Precambrian Perambulations

By Alan V. Morgan

In the last issue of WAT ON EARTH I started to describe a visit to South Australia to track down and photograph some of the young Precambrian fossils in the region about 500km north of Adelaide. The fauna is famous as the Ediacaran assemblage and is found in an area on the western edge of the northern Flinders Ranges. Since the type section itself is rather inaccessible we traveled to a more public access along the Brachina Gorge geological trail, a wonderful 20 km long gravel road that transects the gently westward-dipping sediments of the region. These were deposited an area known as the Adelaide Geosyncline. (A geosyncline is a linear basin that accumulated sediments over a very long period of time). The basal portion of the geosyncline subsided as new sediments were brought into the area, and most of the 9 kilometer thickness of rocks were laid down close to sea level. Geologists have resolved that partially because of a glaciation, and for other reasons, sea-level was fluctuating throughout the 150 million years represented by the rocks in the region. The sediments were transported by streams, although glacial deposits are also present, and most were laid down under marine conditions.

Apparently some 500 million years ago, during the Cambrian Period, the rocks of the area were uplifted in a folding event which left them contorted into a number of gentle folds. Modern erosion has provided a number of east-west trending valleys through the area and these allow a transect through the latest Precambrian and early Cambrian rocks.

We left the small railroad settlement at Parachilna on a sunny but frosty morning and drove the 30 km to the lookout at the start of the Brachina Gorge. This was to be a "back through time" transect starting in the middle Cambrian and moving to the older rocks in the east. The first striking outcrop was a real thrill - a whole small mountain of archeocyathids (left). I have read about archaeocyathids for many years, and although they have a worldwide distribution, I had never seen any in the field. These are strange organisms with calcareous skeletons, restricted to the lower and middle Cambrian. No one is certain of their affinities and they are described in the literature as "probably related to sponges." They did build reefs, and the mound at the entrance to the Brachina Gorge is a superb example. The photograph above illustrates examples of these fossils in the Wilkawillina Limestone. From here it was on a few kilometers to the east, and back across the Precambrian boundary into rocks which contained the Ediacaran fauna.

The youngest Precambrian beds are exposed in a rugged part of the Heysen Range, and the steep walls are due to outcrops of a shallow-water white quartzite known as the Rawnsley Quartzite. We had been told to look here for the fossil known as Dickinsonia, a large annelid-like organism. After about thirty minutes of searching we found one several specimens on the underside of one bedding plane on a very steep bluff (below, left).

Brachina Gorge: Rawnsley Quartzite (above right) and videotaping Dickinsonia fossils on the undersite of the Older Bonney Sandstone (above left). Rawnsley The unit below headlevel is the Bonney.

Finally, some sense of achievement: - my first Precambrian fossil in the field! After a lot of photographs and videotape we moved back still further in time. As we moved eastward the rocks reflected deeper water conditions.

The Dickinsonia (left) were found in near-shore, shallow water sequences, and a time-frame very close to the recognised boundary of the Cambrian. The most recent papers indicate that the true Ediacaran fauna might belong to a restricted time from about 565 to 545 million years. It also appears that fossils such as Dickinsonia lived just beneath microbial mats on the surface of the sea floor. In this way the mats protected them from outright destruction in times of storm surge, and, although they were soft-bodied, they were frequently buried beneath sand horizons ultimately to be preserved on the underside of beds, such as those in the Brachina Gorge.

Several kilometers to the east the Brachina Gorge opens into the broad Bunyeroo Valley, where the Aroona and Bunyeroo Creeks join the main river. Somewhere below us was a bed of impact debris which had been thrown into the region by an asteroid which had crashed into the region some 300 km to the west.This bolide, believed to be about 4 km in size, created a crater 30 km wide and several kilometers deep. The Precambrian Lake Acramen impact crater splattered billions of tons of material across the Adelaide geosyncline, leaving the debris horizon preserved in the Bunyeroo Formation.

Still further to the east we encountered the Elatina Formation. This was a little closer to my heart, a deposit laid-down by glaciation, but this time a Precambrian glaciation. The Elatina appears to be the equivalent of the Varanger glaciation in rocks slightly under 600 million years in age from northern

Norway. The outcrops in the Brachina Trail are exposed as rather small outcrops of a good tillite (seen above/left: lens cap is 5cm) with clasts of still older debris. This glaciation is the youngest known of at least three major glacial episodes in the Precambrian.

Finally we came to the Trezona Range with a series of small escarpments preserved as shallow water limestones and siltstones interbedded with shales. The limestone bands, probably about 620 to 630 million years old, contain abundant horizons of stromatolites, the blue-green (cyanobacteria) algae which we had seen living in the hypersaline waters of Hamelin Pool in West Australia, just one week earlier.

Well, at this point I thought that our encounters with Precambrian fossils were over, but that was not (quite) to be the case. Following some well-aimed advice by Terry, a high school geology teacher we had met at Parachilna, we moved still further north in the Flinders to the "end of the road" at Arkaroola. The 150 km drive over some really rough (in places) roads eventually brought us to this little homestead, to some fascinating geology and to one totally unexpected coincidence. Shortly after we arrived we found that Arkaroola Village was established by a geologist, Dr. R.C. Sprigg, and his family. Sprigg was the geologist that had first discovered the Precambrian Ediacaran fossils in 1948, a decade before the Charnwood, England, specimens that I mentioned in the last WAT ON EARTH. This was the Sprigg after which Spriggina (seen below) was named.

Apparently Reg. Sprigg had worked in the area, first as a student and later for the mining companies who built the roads into this fascinating wilderness area. The Sprigg family purchased the Arkaroola Station pastoral lease when the station came up for sale. The property is now looked after by Mrs. Griselda Sprigg and her children. Reg. Sprigg died a few years ago and is buried along the route that we took the following day called the Ridgetop Road. Perhaps I should back up a little, to the time when the allied forces were looking for weapons grade radioactive minerals during the Second World War. As good Canadians we all know about the part played by Port Radium in our Northwest Territories, but the search was also on in the southern hemisphere and one of the most exciting prospects was at Arkaroola. Early in the 1900's the first prospectors in the region had found radium on Mt. Painter, and this was to become the target for a new road driven in to exploit the deposits. The road engineers put the roadbed in along the valley floors, and it served its purpose, only to be lost just after the war when abnormal rains swept away most of its course. In 1968 Exoil tried to re-examine the prospect, but rather than making the mistake of putting the roadbed along the valley they placed it on the interfluves, hence the name, "The Ridgetop Road".

The road is closed to the general public (it is maintained by the station),but we travelled with Douglas Sprigg (below right) as he explained about the road, the geology, scenery and natural history of the property. Shortly after we started it became obvious why this route is closed to all but the Arkaroola staff. It is not for the faint of heart. In places there are extremely steep sections where the wrong twist of the wheel could put you over the edge on a precipitous slope. We passed Mt. Gee and Mt. Painter where uranium prospects in 1969 had turned up concentrations of 1kg U oxide/ton, and where, on the way back, Doug stopped to present me with a small specimen of Torbernite. Torbernite is a secondary uranium mineral, emerald to grass-green in colour and is a hydrated phosphate of uranium and copper. Eventually the road terminated on Tillers Lookout.

From here we had a stunning view to the east over the Lake Frome (usually dry) lake bed, and a glimpse of the distant Paralana Hot Springs. To the north,Doug explained, was the granite tableland of the Mawson Plateau and in the northwest a small mine which, around the turn of the century, had produced some of the classic azurite and malachite crystals specimens seen in places like the British Museum. Just as he finished, the mail plane on the Birdsville Mail Run over-flew the lookout, heading for the next of 26 landings in its two-day run from Adelaide.

Our time at Arkaroola and the Flinders was almost over. We did manage to squeeze in an overflight of Sillers Lookout, the old copper mine and the Mawson Plateau, and, just as the sun was setting glimpsed several yellow-foot rock wallabies. don't forget, if you are in this part of Australia, this is a wonderful spot to see some of the natural history and geology of the region.Combine it with the Brachina Gorge and you will have memories for the rest of your life.