28 July 1960

Notes on Stratospheric Circulations in the Australasian Region

by W.J. Gibbs

Mr. Gibbs, Assistant Director of Research at the Bureau of Meteorology, presented the results of observations of stratospheric winds in the Australasian region. He pointed out that the work of Murgatroyd in U.K. indicated that there were two warm regions in the stratosphere, one at about 50 km corresponding to the region in which there was strong absorption of solar radiation by ozone and the other at or slightly above 100 km in which absorption was mainly by molecular oxygen. Generally it is believed that the equations of motion used in the study of the troposphere are applicable in the atmosphere to 100 km so that except near the equator the wind field may be derived from the temperature field and vice versa. It was emphasised however that there was no suggestion of cause and effect in this relationship and that the atmosphere may be regarded as a machine in which energy transports and transformations and momentum transports were effected, the resultant circulation being a manifestation of the machine rather than an explanation of the reason for its operation. Diagrams presented illustrated the fact that in summer the Antarctic stratosphere is warmer than the tropical stratosphere with a more or less constant temperature gradient intervening, but in winter there are two cold stratospheric regions, one over the equator and the other over the pole.

This thermal distribution suggests that easterly winds will prevail in the stratosphere at all latitudes in summer, but that strong westerlies will develop in high latitudes in autumn and progressively extend to lower latitudes in winter.

Results of high level observations over Australia during and subsequent to the I.G.Y. were presented, which indicated that in 1958 stratospheric westerlies over Australia were poorly developed. However, this appears to have been an abnormal year and in 1959 the stratospheric westerlies of over 100 kts were frequently observed at Laverton and Hobart.

Mr. Gibbs referred to the work of Godson and Lee in the northern hemisphere which suggests that a stratospheric jet stream exists near that part of the atmosphere which in winter is in continual darkness. He suggested that rather than a jet stream conformation it seemed likely that the very strong stratospheric westerlies extended over a wide latitude band from 65° or 70° to latitude 40°.

This suggestion was supported by the temperature cross-sections and by observations from Wilkes, Macquarie Island and Hobart and Laverton.

There are obviously a number of unanswered questions regarding stratospheric circulation. The extension of observations beyond the present limit appears to depend on the use of unconventional methods of wind measurement such as rockets. There is a need for stratospheric wind measurements over a number of years to establish the "normal" seasonal fluctuation of stratospheric winds. Stratospheric wind circulations appear to have very definite monsoonal characteristics in that they are steady circulations with only small short period fluctuations but with very pronounced changes in circulation from one season to another.

Finally it was emphasised that the reason for stratospheric circulations had not been explained and that this field of enquiry was largely unexplored.

REFERENCES

Murgatroyd, R.J.	1957	Q.J.R. Met. Soc., Vol. 83, pp 417-458
Godson, W.L. and Lee, R	1958	Beit. zur Physik der Atmos., Vol. 31, pp 40-68