Geology

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INTRODUCTION AND EARLY HISTORY

The geology of Taroona or the North Ward of Kingborough has never been written in any detail ever; so much of this work relates more to my own personal field work than to all of the publications which mention this area.

Taroona is nearly a complete microcosm of the geology of the Derwent Valley. It contains many of the elements of the Derwent Valley but lacks a few of the more important ones. The elements which are here are usually better represented elsewhere and there are no enigmatic formations here to cause any interest or controversy. The geology of Taroona is however an important aspect in the consideration of the settlement and construction in the area.

Darwin (1844) must have travelled the then new Brown's River Road because he mentions the volcanic rocks at Blinking Billy Point, Porter Hill and then Brown's River. No mention is made of the geology between these two places.

R.M. Johnston (1888) mentions some of the rocks in passing and uses the Alum Cliffs as an erroneous analogy. A.N. Lewis (1946) makes some observations about Taroona in Chapter XI of his book. Many of the formations mentioned have been superseded and simplified so many of his interpretations of faults and sedimentary formations were unnecessarily complicated. He was more interested in the rocks of Porter Hill (Fort Nelson), just north of Taroona.

The area has been mapped in a very generalised way by the Tasmanian Geological Survey and appears on the Hobart Quadrangle (now out of print). Geology students from the University and other places regularly visit Taroona as part of the Sandy Bay excursion but what they visit and the explanations given provide little insight into the geology of Taroona as a whole.

Early Settlement

The decision to build the road to Brown's River would have been based substantially on geological considerations. Although much of the ground was steep and hilly, most of the route could be driven through softer rocks, which was important at a time when it was uncommon to use explosives for breaking rocks. The main limiting factor was the quality of steel tools, which at that time could only slowly drill shot holes in hard rocks like dolerite.

There are two main types of rock in Taroona. The harder, older rocks on the steep hills and the softer, younger rocks which form a coastal apron. It happens that as the streams emerge from the hilly areas, they have relatively shallow valleys. Lower down as they cut into the softer rocks, the valleys become deeper and very steep. The route taken by the Brown's River Road then had to stick to the ground at the base of the hard, rocky hills where there was less excavation needed.

From about the old Taroona Shopping Centre to the top of Bonnet Hill no soft option was available, so much convict labour had to be devoted to this section which is mainly in steep dolerite. There was however, one consolation in the discovery of a small deposit of very high quality building sandstone on the crest of the Taronga Ridge. This was put to good use to house the convicts at the Brown's River Probation Station and to construct a number of landmarks around Taroona, most notably the Shot Tower and "Acton".

Although limestone outcrops at Porter Hill just north of Taroona, there is no evidence of its use as a mortar in the very early buildings associated with the road. These were either constructed using rammed earth as a mortar or sand and burned seashells as a render or mortar.

Some bricks were made from the deep, clayey soil overlying mudstone at Taronga Road. This was probably the only material known at the time. It is not an ideal brick material and a small number of fairly typical crumbly convict bricks were produced and used.

The road provided better access for the area, improving the prospects for settlement. Although the soil was clayey and swampy in places, much of it was quite suitable for agriculture. The enforced settlement of the Brown's River Probation Station on a high and isolated ridge dwindled and the lower, more amenable terrain prospered.

The Older Sediments

These are mainly mudstones and sandstones of the Permian period, deposited about 250 million years ago. They were intruded by dolerite about 165 million years ago during the Jurassic period.

The oldest rock in Taroona is the Grange Mudstone, though there are older rocks at Porter Hill. The Permian rocks are divided into separate layers or units which are named. Well represented in Taroona, we have the Grange mudstone, overlain by the Malbina Formation, which is subdivided into A, B, C, D and E.

The Risdon Sandstone overlies the Malbina E. and it in turn is overlain by the Ferntree Mudstone. The Cygnet Coal Measures, present in much of southern Tasmania, is absent from Taroona. The next unit is the Knocklofty Formation which is Triassic in age, approximately 220 million years old.

The Grange Mudstone can be seen at its type locality in the large quarry just next to the city boundary. It is pale green to buff in colour and contains some layers which are very rich in fossils. The main fossil types are bryozoa which resemble small lacy or branching corals and brachiopods which are a mostly extinct type of shellfish. These are bilaterally symmetrical, some having a winged appearance and others resemble small spiny half spheres. Occasionally coiled snail-like shells and scallops are found. Many of the fossils found in the Permian rocks are illustrated in texts published by the Mines Department and the University of Tasmania.

The Malbina Formation can be seen in its entirety on the ridge which goes up opposite bust stop 35. The top of the Grange Mudstone can be seen in a little gully nearly opposite the bus stop. On scrambling up the hill, one passes into the Malbina Formation and on upward to the highest sub-unit next to the dolerite high on the ridge.

The upper part of the Malbina is seen better at the base of the Alum Cliffs. Here it is a rather messy formation of dark grey muddy sands and gritty, sandy mudstones. There are bands of small pebbles, often granite or quartzite and "Drop Stones" which are isolated large pebbles in a muddy or sandy matrix. The shape and occasional scratches on these indicate a glacial origin and they probably dropped into the sediment from floating icebergs.

Bands of well preserved fossil shells occur on the shore platform below Taronga Road. It is best not to remove them because they are well displayed and not particularly common in this form. They photograph better "as is where is" than if they are removed and invariably broken.

The Risdon Sandstone is seen just above the fossil layers. It is a buff coloured layer of sandstone about 2 metres thick that can be traced along the cliff rising from south to north and disappearing into the clifftop bush near Wandella Avenue. It contains a few, often broken, fossils and some pebbles.

The Ferntree Mudstone is seen mainly in the southern part of the Alum Cliffs. It is a rather uniform rock of alternating bands of harder and softer mudstone. This rock contains many angular sand grains and a quantity of pebbles and "Drop Stones" in places. The freshly broken surface of this rock shows many intermingled lines of worm castings. The mudstone contains much sulphur which can be smelled when the rock is struck. Much of the sulphur manifests itself as a white encrustation on the sheltered areas of the cliffs. It has the distinct bitter-sweet taste of alum from which the cliffs are named. It is a sulphate of mainly sodium, potassium and aluminium. In the past this white material was collected, dissolved, filtered and crystallized to produce a useful household and industrial chemical. It was used for dying textiles and tanning hides.

The Knocklofty Sandstone occurs as a small outcrop on the top of the Taronga Ridge above the Ferntree Mudstone. This is mostly a well sorted sandstone with angular, interlocking grains. There are a few layers with small pebbles. This is the rock that was found to be an excellent building stone.

The Sedimentary Environment of the Permian and Triassic Rocks

When these rocks were being laid down as sediments, Tasmania was part of Gondwanaland which was a huge continent occupying the southern hemisphere much as Eurasia does in the north today. Most of Tasmania was a basin of accumulating sediments. The formations in Taroona are found over a large proportion of Tasmania. At various times the place was a shallow sea or low, flat land. The climate was most likely subpolar with icebergs drifting in the sea. The most likely environment to be found on earth today approximating that of the Permian rocks is the mouth of one of the great rivers which flow into the Arctic Ocean. Starting at the top of the sequence in the Knocklofty Formation we have a vast riverine plain with a slow river meandering across it.

The Ferntree Mudstone was laid down in a large estuary, probably as tidal mudflats with a few shell fish, pieces of driftwood and sand worms. Sizeable pieces of floating ice must have drifted over the mud to drop in pieces of granite and quartzite from mountains a hundred kilometres or so to the west.

The Risdon Sandstone probably marks a change from estuarine to marine conditions and has been interpreted as a kind of sand bar deposit. Some of the muddy sandstones of the Malbina Formations could fall into this category. The fossils in this region are either fairly robust or broken indicating an environment with a fair amount of wave action.

As we move down into the lower Malbina and the Grange mudstone, the fossils become more delicate and the sediments finer grained, indicating a deeper, quieter water, still with icebergs floating above.

The Dolerite

This is the dark grey crystalline rock capping the hills behind Taroona. Fragments of this are found in many parts of Taroona. It occurs as generally horizontal or steeply sloping bodies many hundreds of metres thick, cutting through the Permian and Triassic rocks. The grain size is usually 3 or 4 mm but is finer close to the boundary with the surrounding rocks. It consists mainly of two minerals, light grey feldspar and dark grey pyroxene.

The surrounding sediments show signs of heating. The mudstones have been changed to a flinty sort of material called hornfels and the Knocklofty sandstone at Taronga Ridge has been welded together by new minerals formed under the intense heat thus enhancing its strength and durability.

The dolerite itself is too tough to be a good building stone though natural blocks make good garden walls. Large blocks along the coast have prevented the soft rocks on the coast from eroding much faster. It has a negative side though. It is responsible for the steep slopes and shallow soil of the hills. It is difficult to move for roads and building foundations and weathers to the black clay soil which can be like putty in winter and concrete in summer. Dolerite was quarried and crushed for bluemetal some years ago, just along Derwent Rise.

The Taroona Fault

This is a major structure which runs through the middle of Taroona. It was formed about 60 million years ago as part of the great subsidence which was the cause of the Derwent Valley. This happened probably as Australia was breaking apart from Antarctica in the final fragmentation of Gondwanaland.

The fault line runs from just east of the Grange quarry, crosses the Channel Highway near St. Joseph's Centre, continues south in a gently wavy line to recross at the top of Taroona Crescent and then heads into the sea at the south end of Hinsby Beach, running under the sea not far out from the foot of the Alum Cliffs. The western side of the fault has risen 300-400 metres with respect to the eastern side.

The Rocks of the Tertiary Period (about 60 million years old)

The Taroona fault divides the older hard rocks from the soft Tertiary rocks which were formed about the same time as the fault was active. The lowest formation in these rocks outcrops on Crayfish Point. It is hard to determine whether this is the lowest formation as there is some debate as to whether the lower levels of this are weathered dolerite bedrock. It consists of boulders of coarse-grained dolerite in a matrix of buff coloured clay. Small veins of limy material and a piece of woody-textured, manganese oxide have been found in this formation. It grades upward into a reddish, mottled clay still with dolerite boulders. This can be seen at the corner of Flinders Esplanade and Norwood Avenue.

The red clay is fairly typical of a red tropical soil indicating that the formation has stood for some thousands of years close to the land surface. This reinforces the theory that it is the top of a deep dolerite soil. Conversely, on Cartwright Point, there are dolerite boulders embedded in a similar red-brown clay with large recognizable volcanic fragments in it.

This was most likely formed from mud and slope debris deposited as a mud slide associated with an earthquake or volcanic eruption.

Above the red clay is a layer of tuff or volcanic ash. This can be seen as a brown porous rock on the beach below "A" Block at Taroona State High School. It consists mostly of glassy vesicular grains about 5mm across. At Sandy Bay there is a similar tuff with a suite of other volcanic rocks. There is a greater depth of tuff here indicating closer proximity to the source, which was most likely a volcano out in the Derwent off Cartwright Point.

Above the tuff there is a layer of dolerite boulders in a clay which varies from kahki colours to a bright blue-green as seen near the Taroona State High School boat shed. This is most likely a mud flow deposit.

At the boat shed the blue-green clay is overlain by a brown sandy, fine conglomerate. This is part of the next suite of Tertiary rocks.

Fresh water sediments

These are highly variable in grain size both from place to place and vertically within the sequence. The lower layers are mostly coarse boulders and cobbles as in the cliffs below Winmarleigh Avenue. They differ from the boulder beds in that they contain little clay and a few layers of enclosed sands which are typical of sediments deposited from fast running water.

Below Karingal Court and north to the State High School the sediments are much finer with clay layers which sometimes contain impressions of leaves and other plant matter. Fossil turtles almost indistinguishable from present Murray River turtles *(Emydura Macquarii)* have been found indicating a warm temperate to sub-tropical climate. These sediments were deposited from small streams flowing into depressions near the fault escarpment. The coarse sediments were deposited near where the streams emerged from the escarpment and the fine clays and sands in ponds and small lakes. Occasionally heavy rain or movement of the fault would cause coarse material to wash into the fine sediments giving alternate bands of sandstones and conglomerates.

Between the top of the Fresh Water sediments and the fault line there is another boulder deposit with a light brown gravelly matrix. Cartwright Point mostly consists of the previously mentioned mud flow deposit which is underlain by a tuff similar to that at the State High School. On the northern side of the Point there is a confused sequence which contains a white mudstone similar to that found under the volcanics at Alexandra Battery at Sandy Bay. There are many beach pebbles of basalt at Cartwright Point indicating the possible proximity of a lava flow.

Most of the Tertiary sediments were laid down horizontally but today the strata slope (dip) all over the place, even vertically. This is caused by two factors. Firstly the sequence was laid down as the fault was active. Each earthquake, and there would have been many, shook and moved about the unconsolidated sediments as it tilted the land. Secondly, quite recently there have been (and are still continuing) slumps and landslides due to impeded drainage.

The environment of Taroona during the deposition of the Tertiary rocks was vastly different from the older Permian or from today. If the Permian was like being transported to Northern Siberia then the Tertiary was like the African Rift Valley. The climate was probably subtropical monsoonal. The land was steep and unstable and wracked by earthquakes and small volcanic eruptions.

The Quarternary Rocks

The last major geological event was about 10,000-20,000 years ago when Tasmania was in the grip of the last glacial epoch. South eastern Tasmania was extremely cold and dry, such that little vegetation existed. Occasional rains and snow-melt washed vast quantities of pebbles and cobbles into existing creek valleys. Most of the little creeks around Taroona contain valley fills which form terraces in the lower reaches of their valleys. At St. Luke's Church the valley was so filled that an extensive fan shaped deposit emerged from the creek valley behind the Church.

Alluvial fans are often areas of indeterminate drainage subject to flooding and stream course changes. At one time, the creek behind St. Luke's must have flowed overland into the gullies near Kelvedon Avenue and upper Seaview Avenue. They joined at the bottom of Seaview Avenue and flowed into the sea there. This explains the presence of creek pebbles at the bottom of Kelvedon Avenue and all the small pebbles of material from the hill behind the Church now on the foreshore below Seaview Avenue. It is interesting to speculate on whether the present nearly straight course of the creek was the result of early attempts at drainage. It is also unusual that this creek has not cut any valley like the others. Perhaps the course runs along the straight line between two early property boundaries.

After the last glacial epoch the sea rose to about the present level. Steep cliffs formed in the hard rocks. Lower cliffs and beaches formed where there were soft rocks and rocky, bouldery foreshores developed where dolerite boulders protect the soft rocks from erosion. Where large amounts of weathered dolerite have been eroded by the sea, the sand contains large amounts of the heavy minerals, ilmenite, magnetite and a few zircons. These are the cause of the black sand on Taroona Beach.

The only ongoing geological problems are to do with land slips which are mainly located near the creek which runs past the schools. Land slips may occur in many places in the lower parts of Taroona. They can be avoided by good housekeeping with water supply and drainage. Broken and leaking pipes or anything else which allows water to collect in the soil must be repaired.

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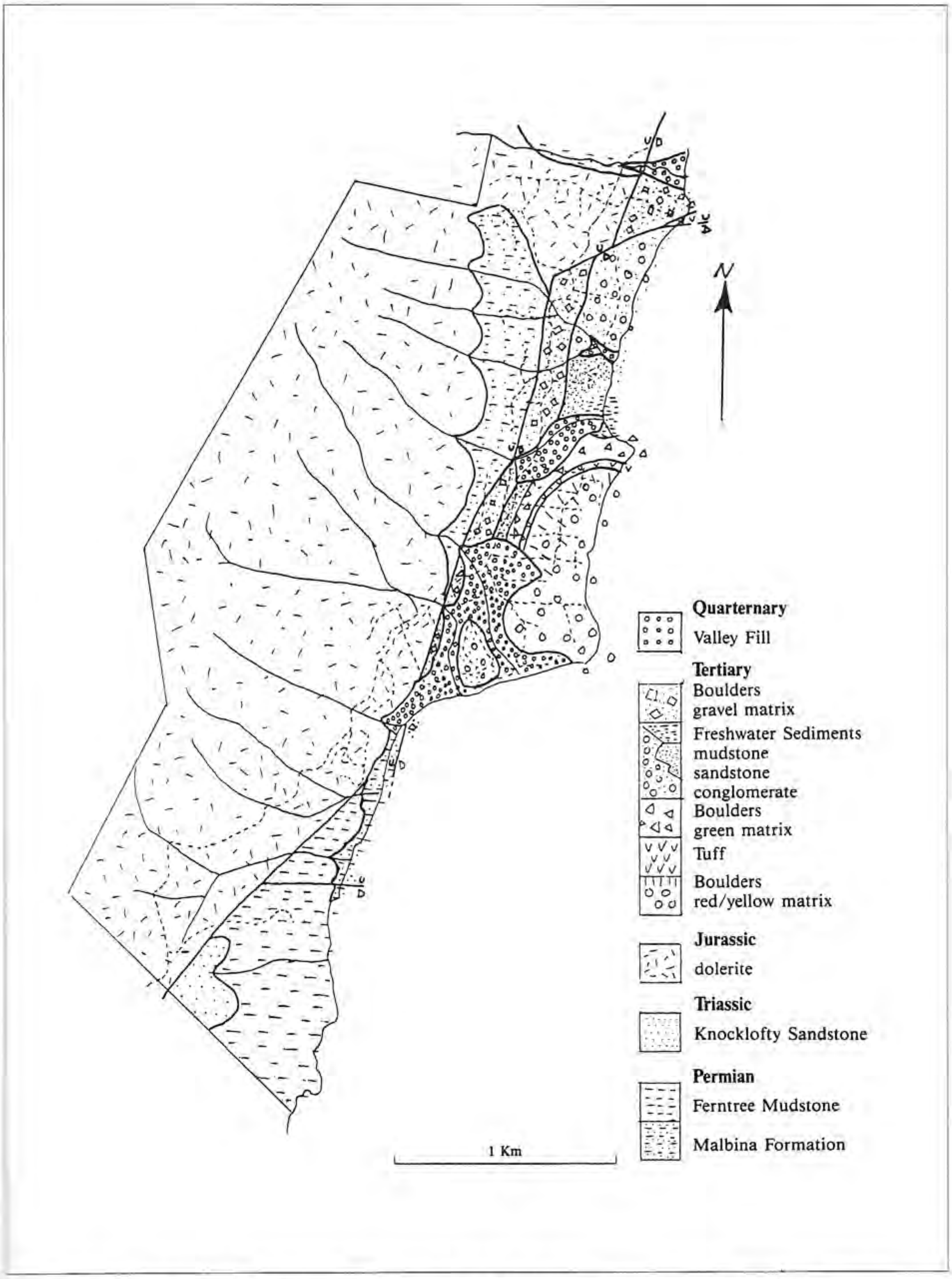

Sketch map of Geology of the North Ward, Municipality of Kingborough.

SIMON STEPHENS.

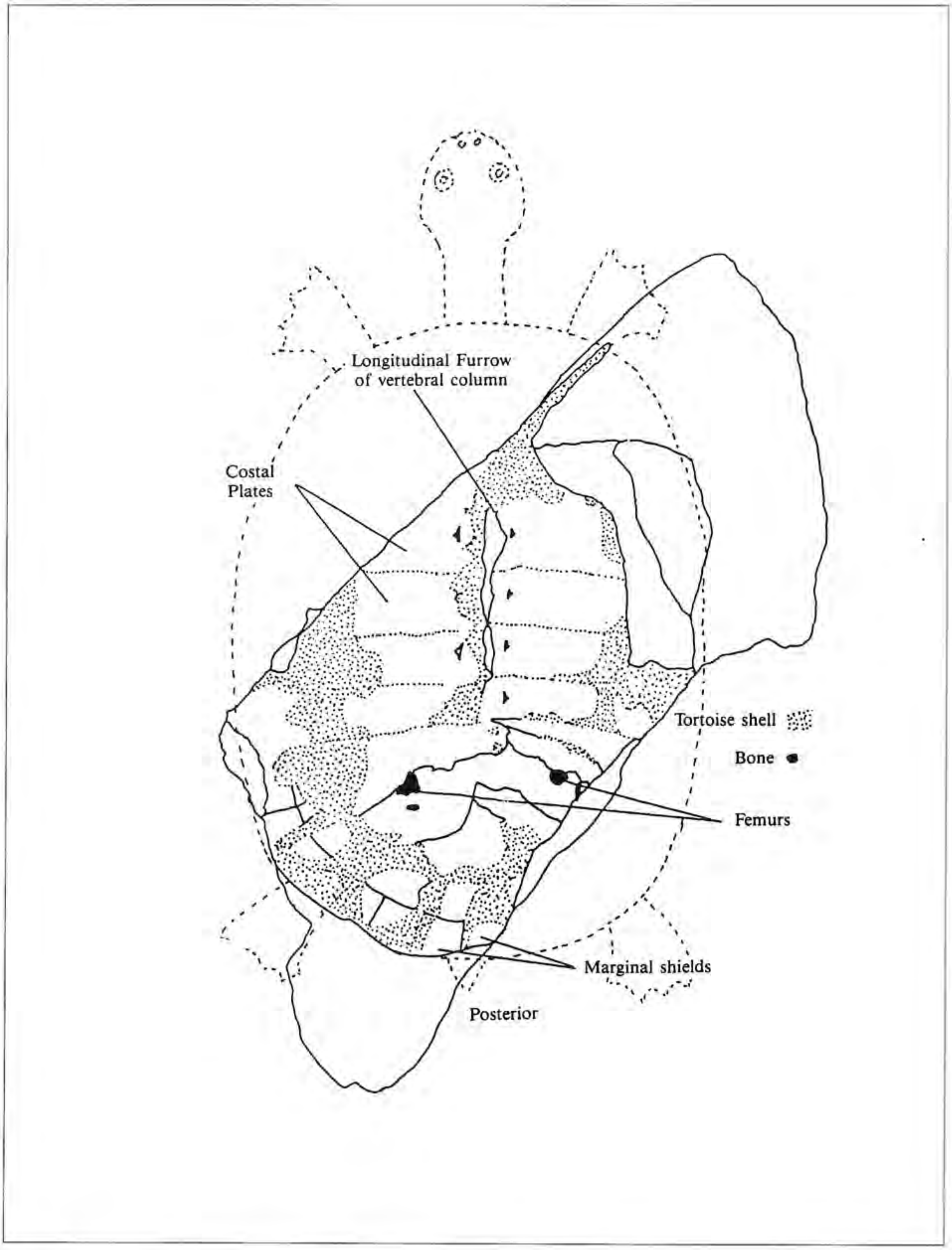

Diagram showing relationship of the living turtle to the fossil in the photograph opposite.
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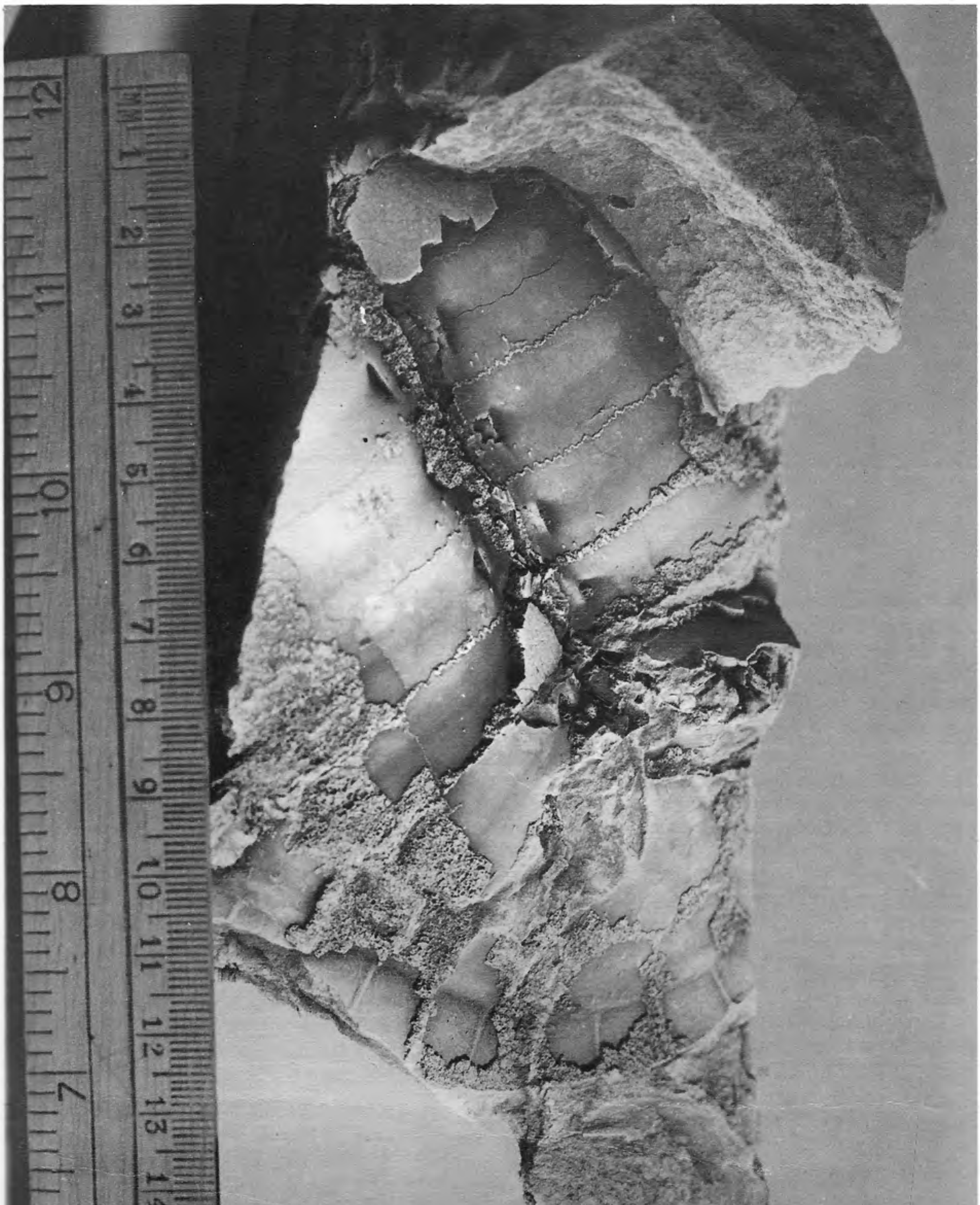

Fossil carapace of "Murray River" turtle from mudstone about 60 million years old at Dixons Beach.
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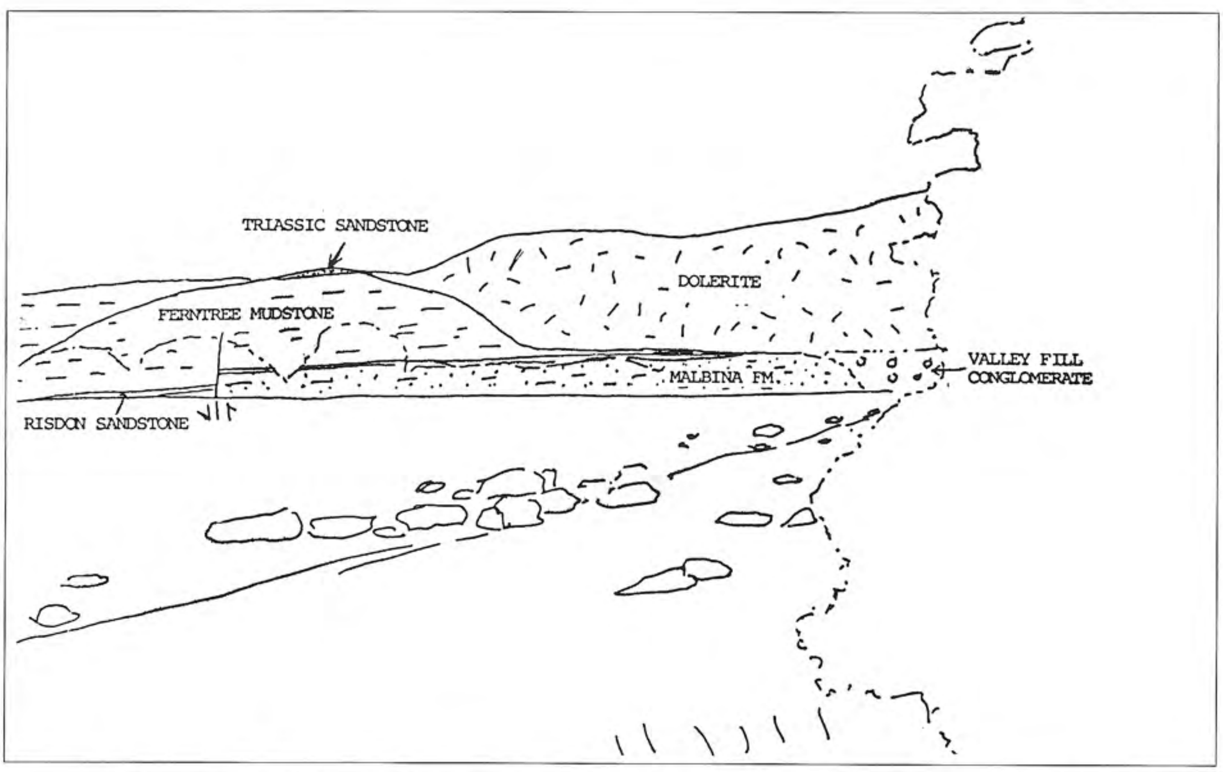
PHOTO J.C.S. BOWLER.



View and diagram looking south west along Taroona Beach showing the structure and sediments of the Alum Cliffs. The beach in the foreground is derived from removal of the clay from around the boulders, leaving sand, boulders and heavy minerals. SIMON STEPHENS.