

ROYAL METEOROLOGICAL SOCIETY: AUSTRALIAN BRANCH MEETING

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The Relevance of Australia's Antarctic Research Program — A New Assessment

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Dr Budd, Glaciologist, Department of Science, Antarctic Division, prefaced his remarks by pointing out that he was speaking as an independent scientist, his views did not necessarily represent those of his Department or Division, and he proposed to speak quite freely about the work being done by various Australian groups in the antarctic area. He wished to stimulate thinking about possible changes resulting from technological development, as these are particularly important in this area because of the long lead time required for new equipment and facilities.

He briefly reviewed the history of antarctic activity over the past hundred years, emphasised that the polar area is a unique international scientific laboratory - notable for the peaceful cooperative efforts under the Antarctic Treaty - and explained the functions of the Antarctic Division in relation to Australian activity.

Dr Budd then turned to the several disciplines involved in antarctic work, proceeding in general order from outer space to the centre of the earth. He could only mention the major points in each program and, in this review, it is feasible to mention only some of those points.

In *cosmic ray studies*, a new underground laboratory has been built at Mawson.

In *meteorology*, a most extensive review included the strength and extent of the strong surface temperature inversion over the continent; the annual surface temperature cycle; the surface katabatic wind flow; the mean surface pressure distribution, and the gradients, in summer and winter; the mean temperature changes from summer to winter over the greater part of the southern hemisphere, related to the nature of the underlying surface; tracks of temperature anomalies; studies of atmospheric energetics; the observational support obtained for earlier theoretical studies on the katabatic wind; and the behaviour of the sea ice related to sea level pressure and temperature changes.

In *glaciology* unique instrumentation is required, a great deal of development of which has been done by the Antarctic Division. A thermal drill, capable of drilling to a depth of 500 m, has been developed; ice core studies made of crystal structure, temperature, viscosity and isotope values; and ice thicknesses have been determined. The ice sheet is close to a condition which could permit convection (temperatures range from -60 C near parts of the surface to 0 C near the bottom); marked changes occur in the ice around the 10,000 year (estimated) level, which, at one location, are equivalent to about 17 C, and are associated with the climatic change at the end of the last ice age combined with the resultant lowering of the ice sheet. Changes about 10,000 years ago also observed in both Greenland and at Byrd in west Antarctica, suggest a global climatic variation. A depth of about 1 km in the ice of the interior of east Antarctica should give climatic observations for about the past 40 to 50,000 years, hence the total ice depth (more than 3.5 km) should permit extension of the

time scale a very long way back indeed. Other glaciological studies mentioned were the problem of burying nuclear waste material, the risk of an ice surge and the expedition to the Amery Ice Shelf.

In *oceanography*, features of the bottom sediments obtained from the *Eltanin's* soundings, oceanic temperatures, salinity, convergence zones, up and down welling, surface currents (variable, but 0.4 to 0.8 kn in some areas), iceberg tracks (deduced from the French EOLE experiment), and the distribution of oxygen content in the sea water, were all discussed.

In *geology* and *geophysics*, the areas where the small amount of exposed rock is found were outlined and the age of some rocks (400 to 1500 million years) and the question of continental drift (a few centimetres a year) were examined. The sub-glacial topography is being determined by a new aerial ice thickness sounding technique which permits an area of about one quarter of the continent being covered in one season. The grid size (100 km) gives a very high degree of detail. A map of earthquake epicentres around the globe illustrated the basic plate tectonics. The various 'plates' were pointed out, between which the more active zones are found. These correspond roughly to the mid-ocean ridges around the Antarctic continent. Magnetic variations can be studied through the crystalline rock found in the ocean sediments, for which the *Eltanin's* soundings are invaluable, as are those of the *Glomar Challenge* which has carried out some deep sea drilling off Antarctica, and in some areas found traces of hydrocarbons.

Dr Budd then turned from work of an international or global nature being carried on under the general auspices of the Scientific Committee on Antarctic Research (SCAR) to that being done by Australian groups under the general coordination of the Australian National Committee for Antarctic Research (ANCAR) of the Academy of Science.

Coordination is effected by the Antarctic Division of the Department of Science, which provides logistic support as well as conducting scientific studies in cosmic ray work, upper atmospheric physics, glaciology, biology, and medicine. The increase of automatic recording techniques has led to a greater need for data interpretation and analysis. In other disciplines, meteorological activities include those of the Bureau of Meteorology, mainly in synoptic work and processing the observational data, but also some research, particularly that which was carried out in the International Antarctic Meteorological Research Centre. The Ionospheric Prediction Service has also maintained an Antarctic Program. The Bureau of Mineral Resources is primarily concerned with geology and geophysics, although some universities have programs in this discipline also. The Division of National Mapping carries out geodesy and cartographic work using aerial photography, ground surveys and more recently data obtained by the ERTS satellite. Only a small amount of work is done in the antarctic by other organisations. However, meteorology (with glaciology) at the University of Melbourne has been an important exception. Very little oceanography has been carried out from the relief ships and this should be remedied. Other programs that should be mentioned include geochronology at the Australian National University and biology and upper atmosphere physics at other universities in collaboration with the Antarctic Division.

Most of the work in many disciplines has been done through summer programs, which require shipping and aircraft support. When the year round program is examined, the extent of the support required at the manned bases, for example in communications for meteorological observations, is found to be very large. The glaciological field program by contrast requires mobile vehicular and caravan support.

Promising future developments include particularly the use of satellites. These will not only be employed for major communications purposes, but also for use with small automatic unmanned field observing stations (including drifting buoys in the southern oceans) to provide observations for synoptic and climate studies. In addition satellites carrying microwave sensors will provide observations, with a resolution of about 30 km, of sea ice.

In conclusion Dr Budd again emphasised the importance of the Australian scientific work in the Antarctic and the need for the most effective planning to secure the best return for the effort expended.

Topics raised in questions to the speaker included:

- The amount of water represented in the Antarctic ice sheet. If melted this would cause a rise in MSL of about 60 m.
- The convective instability of the ice sheet. The viscosity is still probably too great, even with possible feedback mechanisms, to make this very likely.
- Anchoring buoys in the southern oceans. It might be possible to do this but it would be very expensive because of the depth of even the shallowest water (*ie*, about 2000 m).

H.R.P.

