SHORTER CONTRIBUTIONS

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PROBABLE LEE WAVE OVER VICTORIA

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(Manuscript received June 1958)

1. INTRODUCTION

A Vampire jet aircraft attempted a cross-country flight from East Sale to Mount Gambier early in the afternoon of 23 May 1958. The flight proved abortive, since the pilot found himself in an extensive zone of continuous downdraft, and was compelled by fuel considerations to abandon the exercise.

2. DISCUSSION

The soundings made by Laverton and Adelaide Airport at 2300 GMT 22 May 1958 indicated an atmospheric structure well suited for the formation of lee waves in that the first term (the major part) of Scorer's parameter (L) in

$$L^2 = \frac{g}{\theta}\,\frac{\partial \theta}{\partial z}\left(\frac{1}{U}\right)^2 - \frac{1}{U}\cdot\frac{\partial^2 U}{\partial z^2}$$

decreased markedly with height as shown by Figs 1 and 2.

g	=	gravity
θ	=	potential temperature
z	=	measurement in the vertical
U	=	horizontal component of wind at right angles to a ridge or mountain upstream, but in this case taken as the speed of the wind.

The jet aircraft planned to fly from East Sale to Mount Gambier and return (non stop) on a training exercise. Fig. 3 shows the route and contours of the terrain. Planning was on the basis of wind at cruising

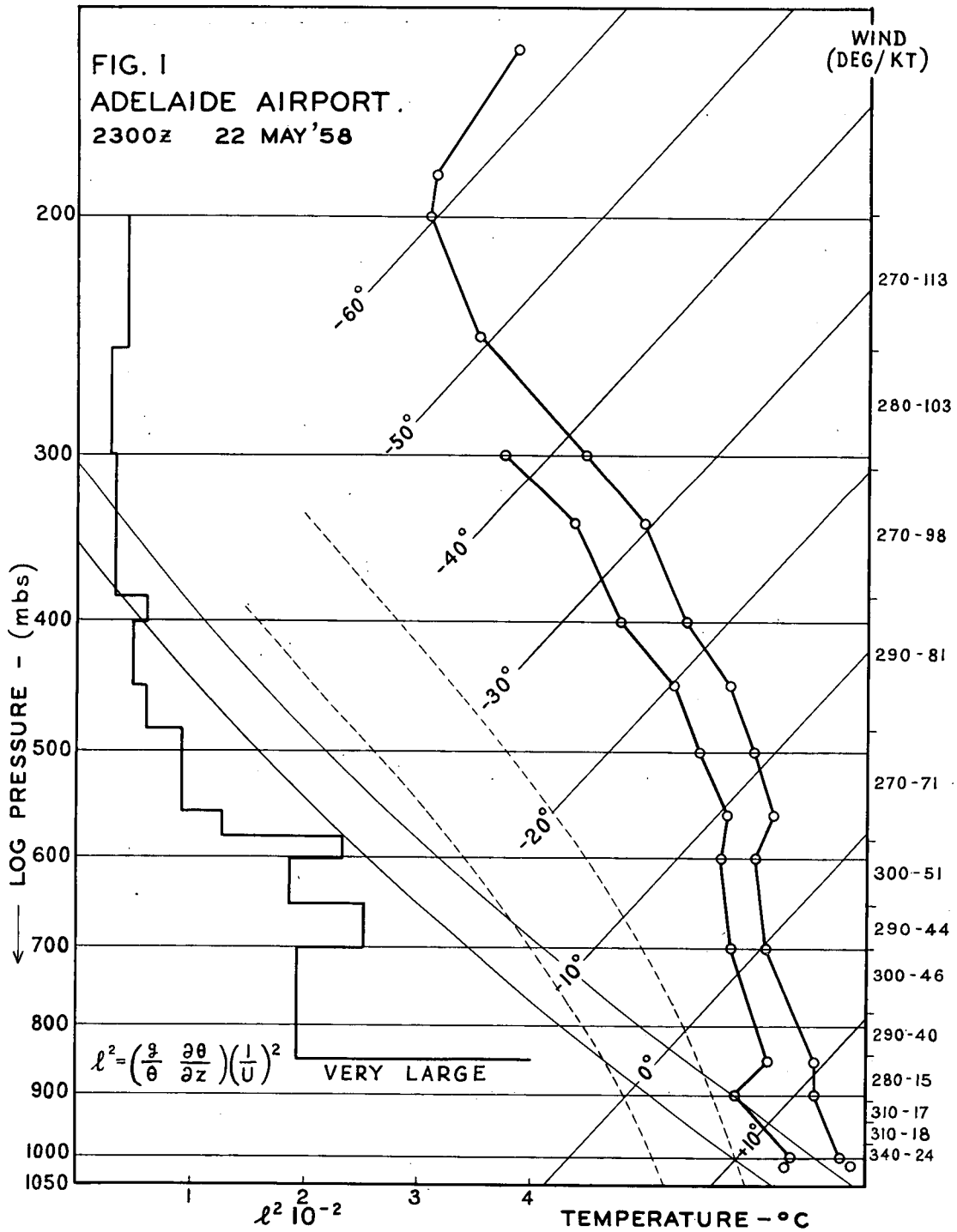

FIG. I. DECREASE OF MAJOR TERM IN SCORER'S PARAMETER FROM SOUNDING AT ADELAIDE 2300 GMT 22 MAY 1958.

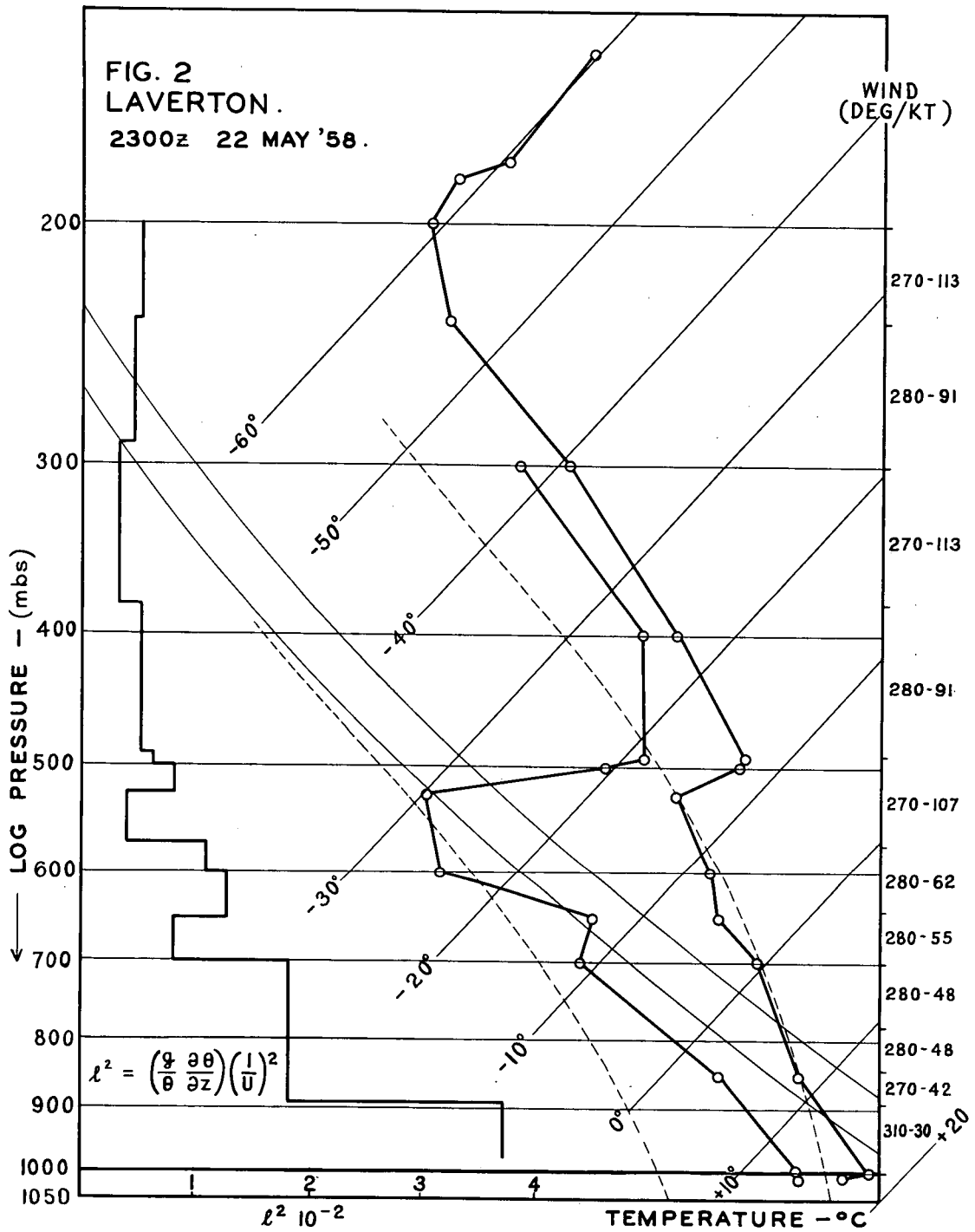

FIG. 2. DECREASE OF MAJOR TERM IN SCORER'S PARAMETER FROM SOUNDING AT LAVERTON 2300 GMT 22 MAY 1958

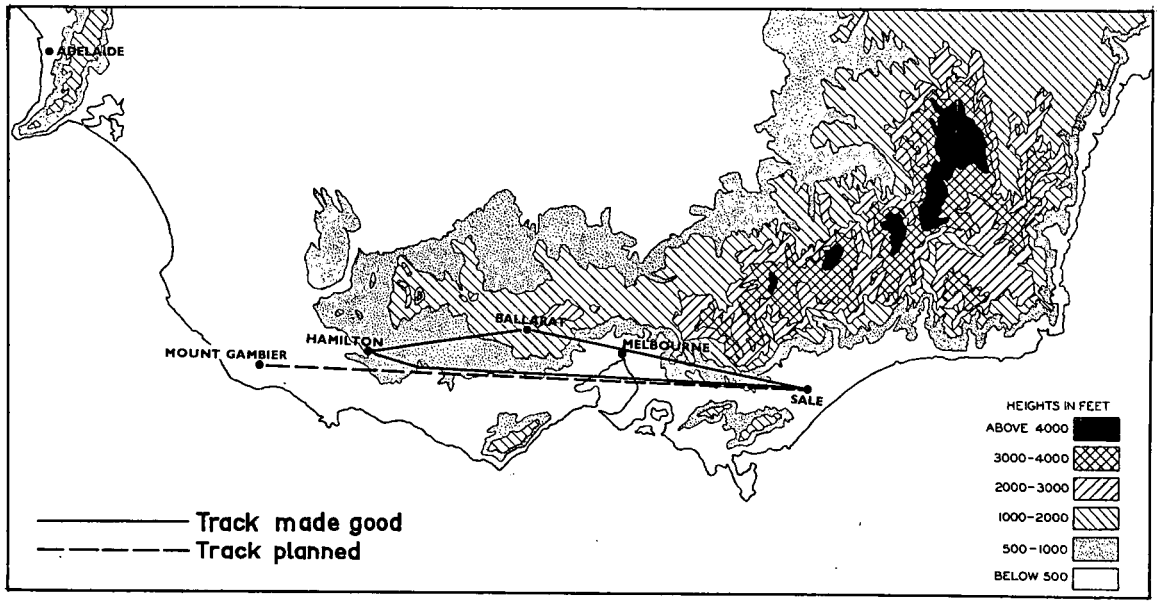

Fig 3. Contour map and aircraft track

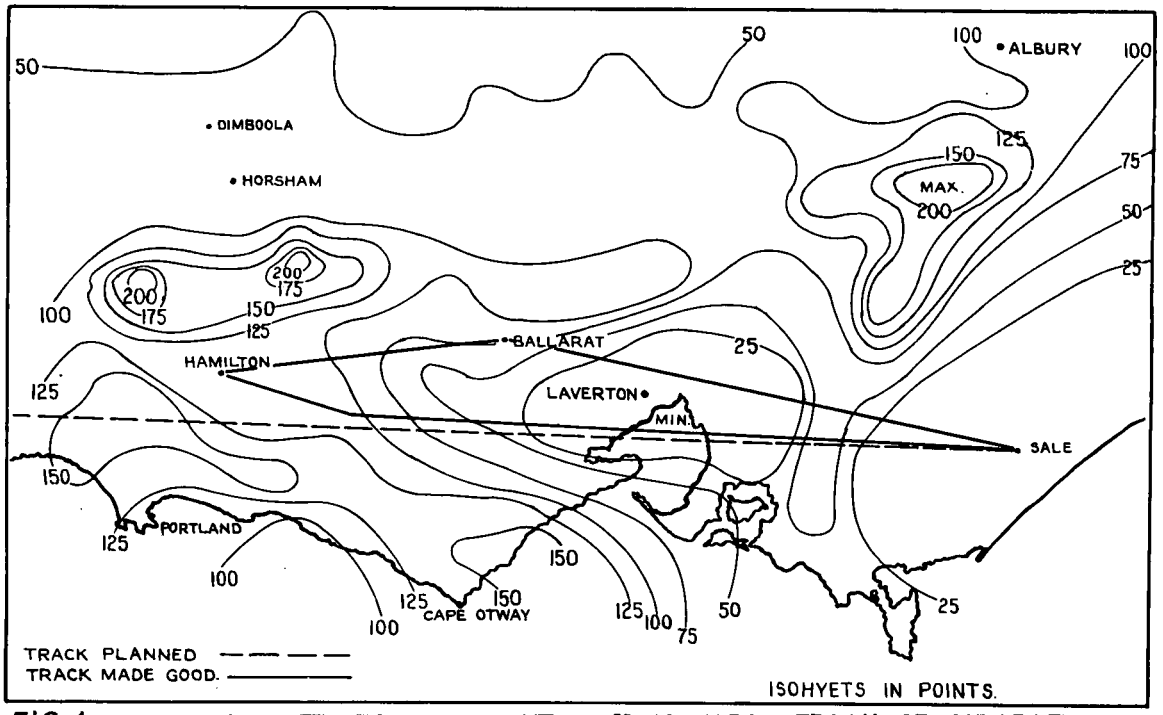

FIG. 4. 24 HOUR ISOHYETS TO 2300 G.M.T. 23RD MAY 1958 – TRACK OF AIRCRAFT.

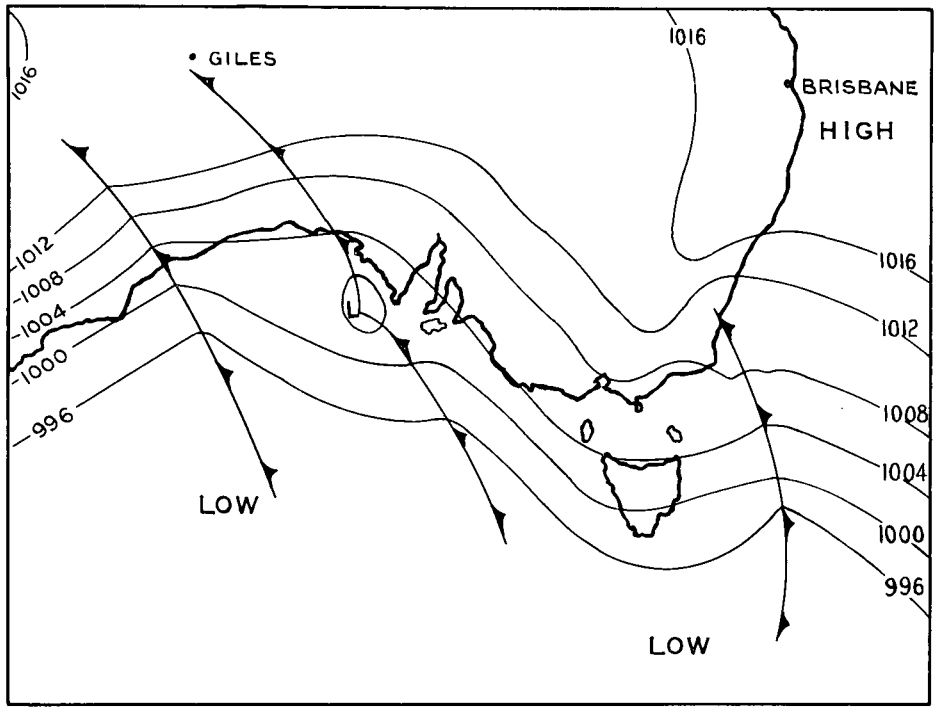

FIG. 5. M.S.L. ANALYSIS 0500 G.M.T. 23RD MAY 1958

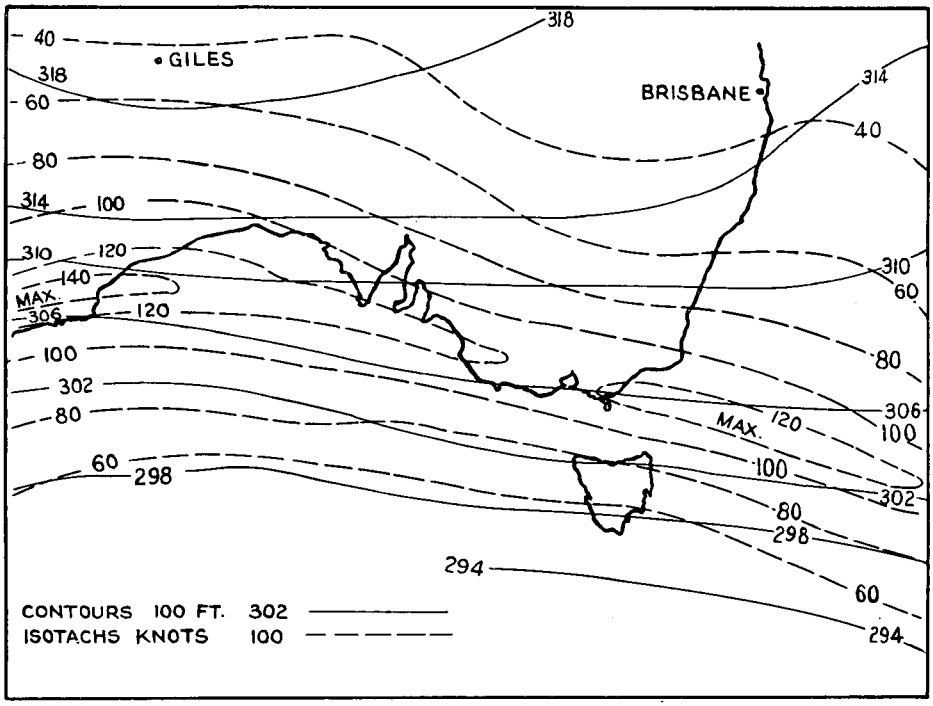

FIG. 6. 300 mb CONTOURS & ISOTACHS 2300 G.M.T. 23RD MAY 1958

height being 280 deg. 115 kt, the cruise being as high as possible because of cloud in layers and being limited by technical considerations involving air temperature.

The aircraft left East Sale at 0315 GMT 23 May 1958. The climb to cruising level of 35,000 ft was normal and extended over 97 miles to a point south-east of Melbourne. To maintain altitude after this point an engine power had to be used which should have resulted in an indicated airspeed of 240 kt, but because of having to adopt a climbing attitude the indicated airspeed was reduced to 155 knots while the true airspeed was 280 kt. The headwind component was computed as 130 kt. There were blue breaks in the cloud above the aircraft.

Fuel consumption was much higher than planned and with similar conditions on return - sinking air resulting in maintenance of true airspeed of 280 kt with high fuel consumption. The pilot decided to deviate still further north of track before abandoning the exercise. By the time he reached Hamilton the indicated airspeed had risen to normal for the power setting and the pilot turned for home via Ballarat well north of his outward track. In this section of the flight there were no indications of ascending or descending air and the computed tailwind component was 120 kt.

It is recognised that the computations of Scorer's parameter have been made neglecting the latent heat of condensation - but a superficial examination shows that were the processes following the wet Adiabatic the form of the distribution of L was even more favourable for lee waves.

If the downward component of air movement persisted for a considerable proportion of the time between the readings of rain gauges at 2300 GMT daily, one would expect a minimum in the isohyetal map of the general rain which spread over south-eastern Australia during the period. Fig. 4 shows the 24 hr isohyets for 2300 GMT 23 May 1958 with such a minimum. The very high maximum to the north-east of Melbourne would have been induced by the mountainous terrain at right angles to the wind stream - see Figs 5 and 6 of mean sea level 0500 GMT isobars and 300 mb 2300 GMT contours and isotachs.

The notable features of the phenomenon were:

(a) The very great distance that the aircraft was in descending air.

(b) The terrain which could have caused the initial disturbance does not at any point exceed 3500 ft and generally does not reach 2000 ft elevation. The altitude at which the phenomenon was encountered was ten times that of the greater elevation and seventeen times that of the lower elevation.

(c) The rapid cessation of descending air as the aircraft moved away from the planned track.

The operational significance is that although the forecast and briefing were substantially correct and the pilot had been warned of the possibility of lee waves being in existence, fuel consumption was much greater, and hence endurance of the aircraft much less than planned, so that a situation could have arisen in which the safety of the aircraft was endangered. Acting upon his briefing and interpretation of what he experienced, the pilot was able to prevent such a situation arising.

Reference:

Corby, G.A. 1958 Met. Report No. 18, Air Ministry, London