5. CIRCULATION IN THE MIDDLE LATITUDES IN NOVEMBER 1969 AND JUNE 1970

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The major features of the mid-latitude circulations and their time and space continuity throughout each period were examined using a series of Hovmoller diagrams (Hovmoller, 1949). These were constructed using daily 500 and 200 mb geopotential height and temperature data and running five-day mean 500 mb geopotential height data at 45°S.

In both daily geopotential height diagrams for November, (Fig 5.1(a) and (c)) the most pronounced features are the quasistationary ridge and trough over the Tasman and western Pacific (between 140°E and 140° W) during the first three weeks of the month. A second, though less pronounced blocking system is evident over the eastern Pacific (around 120°W to 90°W) during the same period; however this ridge shows some eastward movement, especially during the first week, and the passage of troughs across these longitudes between 11 and 17 November brings a temporary weakening of the ridge.

The breakdown of troughs approaching the main blocking region is most notable at 500 mb and it is not until the passage of a major trough through the area from about 19 November that more zonal flow becomes established around the hemisphere.

By contrast, the daily geopotential height pattern for June (Fig 5.2(a) and (c)) is characterised by a zonal regime throughout the month with systems mainly moving steadily, and often quite rapidly eastwards. Only over the western Pacific and during the second week are quasistationary systems seen.

Temperature and contour patterns demonstrate their expected vertical and horizontal relationships during both months; this is a result of the techniques employed by the analysis team (Phillpot *et al*, 1971 and Lamond *et al*, 1972). In particular, the frequent near coincidence of thermal troughs (ridges) and geopotential ridges (troughs) at 200 mb are a consequence of the synoptic models used in deducing the 200 mb thermal field; the occasional departures from this relationship would no doubt result from periods when the tropopause pressure was appreciably less than 200 mb.

No evidence was found of major retrogression in either month although some westward movement may have occurred in the November blocking trough over the western Pacific not long before its collapse.

The five-day mean geopotential height diagrams emphasise the dominant long wave patterns during each period by suppressing the effects of the shorter waves.

The November diagram (Fig 5.3(a)) shows

- long wave troughs quasistationary between 50°E and 110°E, and 160°W and 120°W for most of the month
- a long wave ridge quasistationary around 160°E to 180° for the first two weeks but breaking down during the third as a new ridge develops upstream near 130°E and subsequently moves steadily eastwards being near 180° by the end of the month
- a long wave trough-ridge system showing general eastward movement between 120°W and 50°E during the first half of the month with redevelopment occurring upstream later in the month just to the east of the long wave trough quasistationary near 140°W.

The June diagram, (Fig 5.3(b)) shows

- a long wave trough, quasistationary between 90°E and 130°E from 8 June until the end of the month with some retrogression after 25 June

- a blocking ridge between 30°E and 50°E from 16 June to the end of the month

- a long wave trough retrogressing from near 40°W on 3 June to 70°W on 8 June and remaining quasistationary with an accompanying ridge downstream near 30°W until 13 June

- generally steady eastward movement in other long-wave systems, although some display short period deceleration and retrogression.

The geopotential height and temperature patterns at 45°S are summarised for each month in Fig 5.4 by the departures of their 30-day means from their zonal means. Also shown are the departures of the long term normal heights at 45°S (after Taljaard *et al*, 1969) from their zonal means. Good agreement is seen in each month between the locations of 500 and 200 mb contour and 500 mb thermal troughs and ridges, and between these and the 200 mb thermal ridges and troughs respectively.

The November means show a three wave pattern with geopotential troughs over the central Indian and Pacific Oceans and South America and ridges over New Zealand, and the eastern Pacific and central Atlantic oceans. This pattern is similar in location to the normal; however the dominant wave in November associated with the blocking systems between 50°E and 180° was much more intense than normal with departures from the zonal mean of up to +145 m in 200 mb height and +3.0°C in 500 mb temperature.

A three wave pattern is also evident in June - major geopotential troughs are located over the eastern Indian Ocean, just off the west coast of South America and near the Greenwich meridian and ridges south of Malagasy (near 40°E), over the central Pacific and off the east coast of South America. The dominant wave was associated with blocking systems between 30°E and 130°E and was again more intense than normal; departures from the zonal mean ranged up to -142 m in the 200 mb height and -2.8°C in the 500 mb temperature. The mean trough over the Indian Ocean appeared to be displaced slightly eastwards from its normal position. Marked pattern anomalies can be seen over the Pacific where, at both levels the normals show ridges near 150°E and 90°W and a definite trough between 160°W and 140°W whilst June 1970 showed a broad ridge there with only minor shortwave troughs. The difference pattern is particularly pronounced at 200 mb.

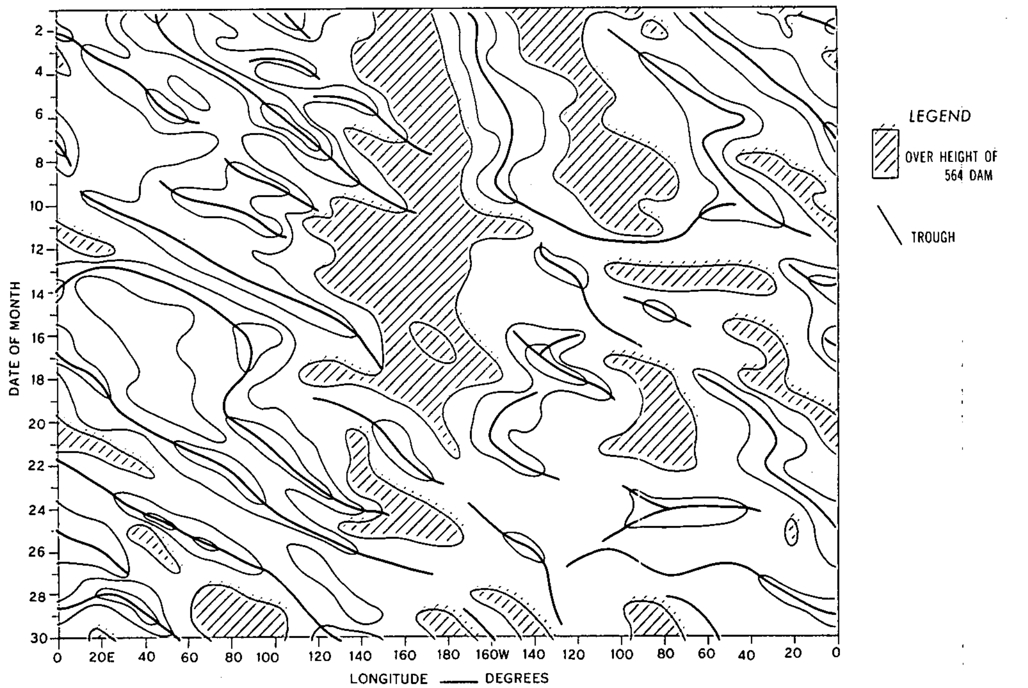

Fig 5.1 (a) The variation with longitude, at 45°S, of 500 mb geopotential height during November 1969.

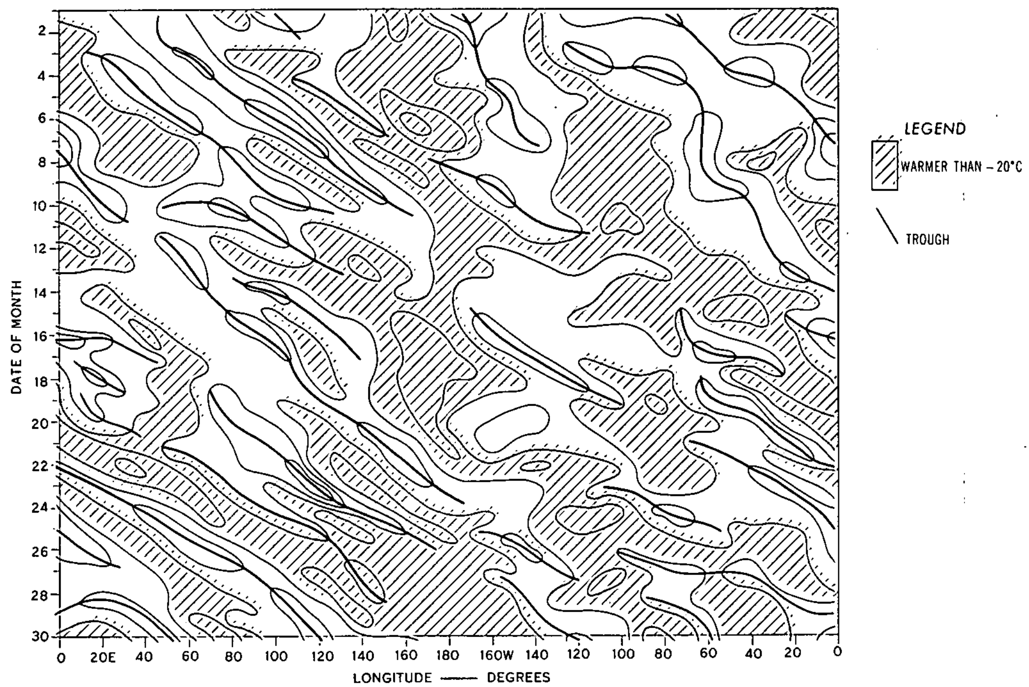

Fig 5.1 (b) The variation with longitude, at 45°S, of 500 mb temperature during November 1969.

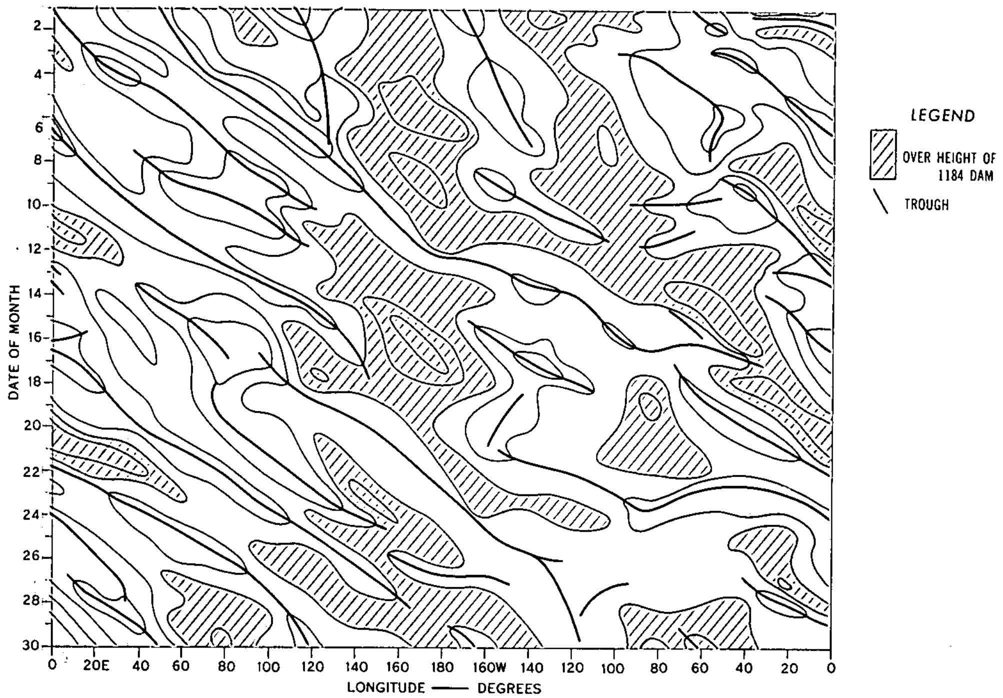

Fig 5.1 (c) The variation with longitude, at 45°S, of 200 mb geopotential height during November 1969.

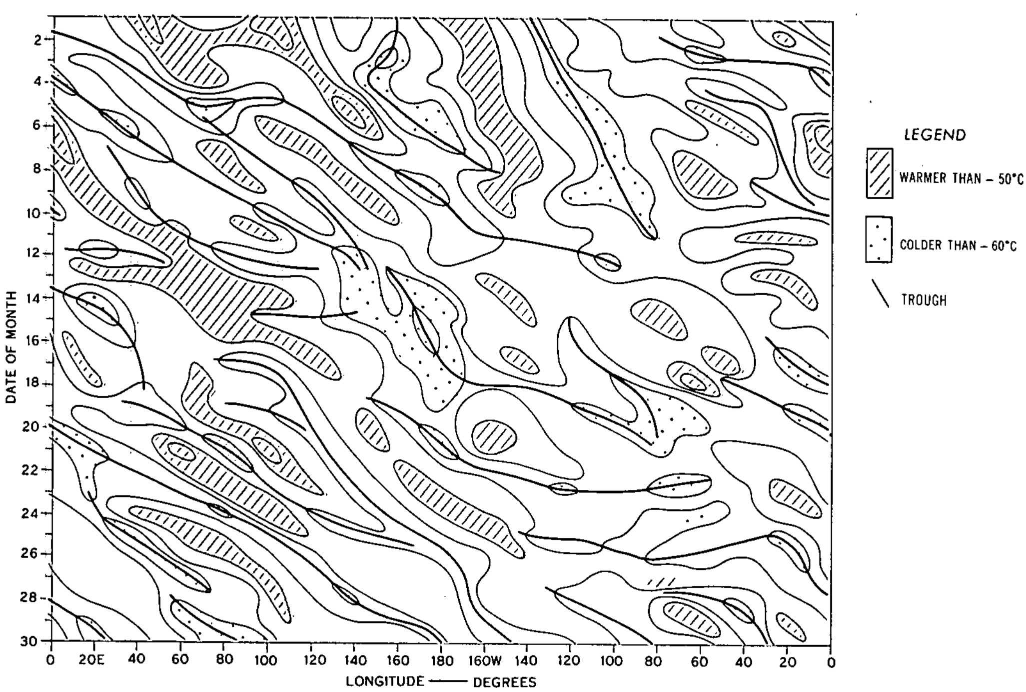

Fig 5.1 (d) The variation with longitude, at 45°S, of 200 mb temperature during November 1969.

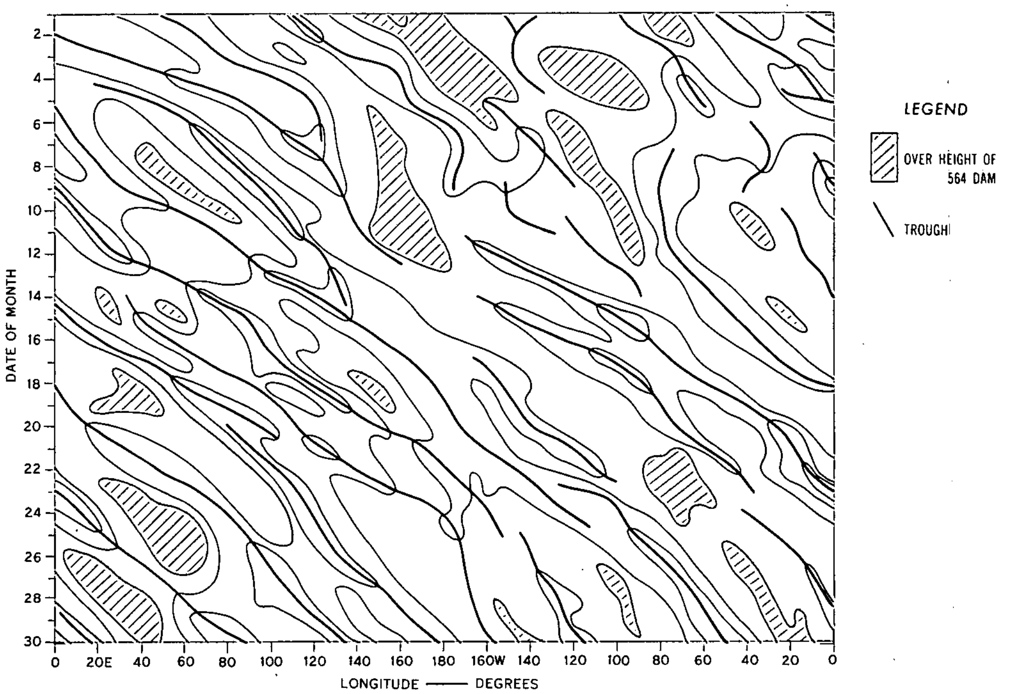

Fig 5.2 (a) The variation with longitude, at 45°S, of 500 mb geopotential height during June 1970.

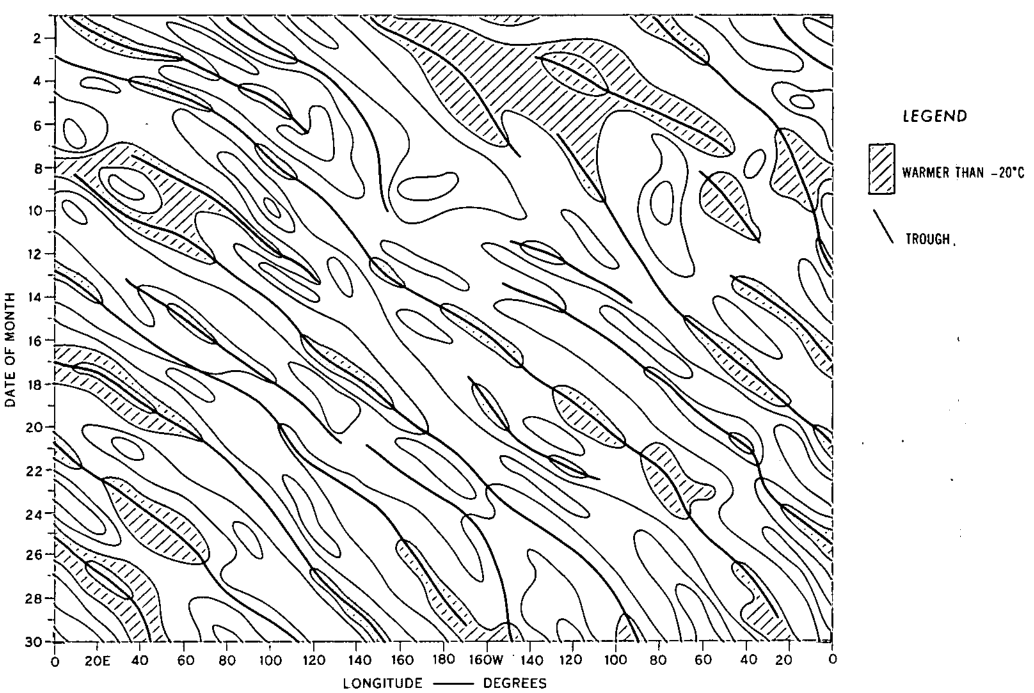

Fig 5.2 (b) The variation with longitude, at 45°S, of 500 mb temperature during June 1970.

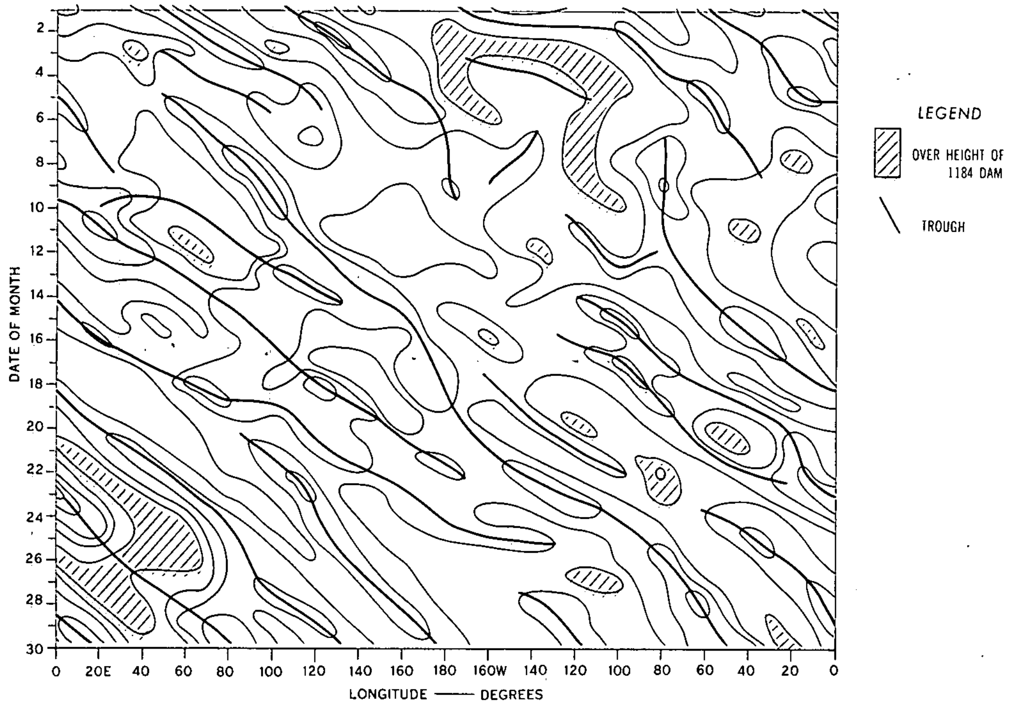

Fig 5.2 (c) The variation with longitude, at 45°S, of 200 mb geopotential height during June 1970.

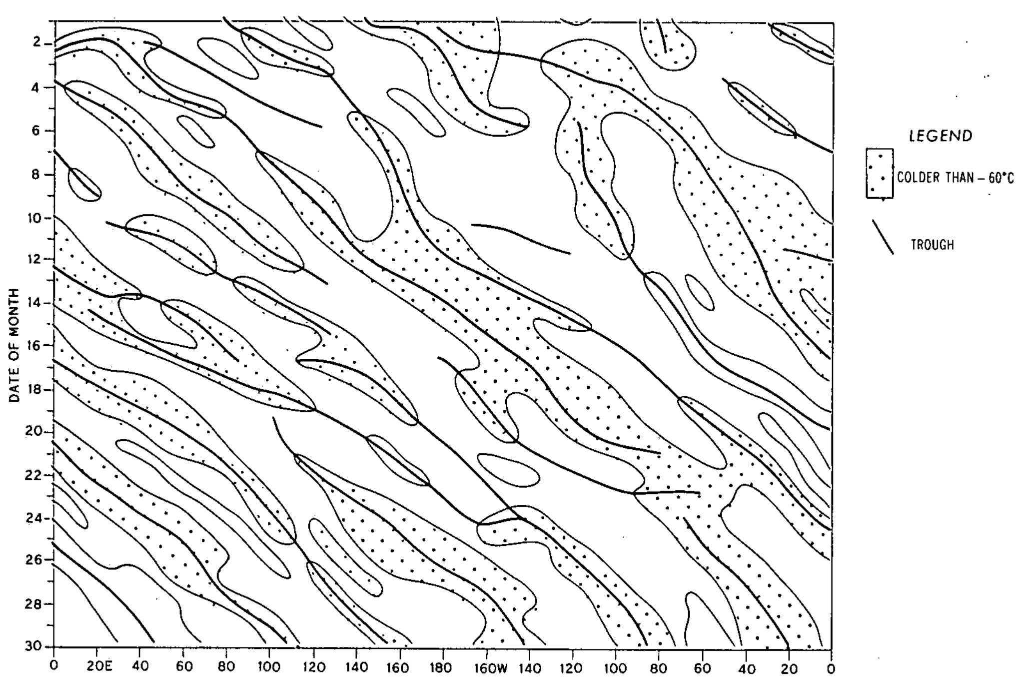

Fig 5.2(d) The variation with longitude, at 45°S, of 200 mb temperature during June 1970.

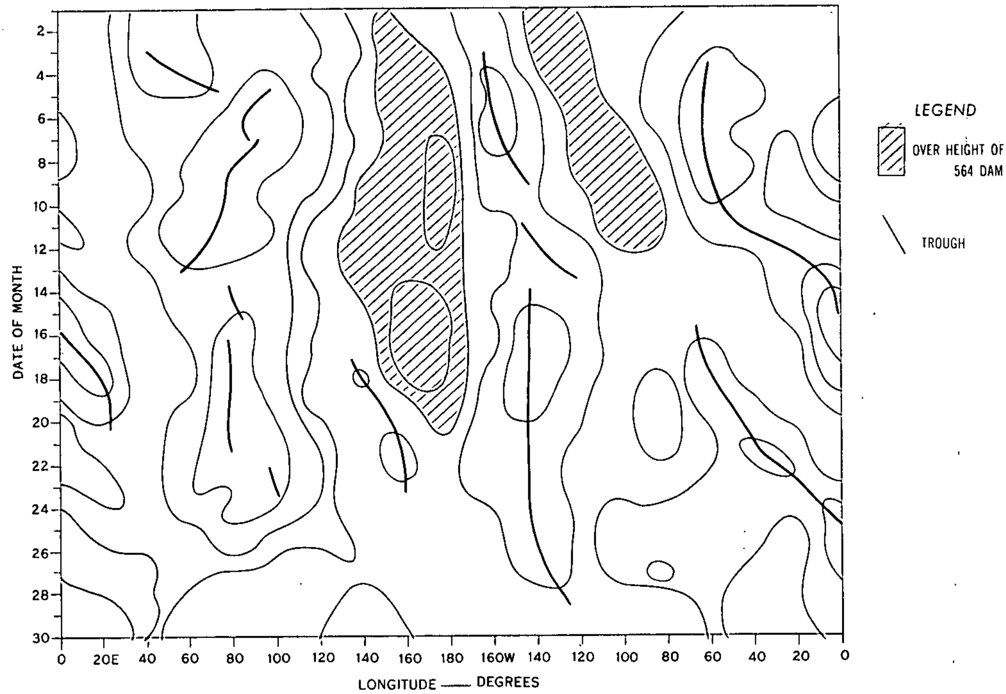

Fig 5.3 (a) The variation with longitude, at 45°S, in running 5-day mean 500 mb geopotential height in November 1969.

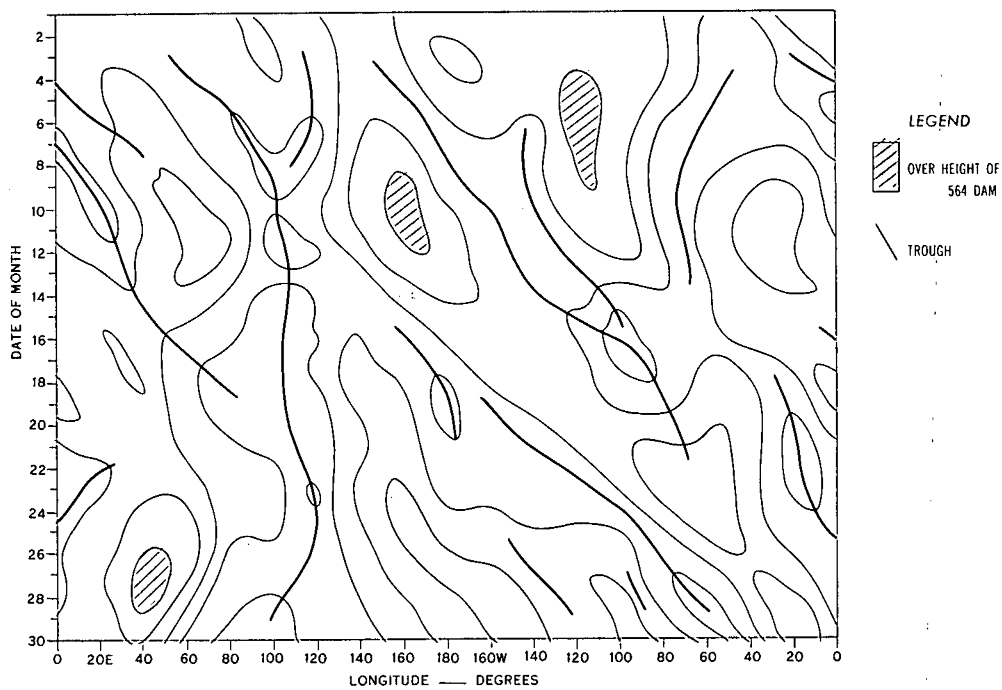

Fig 5.3 (b) The variation with longitude, at 45°S, in running 5-day mean 500 mb geopotential height in June 1970.

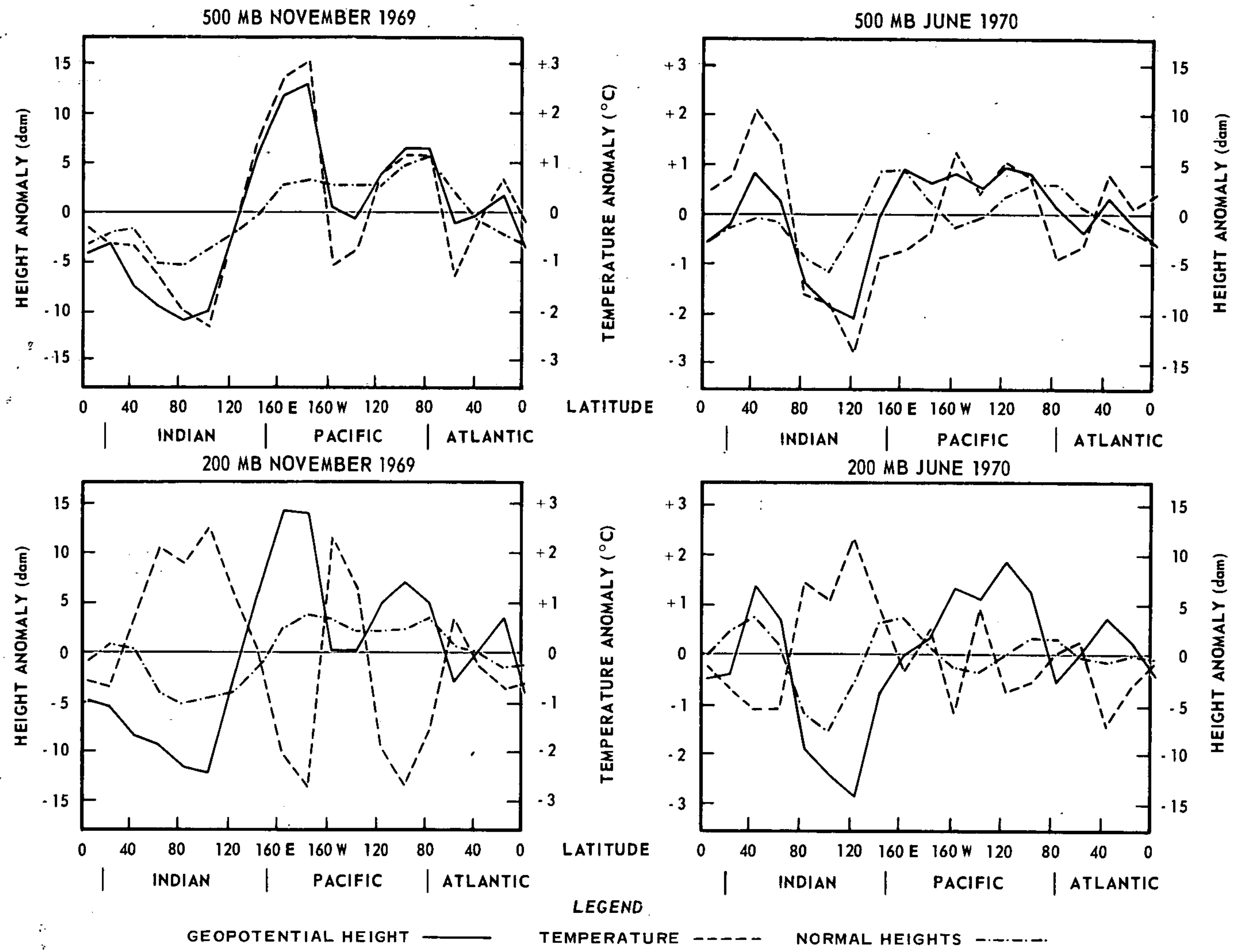

Fig 5.4 Departures of 30-day mean November 1969 and June 1970 500mb and 200 mb geopotential height and temperature, and of normal 500 mb and 200 mb heights (after Taljaard et al 1970), at 45°S from their zonal means.