551.551 (94-13)

MAXIMUM WIND GUST AT SOUTH AUSTRALIAN REGIONAL OFFICE, 13th JULY, 1964

by G. Furler

South Australian Regional Office,
Bureau of Meteorology, Adelaide

(Manuscript received February 1965)

1. INTRODUCTION

At 0145 CST on 13th July 1964, a record wind gust of 92 miles per hour (80 knots) was recorded in Adelaide. Damage reported was from localities directly west of the anemograph and was localised. Observations were available from three Adelaide stations - the Regional Office, the Airport and the Waite Agricultural Research Institute - whose positions are shown in Fig. 1.

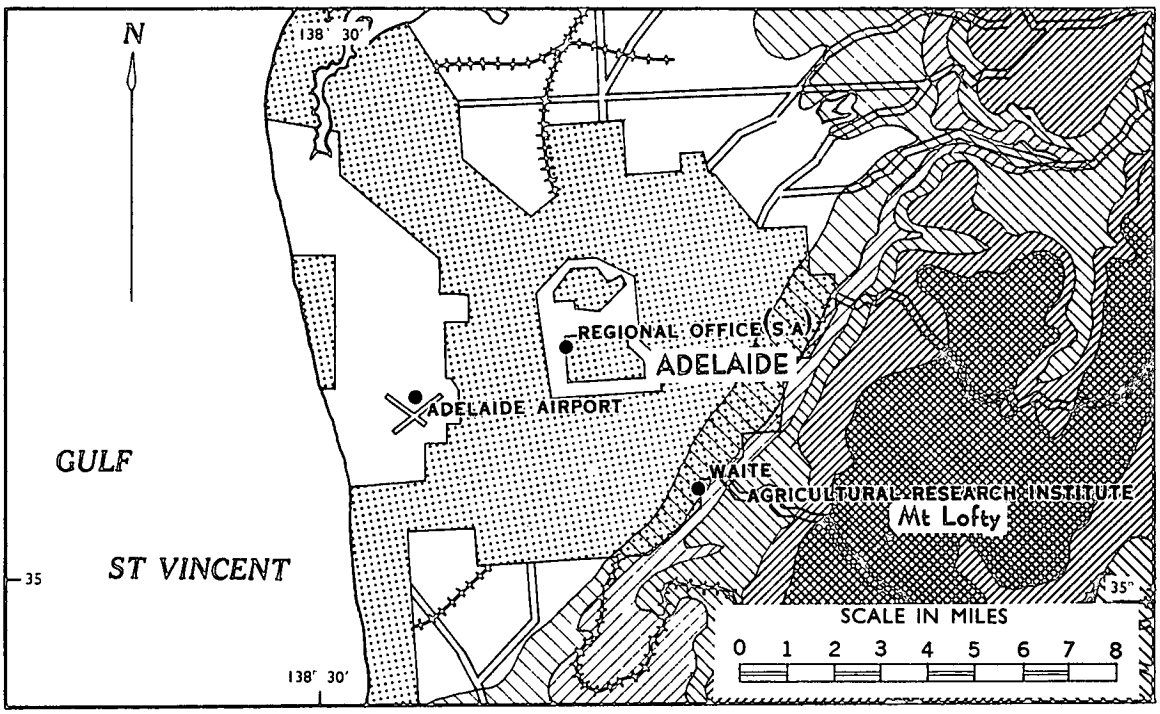


Fig.1 Positions of recording stations.

2. SYNOPTIC SITUATION AND OBSERVATIONS

On the morning of 13th July, a cyclone, central pressure about 965 mb, was located about 300 miles southwest of Tasmania, with gradient winds of about W/50 kt over southeast South Australia. A trough in the westerly stream passed Adelaide about 0130 CST, as is evident from the anemograph records presented in Fig. 2. The later wind shifts between 0300 and 0430 CST were probably associated with the passage of Cb and showers, although that between 0330 and 0400 CST may have been associated with a minor trough. The Waite Institute anemobiagraph was known to be recording about 20 per cent low, so the true gust speed there was about 44 kt.

Adelaide Regional Office microbarograph, thermograph, hygrograph and pluviograph records are presented in Fig. 3. These records show a pressure jump of about 0.035 inches, a temperature fall of 10°F, a rise in relative humidity of about 8 per cent and the onset of heavy rain about or just prior to the time of the record gust. Cumulonimbus cloud, base 2000 feet, and lightning were observed at Adelaide prior to and after the record gust.

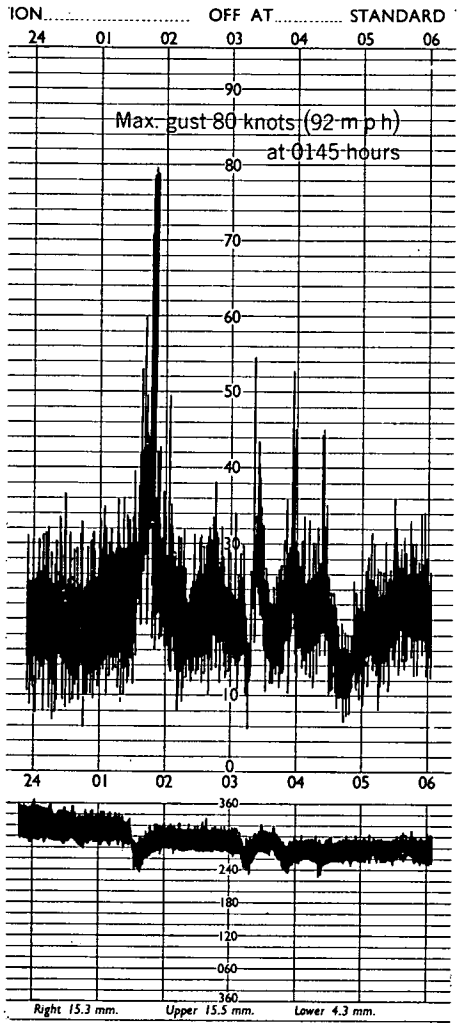
Adelaide Airport upper winds at 2100 CST 12th July and 0300 CST 13th July were as follows:

Height	2100 CST 12th July		0300 CST 13th July	
2000 ft	290 deg	49 kt	280 deg	48 kt
3000	280	51	260	48
5000	270	57	260	62
7000	270	66	260	67
10000	280	63	280	78
12000	280	60	270	68
14000	280	75	280	93
19000	280	86	270	83
24000	270	86	240	119
31000	270	123	270	144
34000	270	129	270	121

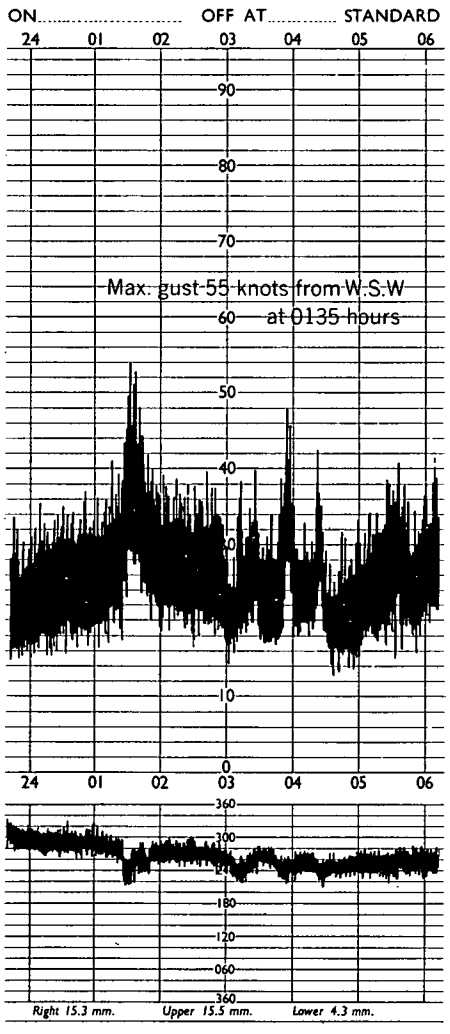
The aerological soundings for Adelaide Airport at 2030 CST 12th July and 0830 CST 13th July are presented in Fig. 4. There were thunderstorms in the area at the time of the peak gust and the autographic records are consistent with the gusts at the Regional Office at 0145, 0355 and 0425 CST being associated with rain from Cb clouds.

3. DISCUSSION

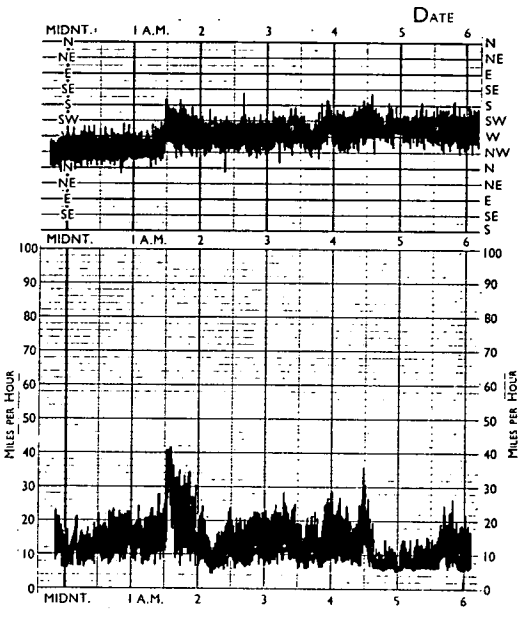
"Smith's Classification of Gustiness" (Haltiner and Martin, 1957) is based on the directional variability of wind and is divided into various types. Type B gustiness reflects a combination of thermal and mechanical turbulence, and Type C is caused also by both thermal and mechanical turbulence, but the mechanical turbulence usually predominates to the extent that Type C becomes a definition of mechanical turbulence if a neutral lapse rate exists. The anemograph traces at the South Australian Regional Office and Adelaide Airport indicate Type C gustiness up to the time of the maximum gust and changing more towards Type B gustiness for the following four hours.



(a) Adelaide Regional Office

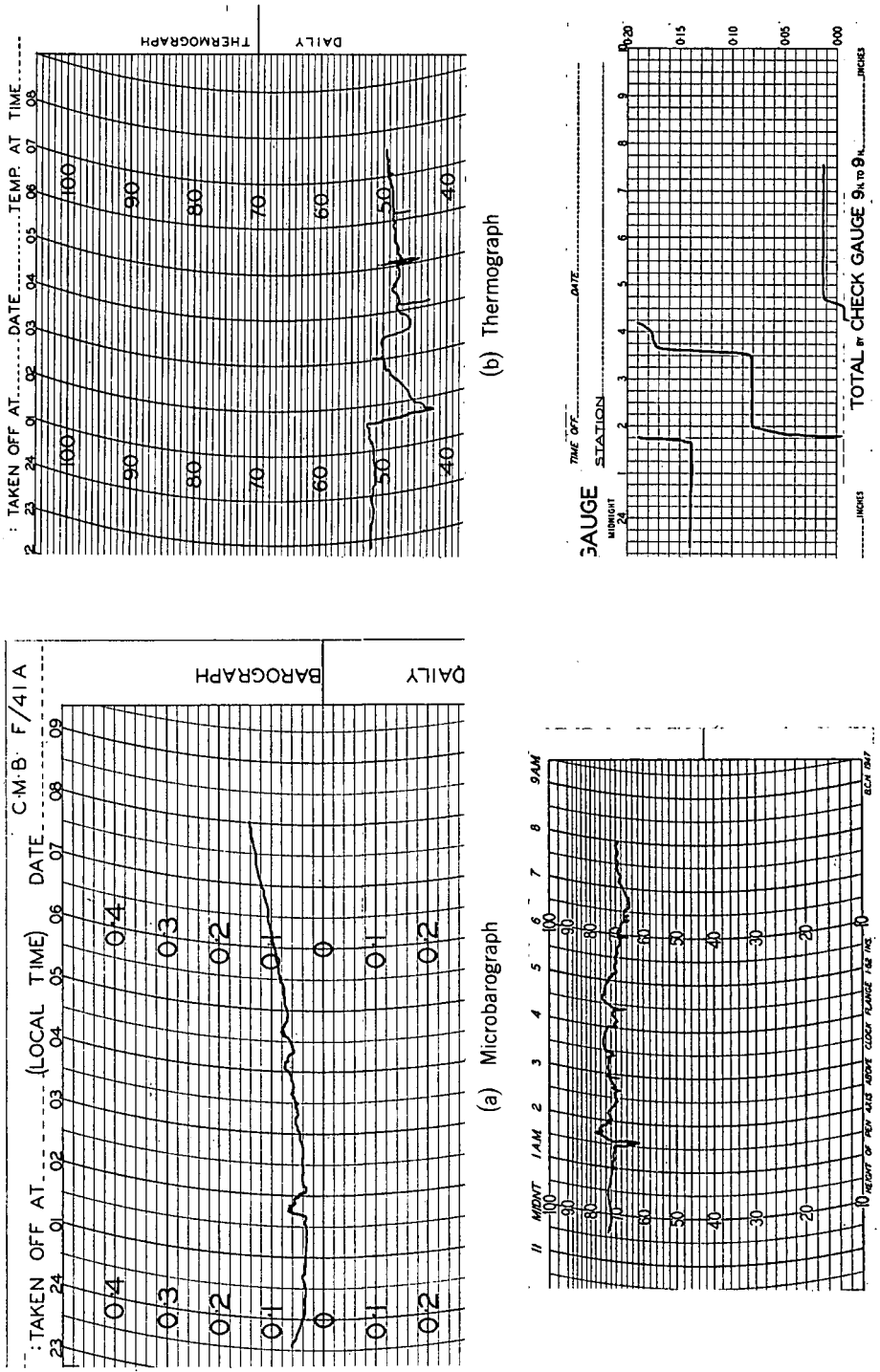


(b) Adelaide Airport



(c) Waite Agricultural Research Institute

Fig. 2 Anemograph records for 0001—0600 CST on 13 July 1964.



(a) Microbarograph

(b) Thermograph

(c) Hygrograph

(d) Pluviograph

Fig. 3 Adelaide Regional Office autographic records for 0001–0600 CST on 13 July 1964.

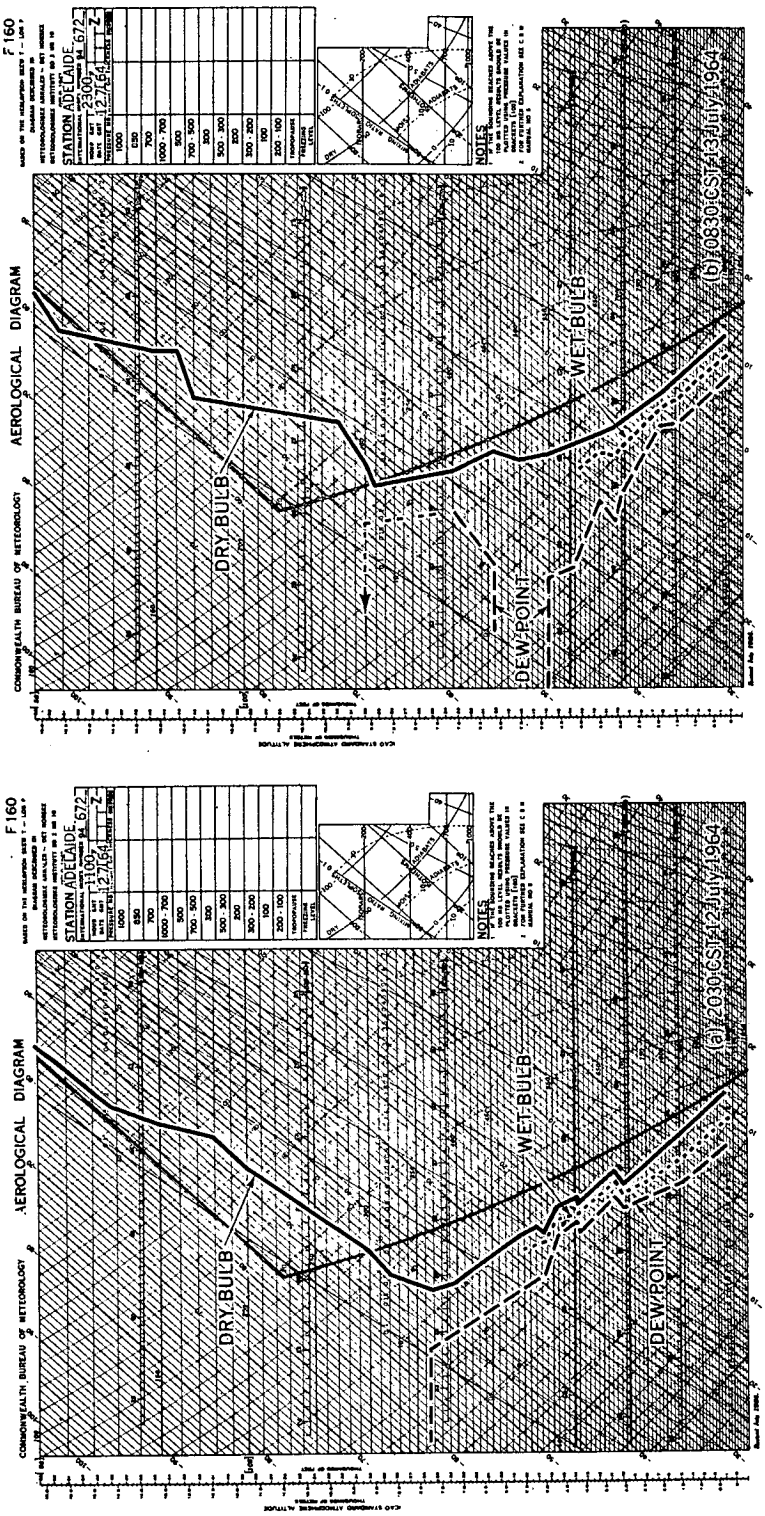


Fig.4 Adelaide Airport aerological soundings.

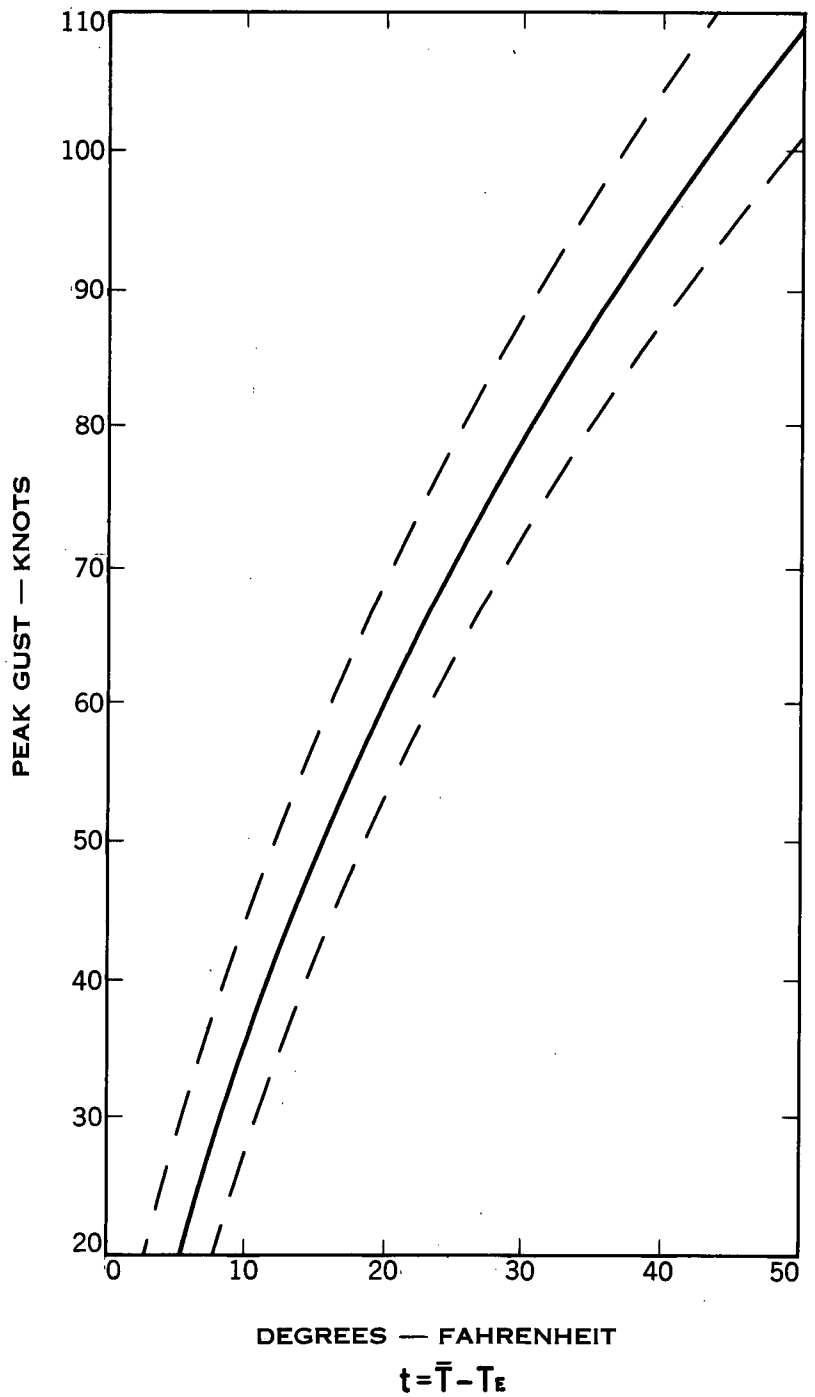


Fig.5 Peak gusts and temperature differences in non-frontal thunderstorms

with regression curve and standard error of estimate.

Abscissa is temperature just prior to the thunderstorm minus temperature immediately after downrush

(Fawbush & Miller,1954)

Fawbush and Miller (1954) derived a relation between the peak gust and the difference between ambient surface temperature and the surface temperature of the saturation adiabat through the intersection of the wet bulb curve and the 0°C isotherm. This latter temperature was found by experience to be the temperature of strong downdrafts reaching the surface. Sixty-eight per cent of gust predictions should be within 8 knots of the actual value. The authors also state that reports of gusts less than calculated may be due to paths of thunderstorms not passing directly overhead. Winds greater than indicated are probably due to the addition of momentum from strong winds aloft.

By considering the radiosonde for 2130 CST 12th July (Fig. 4(a)) - the sounding closest to the time of occurrence of the record gust - a value of 5.5°C (10°F) for the difference between the surface temperature and the downrush temperature is obtained. This agrees with the observed fall in temperature at the regional Office at the time of the gust. The sounding 12 hours later, Fig. 4 (b), shows little change below 700 mb, indicating that the earlier sounding was probably representative of conditions at least to the height of the wet bulb freezing temperature.

The Fawbush Miller graph (Fig. 5) for stationary thunderstorms gives a peak gust of 36 ± 8 knots. In determining the peak gust, the upper level of its origin is considered to be the wet bulb freezing level and this occurred at approximately 5000 ft. The mean wind for 0-5000 ft was $280^{\circ}/52$ kt at 2100 CST and $270^{\circ}/52$ kt at 0300 CST, and is assumed to have been $280^{\circ}/52$ kt at time of peak gust.

In view of the temperature drop being in agreement with the forecast drop and the backing of the surface wind to the direction of upper winds, it is assumed a cumulonimbus cloud passed directly overhead.

By vector calculation using the 0-5000 ft mean wind and resultant gust, it is found a gust of 30 kt would have to be superimposed on the mean 0-5000 ft wind to give a gust of 80 kt at the surface. Thus, providing complete transfer of momentum occurred, the observed gust is within the limits of the predicted gust.

The agreement is probably fortuitous. Possibly the thunderstorm passed directly over the Regional Office (no visual or radar observations are available for this time). The lack of agreement between the predicted gust and the gusts about 0130 CST, at Adelaide Airport and the Waite Institute, and the later gusts at all stations, might suggest that these other gusts occurred on the edges of downdrafts from Cb clouds.

4. CONCLUSION

The record gust in Adelaide was associated with a downdraft from a thunderstorm.

REFERENCES

Haltiner, G.J. and Martin, F.L. 1957 Dynamical and Physical Meteorology, McGraw-Hill, New York, p. 226

Fawbush, E.J. and Miller, R.C. 1954 Bull. Amer. Met. Soc., 35, No. 1, p. 14