been described from the north of the State, in the Cooper, Pedirka and Arckaringa Basins (Ludbrook, 1969).

Although no fossils were recognised at the time, Howchin (1895) assigned a Permo-Carboniferous age to these sediments at Hallett Cove based on their similarity to fossiliferous glacial sediments at Bacchus Marsh, Victoria. With the advent of age determinations using fossil microfloras (spores) during the past 25 years and the absence of any positive Carboniferous age assignments, many South Australian geologists have come to accept a Permian age for the entire Late Palaeozoic succession in the State. Foster (1974, p. 38) recognised the possibility of a Carboniferous age for some of this succession as a consequence of radiometric age determinations from Queensland (Black et al., 1972; Balme, 1973).

Biostratigraphy

The age of Late Palaeozoic sediments in South Australia is best determined using the widespread microfloras. Ludbrook (1967) recognised that the foraminiferal fauna was endemic and provided no reliable basis for correlation. Other fossils are of little stratigraphic value at present.

Correlation using microfloras is mostly facilitated by a series of five numbered "Stages" first proposed by Evans (1969) and subsequently revised by Paten (1969), Price (1967) and Kemp et al. (1977). Additional biostratigraphic units have been recognised at the top of this succession by Helby (1973) and modified by Foster (1979). This biostratigraphic scheme is based largely on the successive appearances of selected key species (Fig. 1).

Evans' microfloral stages can only be related to the standard succession in the northern hemisphere with difficulty as the age defining fusiline foraminifers are absent and the stratigraphically useful ammonoids are not widely distributed in Australia.

Stage 2 through to State 5 and younger microfloras are currently recognised in South Australia.

Carboniferous/Permian boundary determination using microfloras.

When proposing his microfloral stages, Evans (1969) placed the Carboniferous/Permian boundary at the base of Stage 2. This he regarded as approximating the horizon at which the Rhacopteris megaflora gave way to the Glossopteris megaflora, the traditional floral indicator for the Carboniferous/Permian boundary in Australia. Helby (1969) thought the most appropriate location of the boundary was at the base of Stage 1.

Kemp et al., (1977, p. 195-197, 204) compared late Pennsylvanian microfloras from Kentucky, U.S.A., with lower Stage 3 microfloras in Australia and went on to suggest a younger placement of the Carboniferous/Permian boundary in Australia. They cross-correlated their palynological determinations with the marine succession in the Sydney Basin.

Balme (1980) has discussed the problem of the Carboniferous/Permian boundary in Australia in detail. He considered the ammonoid evidence from Australian successions and compared the microfloras from Russia, Western Europe and the U.S. midcontinent with those of Australia. He concluded that the base of Stage 3 was the most appropriate datum for the base of the Permian in Australia.

With the boundary considerations of Kemp et al., (1977) and Balme (1980) based more firmly on international correlation than on conventional practice, and with a large group of stratigraphers advocating a younger boundary placement, there is good reason to regard at least some of the South Australian Late Palaeozoic succession as Carboniferous. As the Carboniferous/Permian boundary has yet to be fixed internationally, it seems best for the time being to refer to South Australian Late Palaeozoic strata as simply Permo-Carboniferous. However the base of Stage 3 as determined by the first appearance of the spore Verrucosisporites pseudoreticulatus Balme and Hennelly seems to be the best biostratigraphic indicator of the Carboniferous/Permian boundary in South Australia.

Implications

Adelaide Region: Palynological investigations of the Cape Jervis Beds in the Troubridge Basin have yielded only Stage 2 microfloras (Harris and McGowran, 1971; Foster, 1974). As a consequence, this unit is more likely to be Late Carboniferous on present information than Permian. As most microfloras have been obtained close to the base of the unit, a younger age is possible in the thick sections encountered in bores. An important implication of a Late Carboniferous age near the base of the Cape Jervis Beds is that the well known "Permian" glacial pavement at Hallett Cove, underlying this unit, also might be no younger than Late Carboniferous.

Northern Basins: Stage 2 microfloras have been recognised from the Boorthanna Formation and from the lower part of the Stuart Range Formation in the Arckaringa Basin (Harris and McGowran, 1973; Townsend, 1976) thus these units could be Carboniferous.

Similar microfloras have been recognised from the Crown Point Formation in the Pedirka Basin (Harris, 1975) as well as from the Merrimelia Formation and the basal half of the Tirrawarra Sandstone in the Cooper Basin (Thornton, 1979) so these horizons also might be older than originally thought.

A correlation chart of Late Palaeozoic stratigraphic units in South Australia is shown on Fig. 2, tentatively placing the Carboniferous/Permian boundary at the base of Stage 3.

Late Palaeozoic Stage Divisions

Most detailed stratigraphic investigations relate to a stage subdivision of the system and in the Late Palaeozoic of South Australia recourse has generally been made to the classic Permian stages of the Russian Platform (e.g. Thornton, 1979, Table 1). This procedure now requires modification because of recent revision of the standard Permian stages (Stepanov, 1973; Furnish, 1973; Waterhouse, 1976) and proposal of formal local subdivisions of the Permo-Carboniferous in Tasmania (Clarke and Farmer, 1976).

Precise correlation with international stages is virtually impossible with Late Carboniferous and Permian successions in Australia. Problems arise because the internationally accepted subdivisions of this interval are essentially based on warm-water successions whereas Australian sediments were deposited under cool to glacial conditions. Nevertheless correlation with the international standard should not be ignored. A tentative correlation of South Australian successions with the Late Carboniferous stages of Western Europe and an updated Permian standard is also shown on Fig. 2. The international Permian standard itself has been subject to much recent revision. The stage scheme of Waterhouse (1976) is followed here because it is the most comprehensive recent contribution.

Arising from difficulties in correlating Late Carboniferous and Permian successions in Australia with the international standard, there has been a tendency towards development of a locally based time nomenclature. Runnegar and McClung (1975) have argued strongly for a locally based regional time scale. Runnegar and Campbell (1976) proposed a scheme of informal annotated chronostratigraphic units. Clarke and Farmer (1976) formally proposed a succession of four chronostratigraphic units based on the Late Carboniferous-Permian succession in Tasmania. They are from youngest to oldest:

Lymingtonian

Bernacchian

Tamarian

Hellyerian

These stages are based largely on shelly marine macrofossils but they have been correlated with the microfloral stages largely through the efforts of Truswell (1978). Consequently this scheme offers the best means of chronostratigraphic subdivision of the South Australian Late Palaeozoic succession at present. The scheme is currently being incorporated in the explanatory legends of the 1:50 000 geological map series of the Geological Survey of Tasmania, e.g. Kingborough and Maria sheet, in press (M.J. Clarke, Geol. Surv. Tasm., pers. comm. 1981).

One problem with the application of the Tasmanian stages in South Australia is the undefined top to the Lymingtonian Stage corresponding to the Toolachee Formation in South Australia's Cooper Basin. It probably occurs within Upper Stage 5. For

practical purposes, it is best to place the top of the Lymingtonian at the international Permo/Triassic boundary. A similar recommendation was suggested for the youngest annotated chronostratigraphic unit of Runnegar and Campbell (1976, p. 252).

Clarke and Farmer (1976) also highlight the strong stratigraphic continuity of Late Carboniferous and Early Permian sediments, in eastern Australia and proposed the Rekunian Series to embrace this entire interval.

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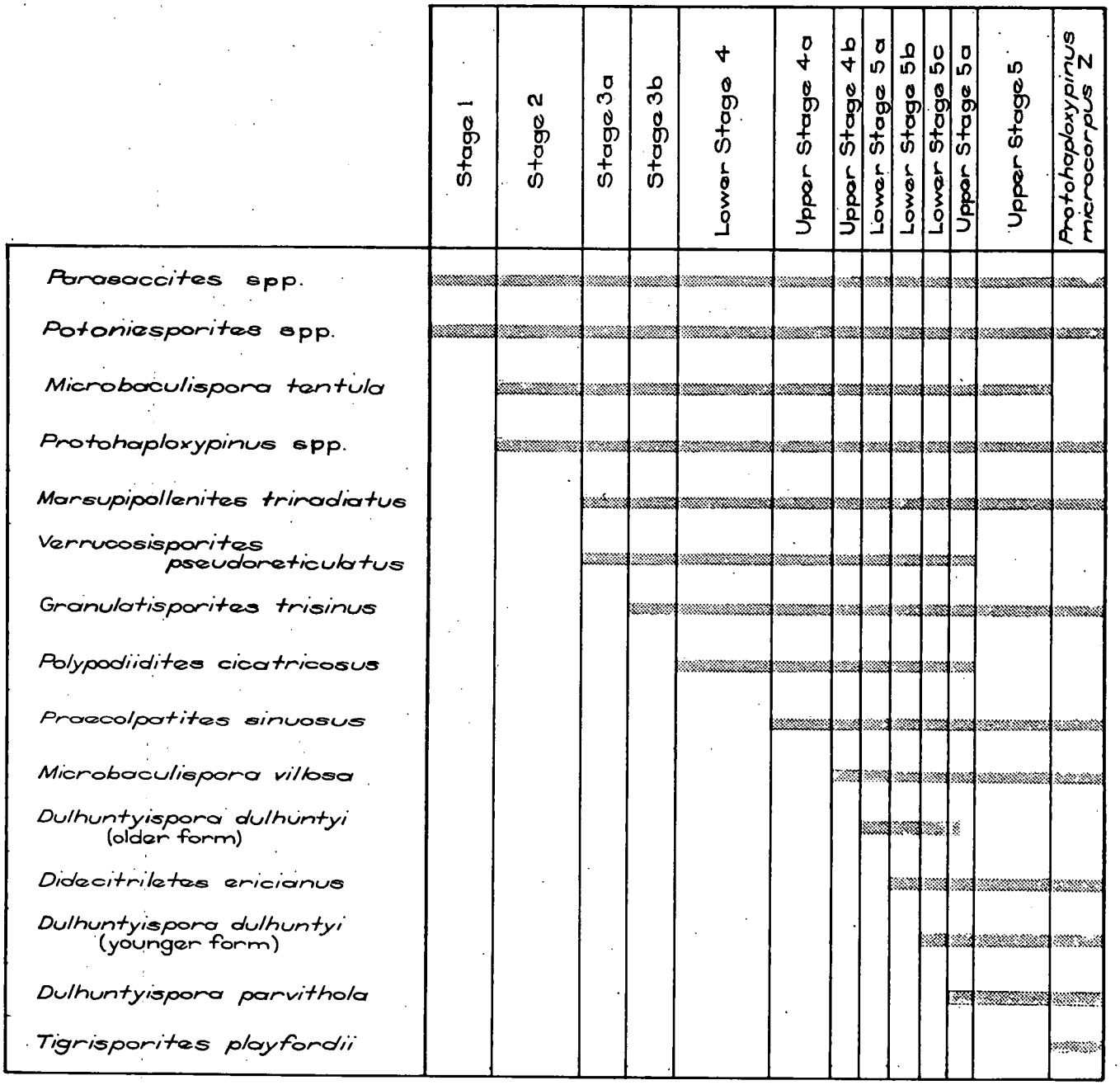

FIG. 1

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C.D.O. 16.3.81 DATE

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SCALE

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KEY SPECIES OF LATE CARBONIFEROUS-PERMIAN MICROFLORA AND THEIR STRATIGRAPHIC DISTRIBUTION MODIFIED AFTER FOSTER, 1979

2342

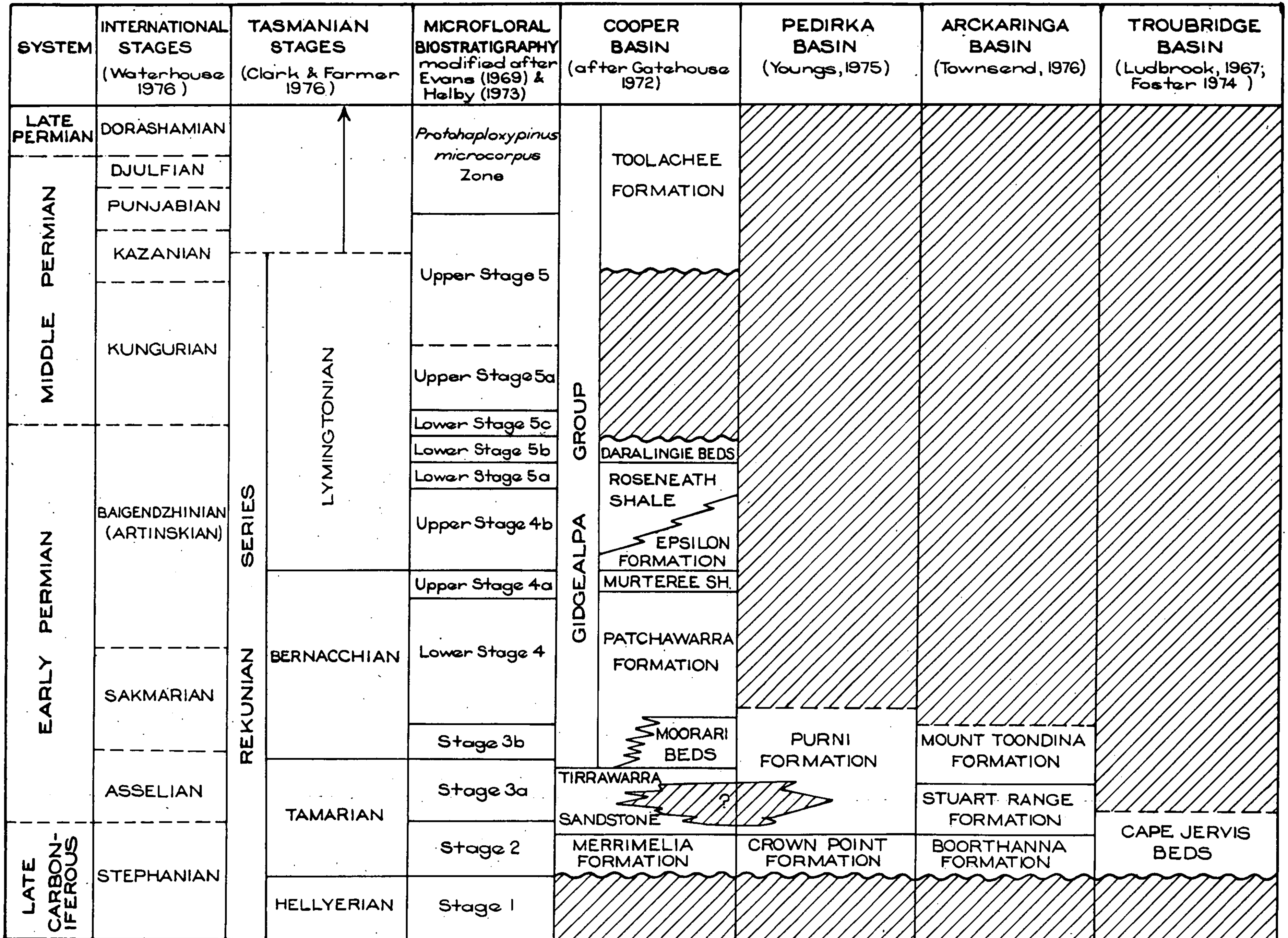

FIG. 2

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DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

CORRELATION OF SOUTH AUSTRALIA LATE PALAEOZOIC UNITS

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