INTRODUCTION

This little homily is about the influence of Antarctica’s past, and southern Australia’s connection with it, on our day to day life. It has a Tasmanian emphasis but similar stories could be put together, perhaps not so well, for some other parts of southern Australia and the Southern Hemisphere.

Antarctica is often seen as the great white, inspirational but isolated continent well to the south. It is seen as remote and perhaps irrelevant in our normal existence. My thesis is that it is not irrelevant but has a big influence on our daily lifestyle, and eventually on our culture, especially in Tasmania. I will ignore the question of the influence we have on Antarctica and also the human side of our association that is a result of the longer-term history. Those of us who live in southern Australia watch our weather charts each night and see a succession of cold fronts. If farmers, we may be grateful for the rain that may follow, but for those who like sunbaking, the reaction is different.

It would be useful if sometimes the weather map could be set a little farther south so we could see Antarctica, a succession of lows around it, and realise that this is the source of our cold fronts.

Modern Antarctica affects our daily lives.

THE LONG TERM

But the long-term history of Antarctica, or Australia’s past history with Antarctica may be even more significant. It is that that I wish to draw out here.

The Universe is roughly 12-15 billion years old and earth about 4.5 billion. After a brief excursion to the 600 million year timescale, I will talk mainly about the last 300 million years of that history and only as that relates to Tasmania and Antarctica. Even at 600 million years, that is only 13% of Earth’s history.

At 600 million years, just before animal life in the marine environment exploded, Gondwana existed, but had not done so for long. There had been a succession of previous supercontinental assemblies. Gondwana was the latest, and a new one is now forming.

Tasmania in Gondwana lay adjacent to the north western entrance to what
is now the Ross Sea. But the assembly was rotated about 90° anticlockwise so
that modern Western Australia was the southern side of Australia. In addition,
the equator ran through the centre of Australia and Antarctica so that both lay
astride the equator and both had half in each hemisphere. Hobart lay well into
the Northern Hemisphere and was the north eastern extremity of Australia.
There is no hint of glaciation at the time, and it was probably quite warm with
15-20 times as much CO₂ in the atmosphere as now, and correspondingly less
oxygen.

Between about 400 and 300 million years, the supercontinent underwent
what has been called the ‘Waltz of Gondwana’ and moved to the southern
reaches with Antarctica over the South Pole. It has remained there ever since
but has wandered somewhat and the Pole has not always been in Antarctica but
has spent time in Australia, and the south Pacific.

As Antarctica came over the Pole, Gondwana became heavily glaciated –
not the modern glaciation – but probably on a larger scale than the modern,
covering several modern continents. Glaciation alternated with forests and the
coal of the Bowen Basin, Hunter Valley, Tasmania, and Prince Charles
Mountains formed.

When Robert Falcon Scott was found dead in his tent, also found were
specimens of the Permian (250-290 million years) Gondwana index plant fossil
Glossopteris. The timing is exquisite. The concept of Gondwana evolved in the
1870s as an hypothesis to explain the distribution of Glossopteris. Scott and his
people recognised the significance of finding plant fossils in ‘this awful place’.
They had jettisoned everything they could, but not Glossopteris. The year was
1912, just three years before Alfred Wegener published his book ‘The Origin of
Continents and Oceans’ in German. While Scott was in Antarctica, Wegener
was in Greenland.

_Glossopteris_ is the Gondwana fossil.

The _Glossopteris_-bearing Permian rocks of the Transantarctic Mountains
and Tasmania have a great deal in common. They lie on older granite such as
that extending from just north of Eaglehawk Neck, through Coles Bay, Bicheno,
and Flinders Island to Wilsons Promontory. There is more than one age of older
granite but the surface on which the Permian sediments sit was continuous and
we see it excellently displayed just north of Eaglehawk Neck and at Terra Nova
Bay in Antarctica. The sediments have minor differences in that a significant
part of Tasmania’s Permian was deposited in a shallow-water marine
environment and all the Antarctic Permian is non-marine. There is a gradient
here.

Following the Permian is the Triassic and here the similarities with the
Transantarctic Mountains are more obvious. All are non-marine sediments with
many fossils (plant and animal) in common. No evidence of glaciation anywhere on earth. But we are going to skirt over this time period to look at the Jurassic, perhaps the key link in our joint past.

The seeds of Gondwana’s disintegration were being sown. Tension was growing between the continents and at about 170 million years, there occurred one of those large-scale, unique events. As the continents underwent tension, at about 100 km, Earth’s mantle began to melt and generate magma (the parent of lava and of igneous rocks). This was not over all Gondwana but concentrated near the margins of the constituent units. The magma rose and forced its way laterally between the Permo-Triassic rocks, thus lifting them. It spread out like a sheet about 350 m thick. It was a dry, low viscosity magma and occurs in Tasmania, Kangaroo Island, the Transantarctic Mountains and around to Horn Bluff in Antarctica. It does not extend to the mainland of Australia. The rock chilled and shrank, generating tension in the horizontal and thus causing it to crack into the very characteristic hexagonal joint structures of so much of central and south eastern Tasmania including the Organ Pipes of Mt Wellington and the Organpipe Cliffs of Horn Bluff. In Antarctica, there was a lot of volcanism with this process but the evidence for volcanism in Tasmania is limited.

At about 128 million years, Antarctica began to disintegrate in earnest. India departed; South America and Africa departed as a unit which immediately separated into two. South America stayed close to Antarctica and communication between them has been possible almost ever since but India and Africa have almost lost their Antarctic heritage.

This left Antarctica and Australia as the ones still faithful to each other. But even this union had a limited future.

The tension within Gondwana, which began in the mid-Jurassic, continued and eventually, at about 89 million years, Australia began to head north. This was somewhat tentative at first at only a few millimetres per year, but at about 55 million years, movement accelerated to the current rate of northward movement of 6 cm/year. The separation was not totally simple and northward, because the opening between Australia and Antarctica began in the west and Australia underwent a slight clockwise movement, putting the south eastern region under a slight torsion. This slight rotation was one of the most significant events in Tasmania’s history. It had begun earlier and put Tasmania under a northeast-southwest tension that reactivated old lines of weakness and probably induced some new ones. The crust underneath Tasmania stretched and some areas sank gently to form the Bass Basin which is now underwater. Similar tension caused the mainland of Tasmania to break into a series of smaller units. Some rose to give the highlands and some sank to give the major lowlands – Derwent Graben, Tamar Graben, Oyster Bay, Macquarie harbour, Coal River Valley and so on. The modern landforms of Tasmania came into being. It was
the time of uplift of the Transantarctic Mountains and the development of the easterly flowing glaciers that now cut through the Mountains (perhaps following old river valleys or new geological structures) to the Ross Sea.

While all this was happening, other important events were taking place. While Australia and Antarctica were joined, no water could circulate between the continents, and the same held true between South America and the Antarctic Peninsula. At 53 million years (Early Eocene) Antarctic waters were about 16-18°C, there was subtropical weathering to form kaolinite clays, and Antarctica was vegetated without any evidence of glaciation. This is not to say that there was no snow or ice on high land, but the margin of the continent had a diverse vegetation, with estuarine systems and reasonably warm water biota. The vegetation is reasonably well known from wood, leaves, spores and pollen, and isotopes in some other microfossils tell of the water temperatures in some detail.

As Australia moved north, it was a long time, about 15 million years, before circulation began between the continents. The reason is that Australia had a southerly extension – Tasmania and its surrounding seafloor – which got in the way. When that cleared, water was free to circulate without going to the tropics to warm. Antarctica became colder until, at about 35 million years, it contains evidence of an ice sheet and its influence is recognised globally because of a marked sea level fall at this time. Vegetation was reduced markedly but there were refuges and recolonisation from time to time from South America via the Antarctic Peninsula. There is ample evidence of land mammals, even a marsupial fossil, from the northern reaches of the Antarctic Peninsula.

The Antarctic vegetation has strong links with Tasmania and many typically Tasmanian plants have ancient Antarctic relatives – Man Ferns, Huon Pine, Creeping Pine, Guitar Plant, Sundews, Celery Top Pine but especially the Southern Beeches – *Nothofagus* – Myrtle and Deciduous Beech.

There were further developments to come. At about 23 million years, the sea filled Bass Strait and Tasmania became an island.

Somewhere in this history, Macquarie Island came into being, but its history is very complex and linked closely with the evolution of New Zealand. The structure of which Macquarie Island is an exposed part, is closely tied to the evolution of the Alpine Fault, the structure that passes through New Zealand and is the cause of the earthquake and volcanic activity so characteristic of that country.

At about 20 million years, the Antarctic Polar Frontal Zone (APFZ) or Antarctic Convergence, evolved and Antarctica became totally isolated. A new Antarctic fauna and flora evolved in the Antarctic marine environment as the terrestrial biota was almost eliminated. The details of what happened south of the APFZ are poorly known, but are becoming known via some interesting...
isotopic and biochemical/genetic techniques. There is evidence of some major global event at about 2.7 million years. This probably relates to the closing of the Isthmus of Panama and the resulting reorganisation of global oceanography, including strengthening of the Gulf Stream and initiation of the Northern Hemisphere glaciation that established the modern interval of glaciation. This is probably the time at which Tasmania was glaciated for the first time in modern terms. The Mountain Shrimp (*Anaspides tasmaniae*) carries a record of this time and it may also coincide with the extinction of *Araucaria* from Tasmania.

**CONCLUSION**

In summary, our history with Antarctica, the separation from that southern continent, and the movement via tectonics to our current environment, have led to our landforms, climate, drainage systems, vegetation and lifestyle. They have made us different from the rest of Australia. Ours is not the ‘wide brown land’. Tasmania has a different agriculture, tourist attractions and different energy generating systems. Tasmanians are the inheritors of a fascinating history in common with the Antarctic.