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A COLD OUTBREAK OVER VICTORIA - 31 MAY 1977

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ABSTRACT

The cold outbreak of 31 May 1977 produced the equal coldest May day on record in Melbourne. This cold outbreak is examined firstly in terms of the synoptic-scale developments leading to its occurrence and secondly in terms of distribution and intensity of snowfall over Victoria. It is suggested that an energy dispersion process may have been responsible for the outbreak. Snowfall over the Latrobe Valley in Gippsland was particularly heavy and some explanations are offered. The performance of various snow predictors is examined in relation to this event. A summary of some of the more severe cold outbreaks to occur at Melbourne are also included for comparison.

INTRODUCTION

Cold outbreaks in Australia

Morley (1957) suggested that a cold outbreak could be defined by snowfalls down to low levels (say 600 m AMSL and below). Some notes have also been written on the large scale synoptic features associated with cold outbreaks in the Australian Region (Bahr 1967, Shanahan 1967). Noar (1970) used a 1000-500 mb thickness method to forecast the severity of cold outbreaks and various rough working rules exist for predicting snowfall in the Australian Region (Lamond 1967, Wilkie 1967). However, little effort seems to have been made to document these cold outbreaks in a detailed manner and also to examine the performance of various snow predictors, including the working rules.

The aims of this paper are to:

(a) discuss synoptic-scale developments leading up to the cold outbreak;

(b) examine and document in detail the snowfall distribution and intensity over Victoria;

(c) examine the performance of various snow predictors for this particular case and hence give an indication of their value;

(d) to present a summary of some of the more severe cold outbreaks that have occurred at Melbourne.

A brief description of the synoptic situation, 31 May 1977

Victoria experienced a severe cold outbreak on this date. Snow fell at many centres and the highest temperature reported in the State was only 11°C. Figure 16 shows the statewide distribution of maximum temperature. Melbourne's maximum temperature of 8.3°C was equal to the lowest recorded maximum for May (on 12 May 1896 8.3°C was also recorded). Figure 1 shows the 1000-500 mb thickness analysis and Fig. 2 is the MSL pressure analysis for 0000 GMT 31 May 1977. Figure 2 depicts a vigorous southwest airstream over Victoria. This was preceded by a northwest airstream during the previous 24 hours. A thickness minimum of 522 dm is analysed just NNE of Melbourne. Laverton's thickness value was 524 dm and the 500 mb temperature was -35°C. (Fig. 3). Figure 13 shows satellite imagery on the morning concerned.

Data sources

Data were collected from a number of sources including various metropolitan and country newspapers. Data was also collected by Bureau of Meteorology network; synoptic observations and analyses, rainfall reports, radiosonde data and satellite imagery. Telephone calls were also made to a number of Bureau and non-Bureau personnel to confirm or obtain information.

SYNOPTIC-SCALE DEVELOPMENTS LEADING UP TO THE COLD OUTBREAK

The concept of energy dispersion may be employed to explain the occurrence of the cold outbreak. Figures 4 to 10 present MSL pressure analyses over the eastern half of the southern hemisphere for the period 25 May to 31 May. The equatorward extension of a trough over the Indian Ocean during the first half of the period (system A) seems to have induced marked amplification over the Australian region between 28 May and 31 May of another trough (system B). The rapid northeastward movement of the thermal minimum associated with this latter trough is depicted by Figures 11 to 13, infrared satellite cloud imagery over the east Indian Ocean and Australian regions between 29 May and 31 May. The imagery illustrates the movement of the area of convective activity accompanying the cold pool as it approached Victoria (area C on the imagery). The energy dispersion process is summarised by Fig. 14, the five-day-mean 500 mb geopotential height analysis at 35°S for the period 22 May to 3 June.

SNOWFALL DISTRIBUTION AND INTENSITY

Victorian Regions

Table 1 and Fig. 19 document some important features of snowfall on 31 May 1977 in each Victorian rainfall district. In summary:

- Some snow was reported from all rainfall districts except the Mallee.
- Snow did not fall at a number of quite elevated stations in the northeast and in east Gippsland. East Gelantipy, for example, reported no snow and yet has an elevation of 780 metres. Considerable areas of east Gippsland reported no precipitation for the 48 hours to 0900 hours 1 June 1977 (Figure 15). This is indicative of a rain shadow effect due to the ranges of eastern Victoria in a northwest and then a southwest airstream.

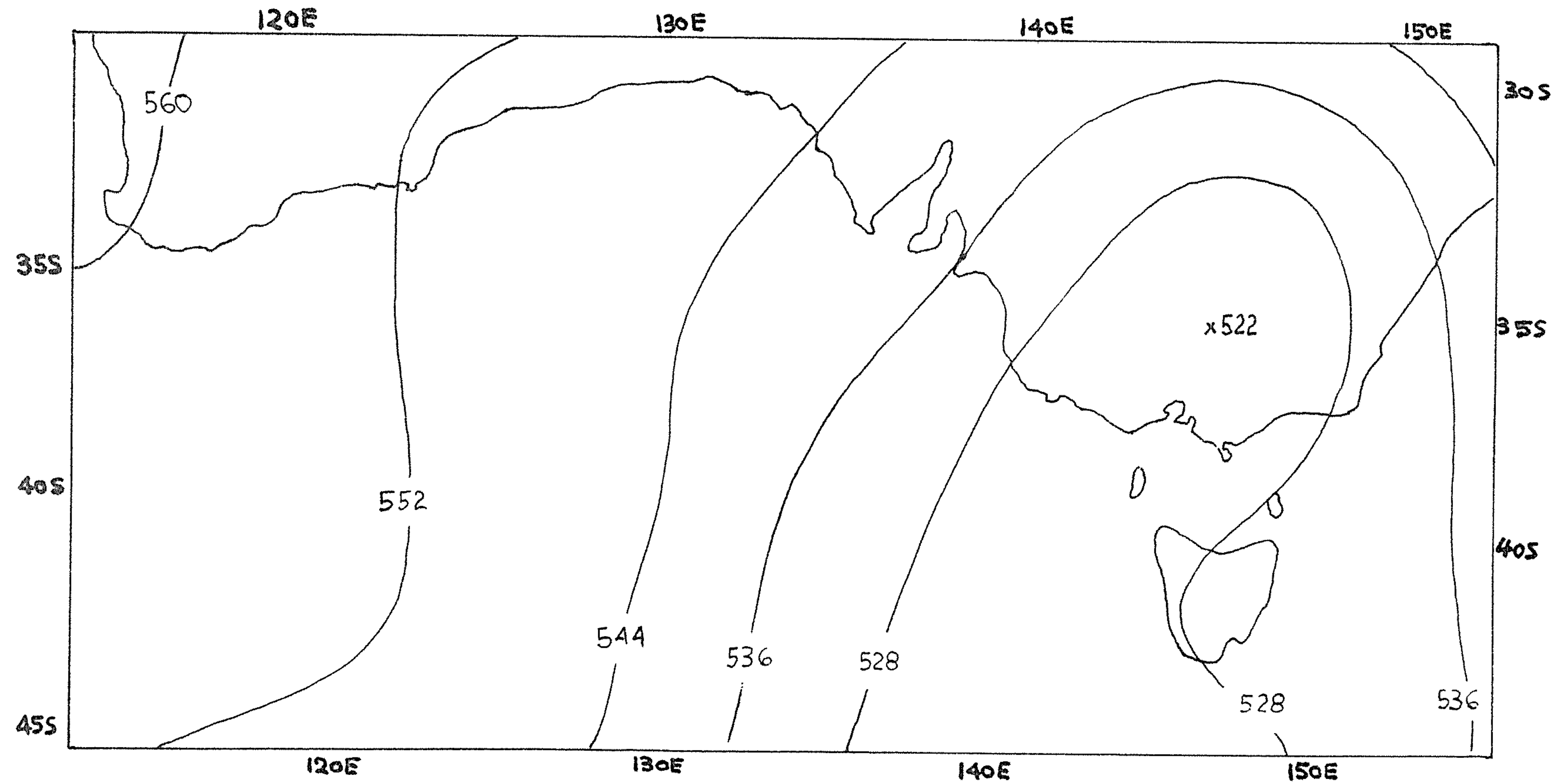

Fig 1. 1000/500 mb thickness analysis over southern Australia
for OOOC GMT 31 May 1977

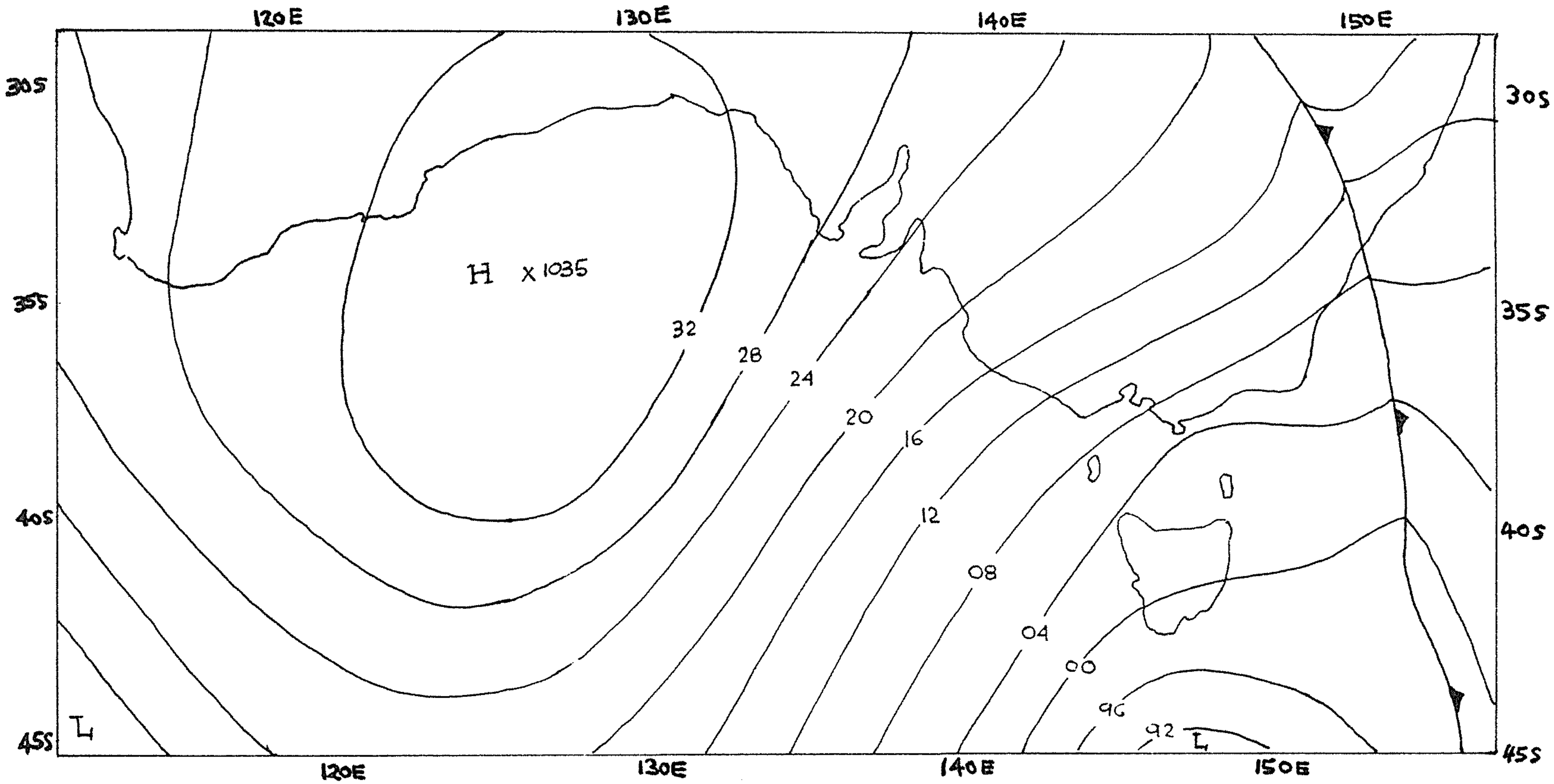

Fig 2. MSL pressure analysis over southern Australia for 0000 GMT 31 May 1977

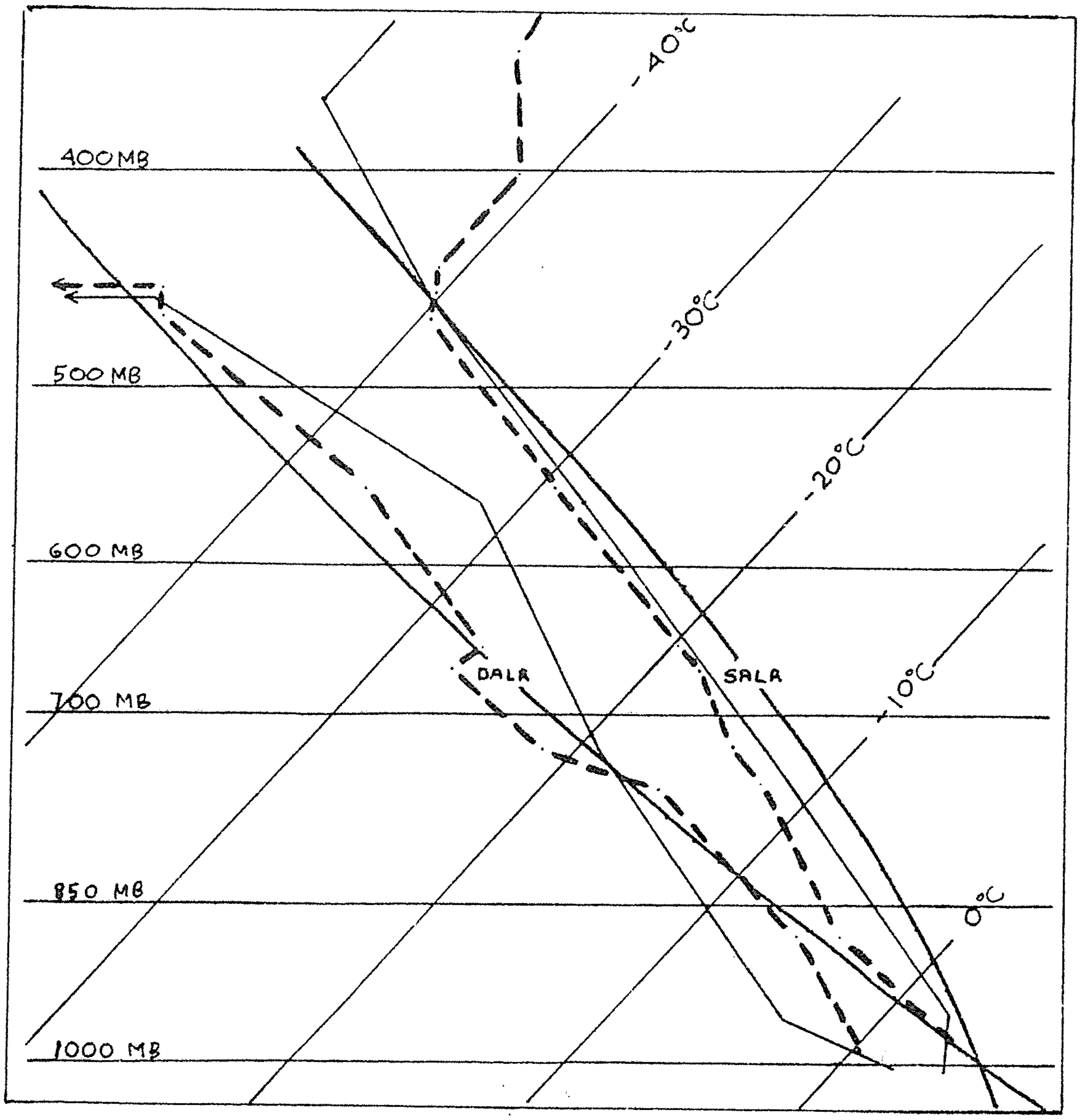

Fig 3. Laverton (———) and Wagga (------) radiosonde soundings for 2300 GMT 30 May 1977. The dry adiabatic lapse rate (DALR) and the saturated adiabatic lapse rate (SALR) are represented by the curved lines.

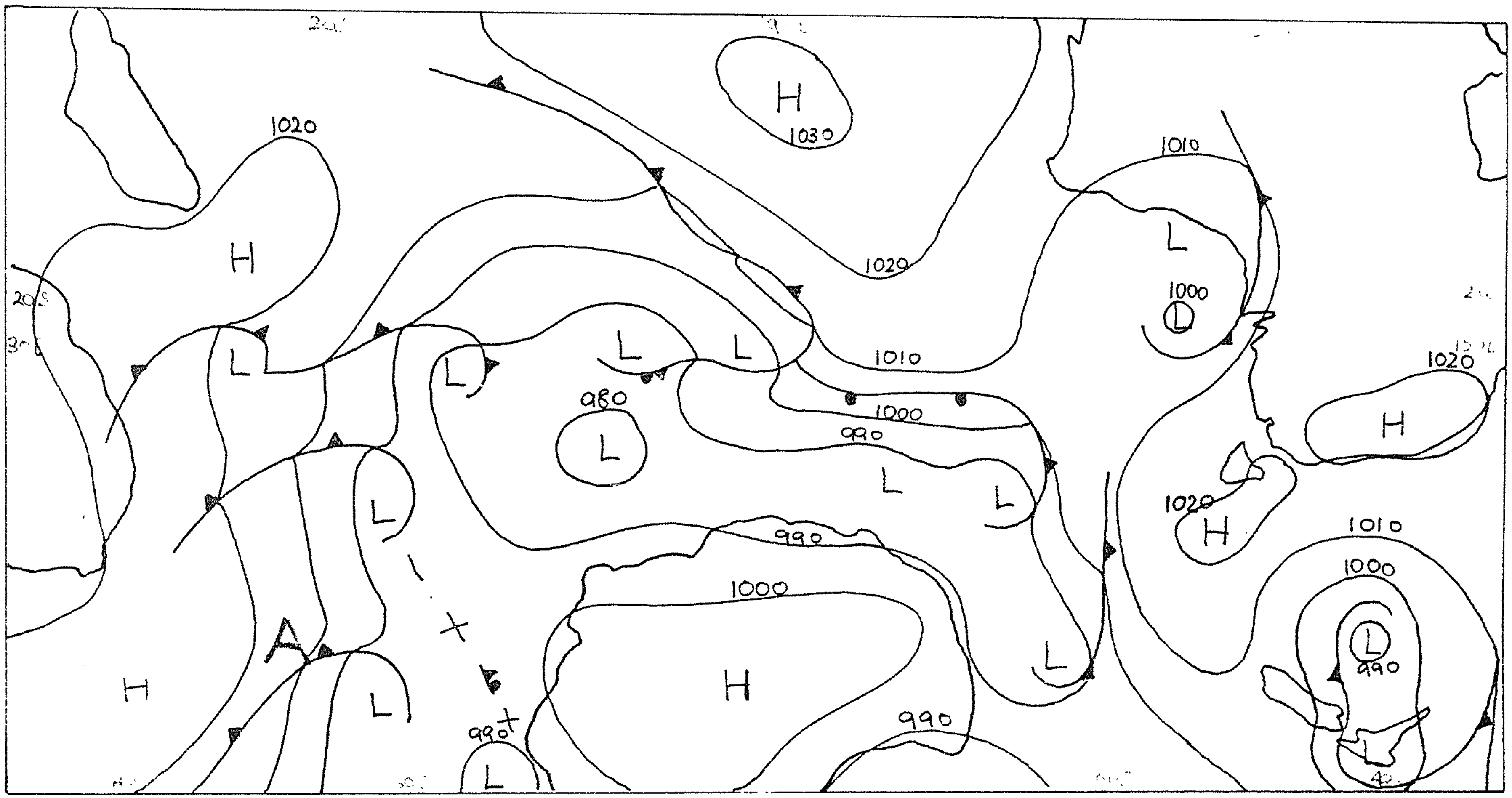

Fig 4. MSL pressure analysis over the eastern half of the southern hemisphere for 1200 GMT 25 May 1977. Note the progress of frontal zone marked 'A' in subsequent analyses.

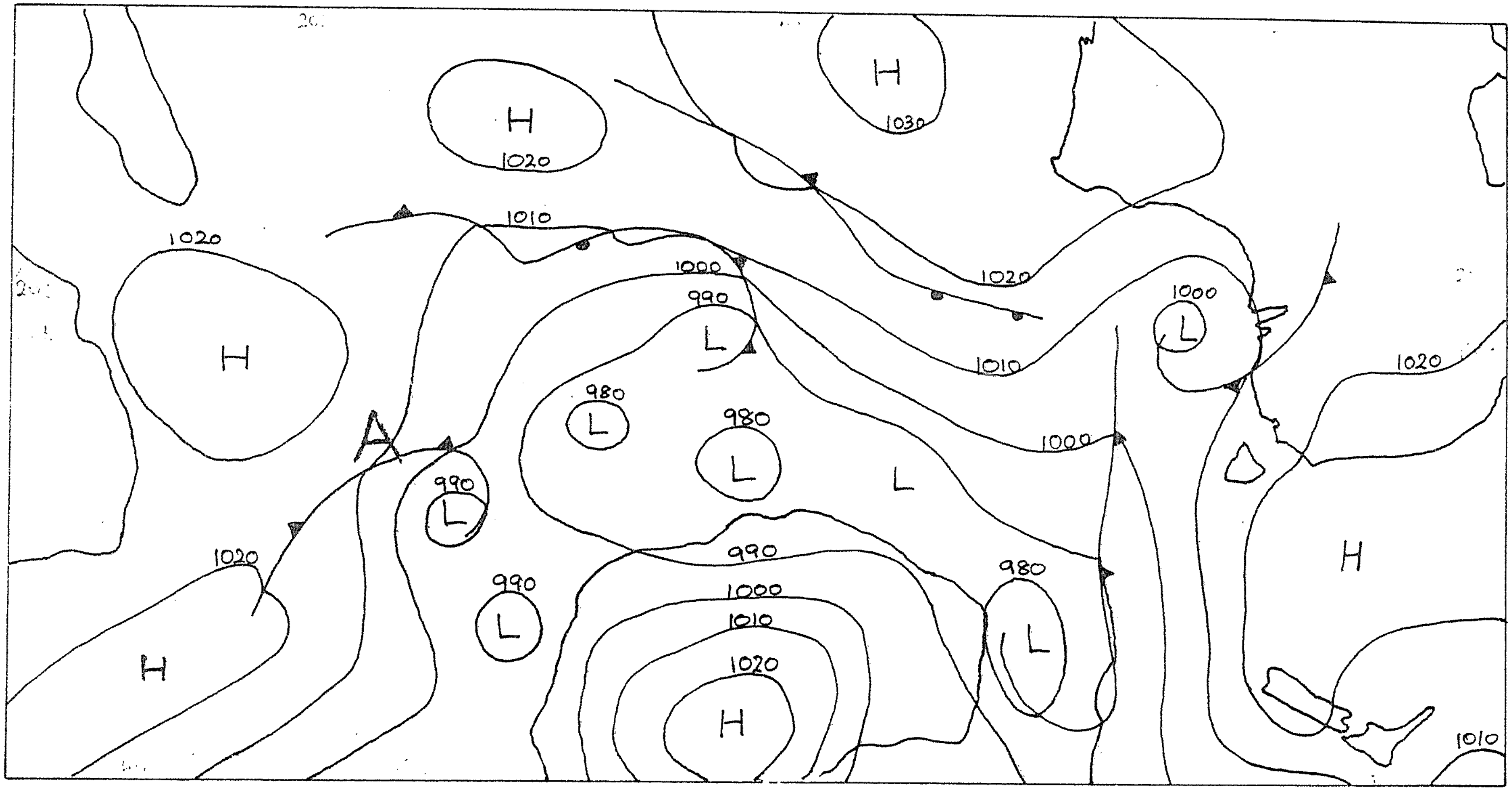

Fig 5. MSL pressure analysis over the eastern half of the southern hemisphere for 1200 GMT 26 May 1977

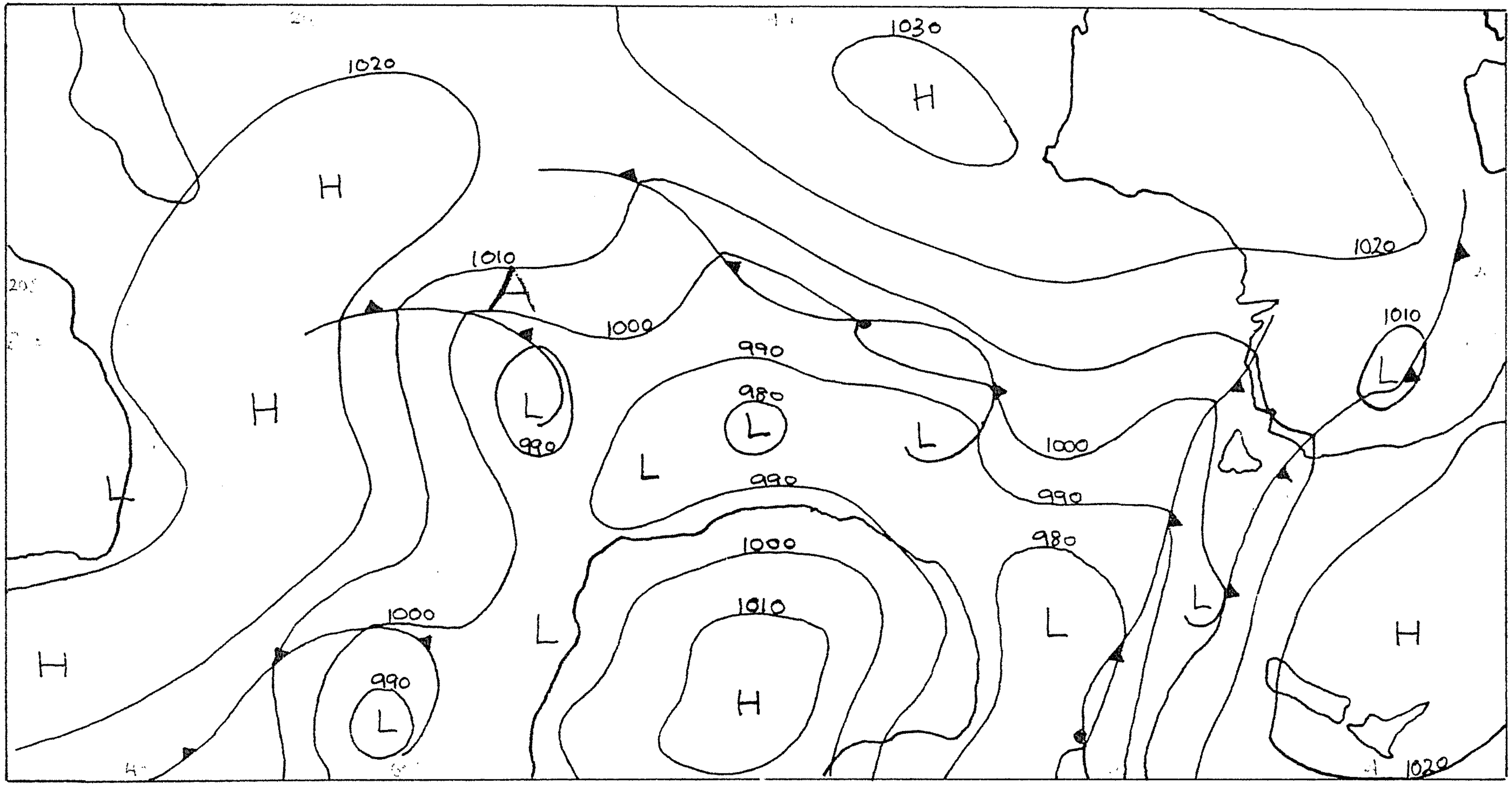

Fig 6. MSL pressure analysis over the eastern half of the southern hemisphere for 1200 GMT 27 May 1977

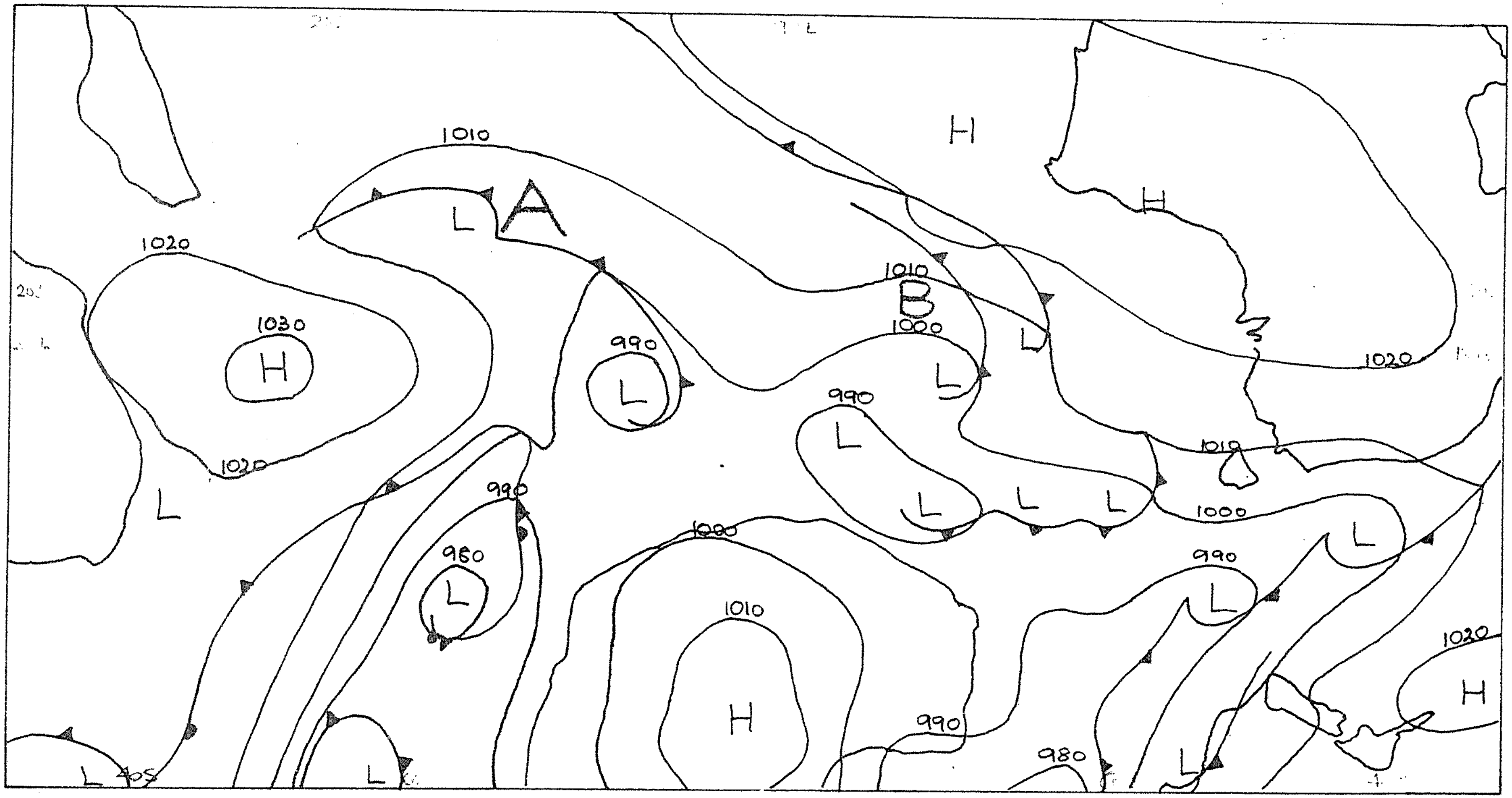

Fig 7. MSL pressure analysis over the eastern half of the southern hemisphere for 1200 GMT 28 May 1977. Note the progress of frontal zone marked 'B' in subsequent analyses.

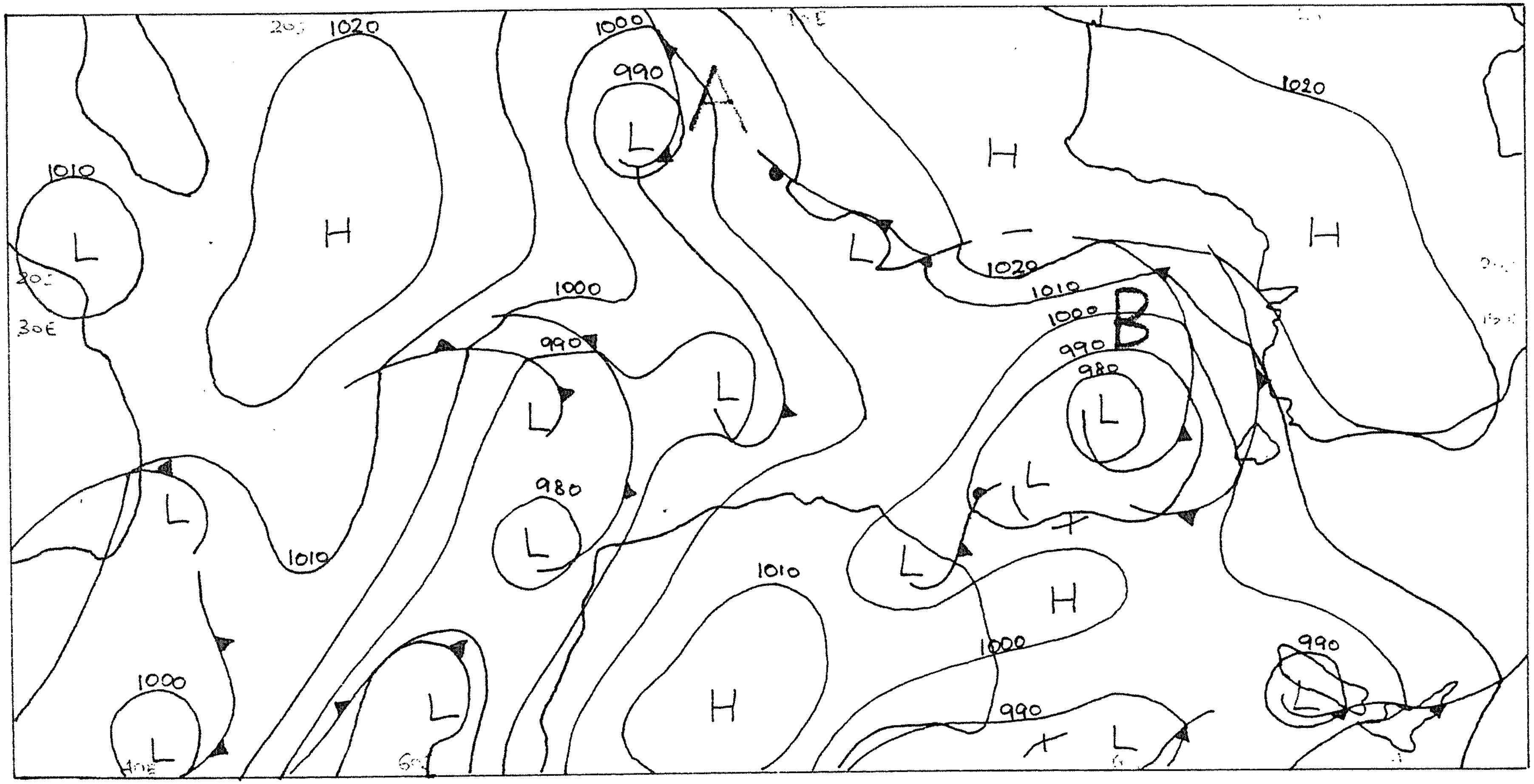

Fig 8. MSL pressure analysis over the eastern half of the southern hemisphere for 1200 GMT 29 May 1977

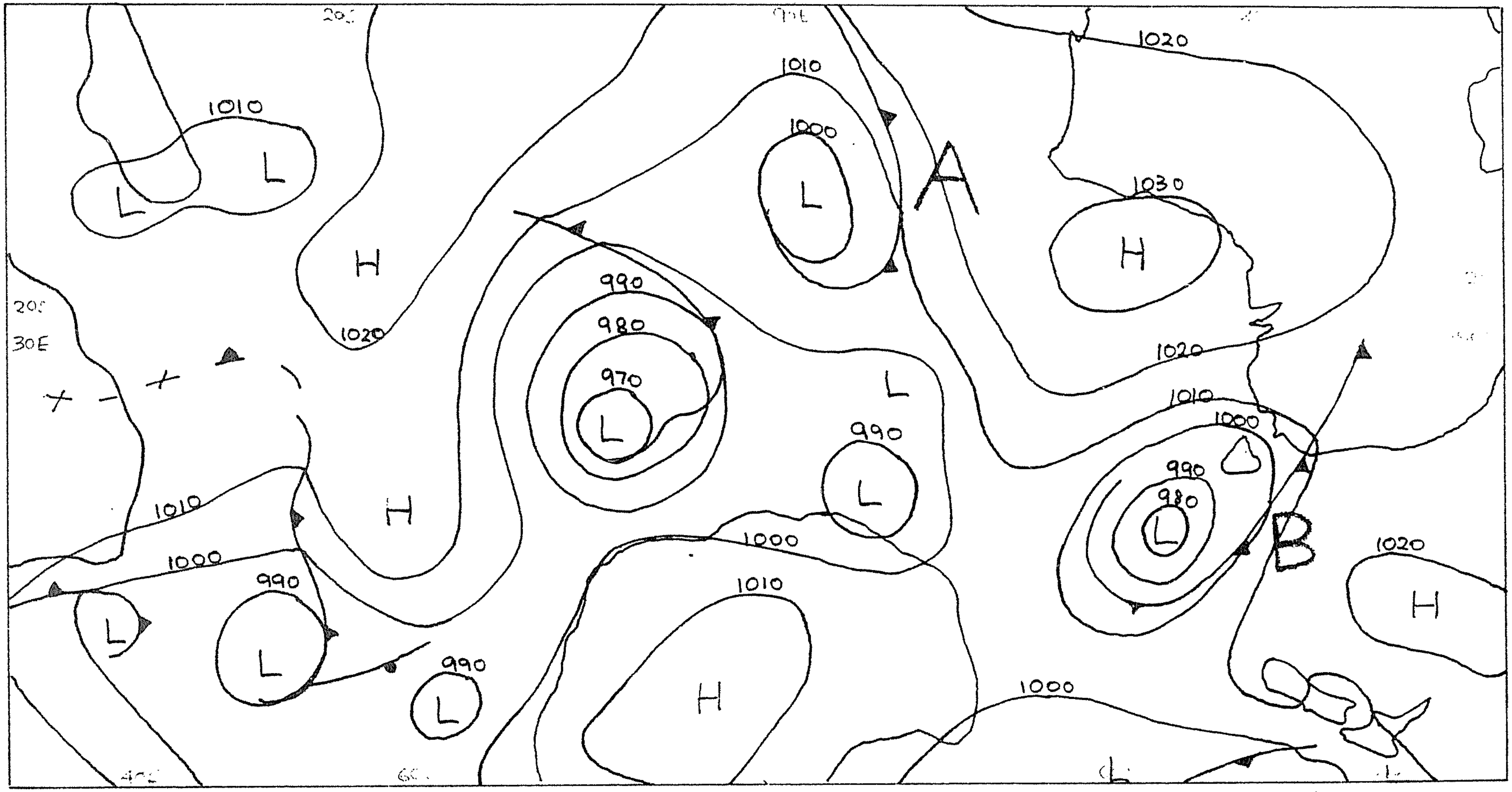

Fig 9. MSL pressure analysis over the eastern half of the southern hemisphere for 1200 GMT 30 May 1977

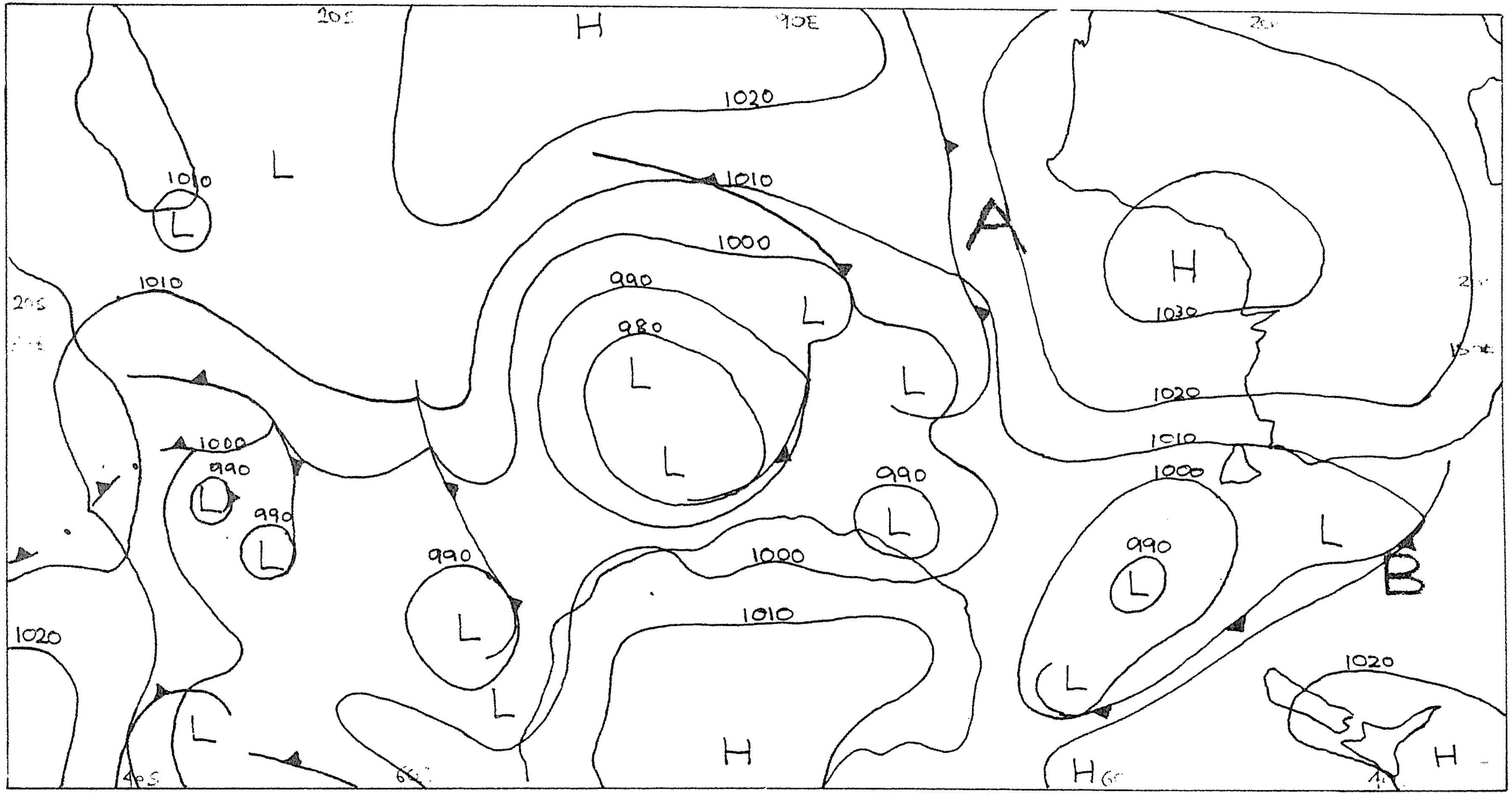

Fig 10. MSL pressure analysis over the eastern half of the southern hemisphere for 1200 GMT 31 May 1977.

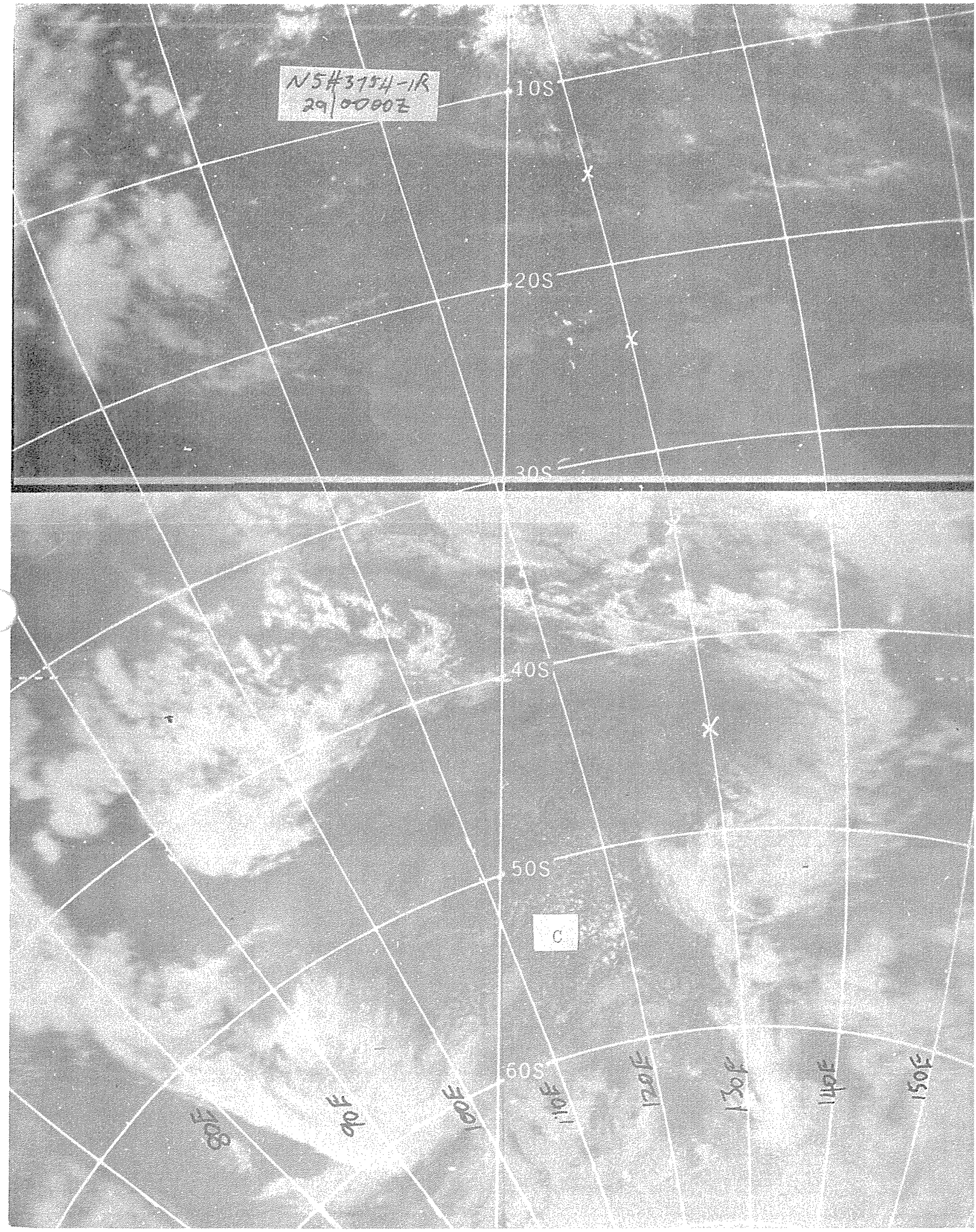

Fig 11. Infrared satellite cloud imagery of the east Indian Ocean region for 0000 GMT 29 May 1977. Note the progress of the cumulus field marked 'C' in subsequent imagery.

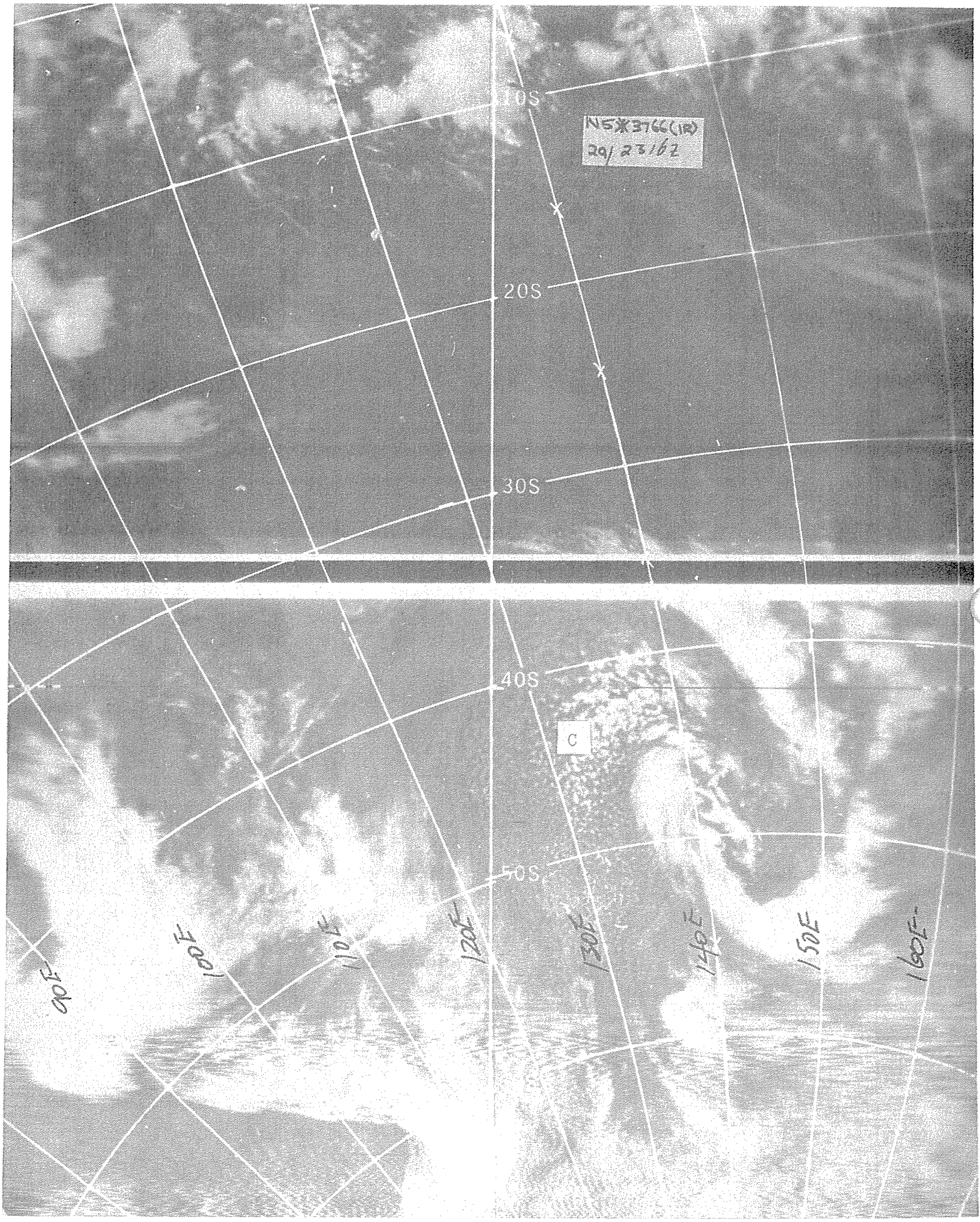

Fig 12. Infrared satellite cloud imagery of the Australian region for 2316 GMT 29 May 1977.