The Norman Wettenhall Foundation Lectures
19 November 2009

‘Taking the Long View – vision and transformation in an age of change’

Presentation by Leon Costermans: ‘Life support—the bottom half of the story’

Note: The following is only a summary in note form, and is not to be quoted. It does not include all the points made in the talk. Captions on the slides indicate relevant key points. The photographs are copyright. Any enquiries should be directed to L Costermans.

When most people talk about ‘the natural environment’, they are thinking primarily of the flora and fauna which they can see from the ground up; they are also aware of the importance of the atmospheric conditions and sunlight. However, there is less consideration of ‘below-ground’ influences.

This talk focuses on the critical role of ‘below-ground’ non-biotic influences—the geological substrate, soil, and groundwater, hence the talk title. Slide 2 sums this up.

Slides 3–4 show southeastern mainland Australia as we now know it; slide 3 shows the main components of the physical landscape, while slide 4 shows the geological diversity of the same area, a diversity which is an important factor in life diversity.

Slides 5–34 trace the story of southeastern Australia’s development, beginning from the time (about 550 million years ago, or 550 Ma) when ‘Australia’ did not exist as such, but the area westward from about the Adelaide Hills was part of the ‘great southern continent’ (Gondwana). At this time, the area of SE Australia was sea, and there was no life on the land to the west.

Southeastern Australia was progressively built onto the margin of the ancient continent in a series of major upheavals and ‘mountain-building’ events over some 200 million years, with both volcanic activity and sedimentation, and always erosion of raised land. It was about 420 million years ago (Silurian) that life first moved from the sea to the land.

By about 360 million years ago (Late Devonian), the base rock for southeastern Australia (and also further north and south) had been created. The sedimentary rocks had been folded and faulted (slide 6), granitic magma had intruded into the sedimentary rocks and solidified, causing the surrounding rock to be altered and hardened forming a ‘metamorphic aureole’—often now recognisable by a change in soil and vegetation (slides 9–10).

There were also massive extrusions of volcanic lava (but with a lot of silica, hence it was different from the much more recent volcanoes), and tending to resist breakdown and erosion (slides 11–13).

In the later part of the Devonian (about 360 million years ago) there were massive rivers, floods and lakes in a north-south area of eastern Victoria (between the Mansfield area and near Bairnsdale) giving deposits of reddish conglomerates, sandstones and siltstones—the 'red-beds'—accompanied by volcanic activity (slides 14–16).

About 300 million years ago, with 'Australia' still only part of Gondwana, and near the south pole, glaciers covered most of 'southeastern Australia', leaving evidence in the form of scratch marks, pebbles dragged great distances by the ice, and other features (slides 17–18).

Hence we see that our geological history has always been one of constant change, in both the nature of the land and climate. Climate change is nothing new!

A major event was the splitting up of Gondwana, and the rifting of 'Australia' from 'Antarctica' about 150 million years ago. At about that time, a long trough was created across southern 'Victoria' which formed into the Otway and Gippsland Basins. The sediments which were washed into these basins, initially as flooding rivers, were uplifted in parts to give us the Otway and South Gippsland Ranges—with sediments which weathered to give different soils and landforms from those further north. Evidence of his period is seen in fossil plants, freshwater fish and other features. Slides 19–22. Our present *Nothofagus* (Southern Beech) had its origins on the Gondwanan continent, as did the plant family Proteaceae (slides 23–25).

The Cainozoic (from about 65 million years ago) saw abundant volcanic activity, initially mainly in the eastern part of our area. Although the lava flowed down valleys, much of the consequent basalt is now on the tops of mountains, showing it had been elevated, and the softer surrounding rock eroded away. This basalt gives a favoured agricultural soil, so much of it has been cleared of native vegetation. Other sediments were also deposited on the Palaeozoic land surface, by both sea when inundated, and by flooding rivers (slides 26–27).

The most recent events (the last few million years) have included extensive volcanic activity in western Victoria (slides 28–29), and the development of the whole inland plain and dune area under the influence of flooding, invasion by the sea, and strong winds from the west (slides 31–32). As well as the inland plains, the near-coastal areas record the changes in sea-level and climate with different types of sand, deposited at different times and under different climatic conditions (slides 33–34). Each of these sand types carries a characteristic assemblage of plants (slide 35).

A look at Victoria, and more particularly the Port Phillip Bay area in terms of the influences of recent geological and human history on vegetation.

We have said that vegetation and fauna have always had to adapt to all these geological and climate changes, ever since life adapted to land. However, because we have removed so much native vegetation, natural processes of adjustment at 'boundaries' cannot now operate as they did before clearing (slides 36–37). (Studies of pollen in lakes show how vegetation has changed with climate with the last 100,000 years.)

A look at the Port Phillip area which is largely produced by faults (slides 38–40).

An example is given of a local situation (Frankston) where vegetation in local reserves has been related to the geology of the area, as a means of determining which plants are appropriate in each area (slides 41–42). The map (slide 41) is taken from a booklet produced for the community, explaining Frankston's remnant natural environment, and the importance of the reserves.

Finally, a look at the Langwarrin Flora & Fauna Reserve, which has great diversity of flora and fauna in its 214 hectares, and where management (including by Friends) is based on knowledge of the variations in the substrate (slides 43–44).

HOWEVER, a serious issue is the fall in the watertable, due both to the drought, and to lack of replenishment because of housing development around the reserve (roofs and roads drain water to the bay); also, bores are extracting water more rapidly than it can be replenished. This reservoir has no sealed bottom—it indicates the watertable in that area. Thus, groundwater is an important factor to be considered, especially in relation to groundwater-dependent ecosystems.

FINALLY—five points for a take-away message (slide 49).