DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY
REGIONAL GEOLOGY DIVISION

FOSSILIFEROUS LOWER DEVONIAN BOULDERS FROM THE CRETACEOUS OF SOUTH AUSTRALIA

A PROPOSED QUARTERLY NOTE

by

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THE BOULDERS (P.A.R.)

In September, 1975, Mark Benbow (Regional Mapping Section, S.A. Department of Mines) found a piece of fossiliferous ~~Lower Devonian~~ Paleozoic quartzite which had weathered out of the Cretaceous Cadna-owie Formation about 6 km NNW of 'Dalhousie' H.S. ruins (DALHOUSIE 1:250 000 map area). The fragment is part of a large water-worn boulder, as shown by the smooth, rounded, surface preserved at one end (Fig. 1). ~~The lithology~~ It is a pale grey, uniform, well-indurated fine-grained quartzite with scattered moulds of brachiopods.

Similar specimens of fossiliferous quartzite were collected by P.T. Russ (S.A. Dept. of Mines) in 1966, from a boulder removed from a shaft at German Gully, Andamooka Opalfield.

Fossiliferous Devonian quartzite boulders have been recorded in Cretaceous strata at White Cliffs Opalfield in N.S.W. (Dun, 1898).

The locations of the boulders are shown on the geological sketch map (Fig. 2).

THE FAUNAS OF THE BOULDERS (K.S.W.C.)

Dalhousie Boulder

Brachiopod:

Howellella jaqueti (Dun) - represented by several specimens, all separated valves.

Bivalve:

Actinopteria sp. - a single, small, fragmentary external mould lacking details of the ornament.

Fig. 1. Fragment of boulder of Lower Devonian fossiliferous quartzite from 'Dalhousie'.

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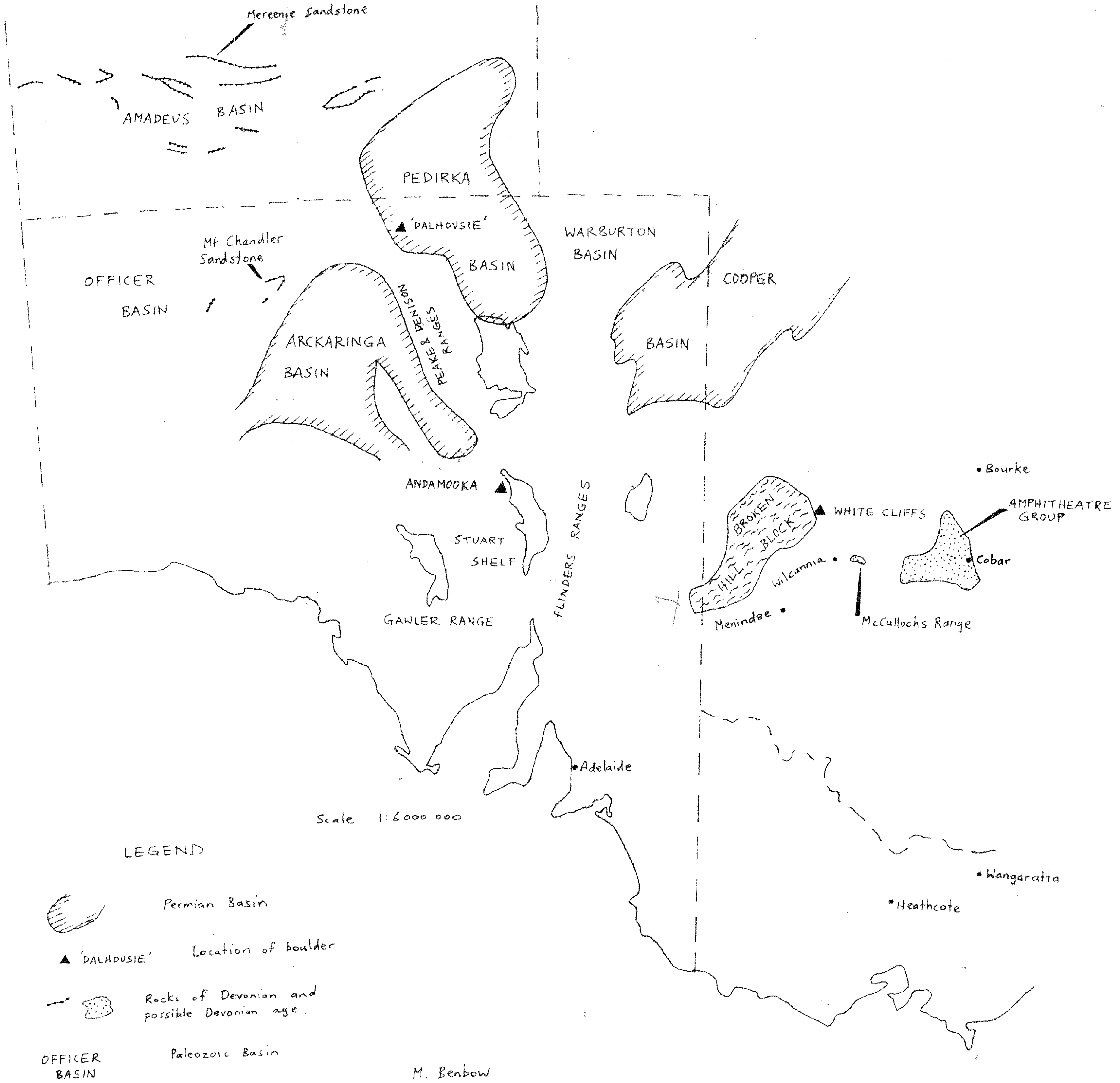

FIG. 2 Geological Sketch map showing locations of Lower Devonian boulders.

Andamooka Boulder

Brachiopods:

Howellella jaqueti (Dun) - represented by several specimens, all separated valves.

Isorthis sp. - two internal moulds of pedicle valves and an external mould of a brachial valve. These specimens can be matched directly with material from the Amphitheatre Group.

Rhynchonellid indet. - one fragmentary internal mould of a pedicle valve.

Atrypid indet. - one internal mould of a juvenile pedicle valve.

Bivalve:

Actinopteria sp.

Crinoid:

Columnal indet. - one isolated columnal.

Tentaculitids:

Tentaculites sp. - several internal and external moulds that can be matched with material from the Amphitheatre Group.

Comment on the Faunas

Landrum (1975, unpubl.) has described the macrofauna of the Lower Devonian Amphitheatre Group throughout central and central western N.S.W. (see also Baker *et al.,* 1975), and this has involved a re-examination of the faunas described by Dun (1898) from the boulders in the Cretaceous rocks at White Cliffs, north of Broken Hill. Many new genera and species have been recognized. In the Dalhousie and Andamooka boulders the commonest species are *H. jaqueti* and *Tentaculites* sp., which are also common in the Amphitheatre Group. The less common species are also represented there. The lithology of the boulders and the nature of the preservation of the fossils are directly comparable with the Amphitheatre Group.

The distribution of the Amphitheatre Group and the facies variations within it have been summarised by Webby (1972) and Landrum (1975). It extends as far west as McCullochs Range, east of Wilcannia, where Packham (1969) has reported an occurrence of *H. jaqueti*, and possibly even as far west as Mootwingee (Webby, 1972) though only trace fossils and plants are known from rocks assigned to the Amphitheatre Group there. The sequence is thought to become deltaic in the region of the Darling River.

It should be noted that faunally and lithologically the facies of the more marine part of the Amphitheatre Group can be recognised at least as far south as Heathcote, where it is represented by the Mt. Ida Formation (Talent, 1965). The Florence Quartzite and the Bell Shale of Tasmania also have some faunal elements in common with these units. The facies analysis of Landrum suggests that "there may have been a short-lived connection with the Amadeus Basin far to the north-west", but almost certainly marine conditions did not persist far in that direction.

Webby (1972, Fig. 1) has given a conservative estimate of the western limit of marine conditions in Early Devonian time. As can be seen from the above comments, there may have been incursions of the sea across as far as the flanks of the "Broken Hill Block." The thickness of the sequence at Heathcote also suggests that there were marine rocks further west in Victoria, but these have subsequently been eroded. Landrum's work suggests that the delta plain shown on Webby's map in the northern part of the Cobar Basin, was much more extensive.

GEOLOGICAL SETTING OF THE BOULDERS (P.A.R.)

The boulders from 'Dalhousie' and Andamooka occur in the Lower Cretaceous *Cadna-owie Formation* (Wopfner *et al.*, 1970). This unit is widely exposed along the margins of the Great Artesian Basin in South Australia and comprises a variety of predominantly arenaceous rock types, deposited mainly in a shallow-water marginal marine environment.

A distinctive feature of the Cadna-owie Formation is the abundance of subrounded to well-rounded boulders, up to 1.2 m in size, in the lower part of the unit. The boulders have a smooth, apparently water-worn surface. Most of the boulders consist of quartzite derived locally from Proterozoic and Paleozoic formations of the Peake and Denison Ranges, Northern Flinders Ranges, Stuart Shelf, and the Officer Basin. The boulders are thought to have originated on shorelines of basement highs during the early Cretaceous marine transgression, and to have been transported down submarine slopes by slow sediment creep (Wopfner *et al.,* 1970). Many boulders are probably reworked from Permian diamictites ~~tillites~~, although no polished or striated surfaces have been recorded. Clasts of reddish acid porphyry derived from the Carpentarian Gawler Range Volcanics are dominant in the south but become less common in the Cadna-owie Formation further north.

The Mesozoic sediments of the Great Artesian Basin overlie three Permian basins in the north of South Australia: the Cooper, Pedirka and Arckaringa Basins (Fig. 2). The Permian deposits include diamictites ~~tillites~~, conglomerates, sands and mudstones with coal layers, deposited in marginal marine, fluviatile and lacustrine conditions. Older Paleozoic sediments occur in the Officer, Amadeus, Warburton and Arckaringa Basins (Fig. 2).

TRANSPORT OF THE BOULDERS (K.S.W.C. and P.A.R.)

The lithology and fauna of the boulders are remarkably similar to the Amphitheatre Group. There is a strong possibility ~~is little doubt~~ that the boulders were derived from the Amphitheatre Group in New South Wales, or from its equivalents in Victoria and Tasmania. The fossils preserved in the boulders have not been recorded in rocks of Devonian or possible Devonian age in the north of South Australia or the Northern Territory, such as the Mereenie Sandstone (Amadeus Basin) or the Mount Chandler Sandstone (Officer Basin).

The large boulders at Dalhousie and Andamooka could not have been carried for great distances by traction currents or creep on submarine slopes. The only available local sources are the Permian ~~tillites~~ diamictites that underlie Mesozoic sediments in the Cooper, Pedirka and Arckaringa Basins. These ~~tillites~~ diamictites are relatively unconsolidated and would have readily shed their clasts. However, no Lower Devonian boulders have been found in the ~~tillites~~ diamictites. Nevertheless, it seems most likely that the boulders were transported to South Australia by Permian ice and reworked later into the Cadna-owie Formation.

Permian ice in Tasmania moved between northeast and southeast, and hence Tasmanian boulders are unlikely to have reached South Australia (see Crowell & Frakes, 1971, for summary). Ice on the possible source areas in Victoria would have been moving to the north and northeast. Such ice is known to have transported Mt. Ida Formation material in these directions to such sites as Eppalock Dam and Wangaratta (Talent & Thomas, 1967). It is possible that some of the material in the boulders at White Cliffs came from the south since they contain specimens of *Notoconchidium* (see the *Rhynchonella ? in* Dun, 1898, Pl. 17, fig. 7) a genus known in Victoria and Tasmania, but not in the Amphitheatre Group. On the other hand if there were an ice cap over central New South Wales as indicated by Crowell & Frakes (1975, Fig. 22.1) blocks picked up in central Victoria or western New South Wales could have been transported around the eastern and northern flanks of the "Broken Hill Block" and on to the Cooper Basin, or possibly into the Pedirka Basin. Erratics may have been carried around the Permian basins on ice-rafts, as happens today in the Great Lakes of North America. The inferred north to northwesterly direction of ice movement agrees with measurements of glacial striations at Hallett Cove and Inman Valley, south of Adelaide (Segnit, 1940; Howchin, 1926).

The last phase of transportation of the boulders would have taken place in the Early Cretaceous, when the advancing sea eroded exposed areas of Permian ~~tillite~~ diamictite and reworked erratics into the Cadna-owie Formation. Areas of ~~tillite~~ diamictite accessible to marine erosion would have occurred on the shallow margins of the Great Artesian Basin and on basement highs such as the Peake and Denison Ranges, where Permian ~~tillite~~ diamictite outcrops on the western flank.

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REFERENCES

Baker, C.J., Schmidt, B.L. and Sherwin, L., 1975. Revised Stratigraphy of the Cobar-Gunderbooka area. *Quart. Notes geol. Surv. N.S.W.*, 20(3), pp. 1-14.

Crowell, J.C. and Frakes, L.A., 1971. Late Paleozoic glaciation in Australia. *Journ. geol. Soc. Aust.*, 17(2), pp. 115-155.

Crowell, J.C. and Frakes, L.A., 1975. The Late Paleozoic Glaciation. *in* Campbell, K.S.W. (*ed.*) Gondwana Geology. pp. 313-331. ANU Press, Canberra.

Dun, W.S., 1898. Notes on the fauna of Devonian boulders occurring at the White Cliffs opalfields. *Rec. geol. Surv. N.S.W.* 5, pp. 160-174.

Howchin, W., 1926. The Geology of the Victor Harbor, Inman Valley, and Yankalilla districts, with special reference to the Great Inman Valley Glacier of Permo-Carboniferous age. *Trans. Roy. Soc. S. Aust.*, 50 pp. 89-119.

Landrum, R.S., 1975. Biostratigraphy, paleontology and paleoecology of some Silurian and Devonian deposits in the Cobar Basin, New South Wales. unpub. Ph.D. thesis, Australian National University.

Packham, G.H. (Ed.), 1969. The Geology of New South Wales. *Journ. geol. Soc. Aust.*, 16(1), 654 pp.

Segnit, R.W., 1940. Geology of Hallett Cove and district with special reference to the distribution and age of the younger glacial till. *Trans. Roy. Soc. S. Aust.*, 64(1), pp. 3-45.

Talent, J.A., 1965. The Silurian and Early Devonian faunas of the Heathcote district, Victoria. *Mem. geol. Surv. Vict.* 26.

Talent, J.A. and Thomas, D.E., 1967. Central Victoria *in* McAndrew, J.M. and Marsden, M.A.H. (Eds.), Geol. excursions handbook; Australia and New Zealand Assoc. Adv. Sci., 39th Congr., Melbourne.

Webby, B.D., 1972. Devonian geological history of the Lachlan geosyncline. *Journ. geol. Soc. Aust.*, 19(1), pp. 99-123.

Wopfner, H., Freytag, I.B. and Heath, G.R., 1970. Basal Jurassic-Cretaceous rocks of western Great Artesian Basin, South Australia: Stratigraphy and environment. *Bull. Am. Assoc. Petr. Geol.*, 54(3), pp. 383-416.