551.501.81 : 551.510.42

RADAR OBSERVATIONS OF SMOKE

By R.L. Birch

Central Office, Bureau of Meteorology, Melbourne

(Manuscript received February 1968)

Echoes have been observed on the 10cm WF44 radar at Mount Gambier corresponding to areas of visible smoke from confirmed 'burning off' operations. Some examples of the radar display are shown in Plate 1. Smoke echoes have been previously reported (for example, Jones (1950), Hiser (1961)) and have been observed by others. This note is merely illustrative; fires occur not infrequently in Australia and such echoes could be incorrectly reported as precipitation.

The visible smoke subtended angles adequate for beam filling in the direction of the echoes which were reported as indistinguishable from rain on the A scan. The reflectivity was 2×10^2 peaking to 1.2×10^3 mm^6/m^3 - equivalent to 0.4 to 1.2 inches of rain per hour. On 24 October 1967 there was an inversion at 900 mb, but its gradient - about $0.007^{\circ}C/m$ - was at least an order less than would be required to enhance the echoes by super-refracting the top of the beam toward the seat of the fire where high reflectivities would be expected; moreover, echoes extended well downwind from the fires. The intensity of the echoes suggests that refractive index discontinuities were not the major cause; more probably the fires were sufficiently well established to carry moderately large particles aloft with little dispersion.

The photograph of 25 October 1967 (see Plate 1) shows both rain and smoke echoes; it was taken after a surface discontinuity, the position of which was deduced from synoptic charts and satellite cloud-cover photographs. The trailing pattern of the smoke echoes, as distinct from the rain, is evident just to the east of the discontinuity.

It would be interesting to examine such echoes with both vertical and horizontal polarization. Stronger horizontal echoes would tend to confirm reflection from particles, if it is assumed that those carried up are irregular and stabilize with the larger dimensions horizontal.

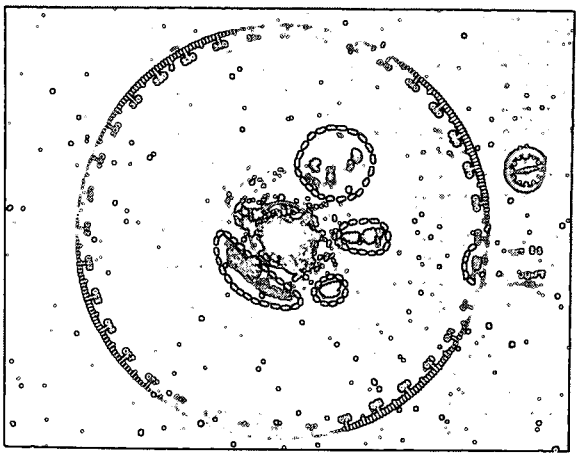
ACKNOWLEDGEMENT

Thanks are due to Mr. P.B. Lane for the notes and observations.

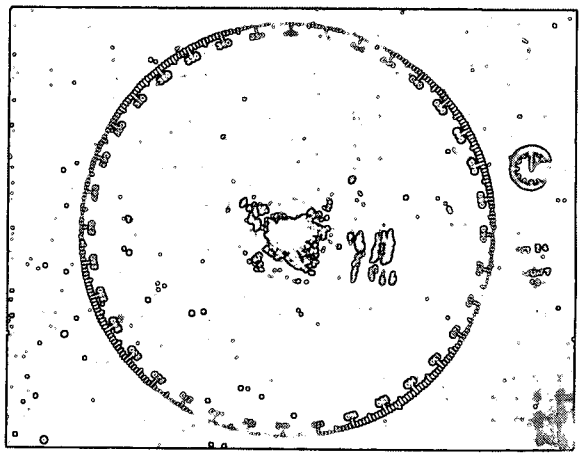
REFERENCES

Jones, R.F. 1950 "Radar Echoes from Smoke", Met. Mag., London, 79, 933. p. 89.

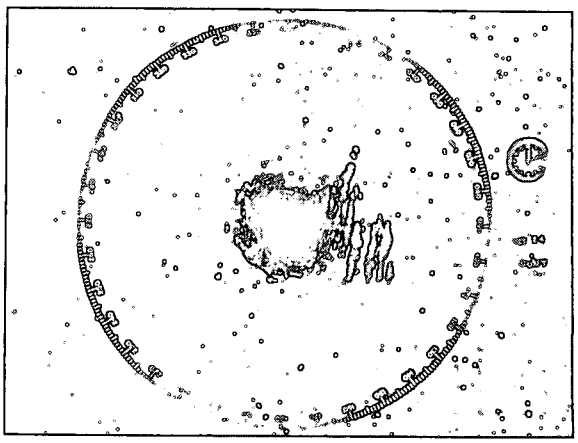
Hiser, H.W. 1961 "Smoke Observations on a 10cm Radar", Bull. Amer. Met. Soc., 42, 9.



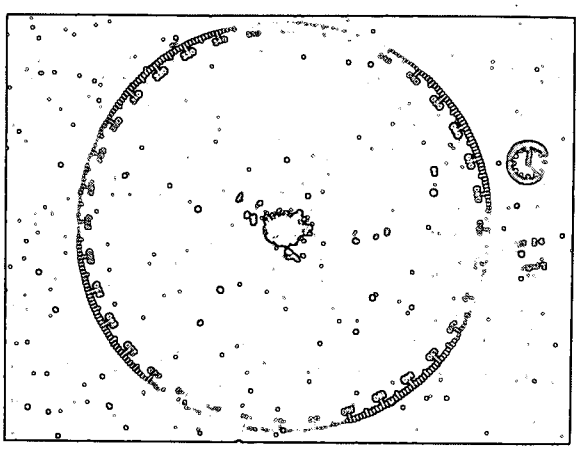
23 October 1967 1444 Local time. Weather : cloudless, smoke haze, light variable NE wind. Radar : Range 60 Nm, Swept gain, Elevation 2°. Echoes from smoke circled.



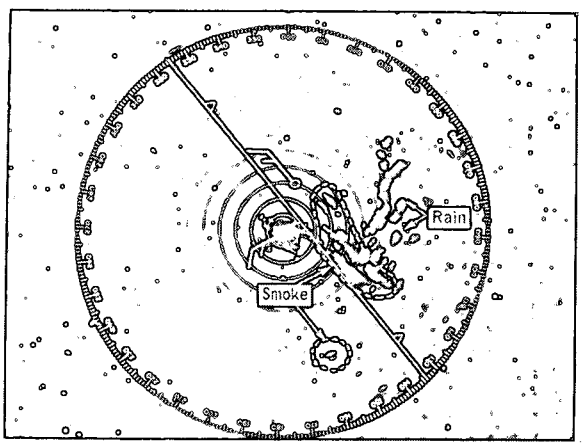
24 October 1967 1208 Local time. Cloudless, wind 010° gusting 10 – 24 kts. Bank of smoke visible from 040° to 180°, estimated height 4000 ft. Radar : Range 60 Nm, Swept gain, Elevation 0°



24 October 1967 1212 Local time. Range 60 Nm, No swept gain, Elevation 0°. Note pronounced trailing pattern of echoes.



24 October 1967 1224 Local time. Range 60 Nm, No swept gain, Elevation 2.5°. At the time, echoes could be discerned with elevations up to 3.6°, in which case lower half power point of beam would be about 4000 ft above more distant fires.



25 October 1967 1430 Local time. Ac with scattered rain to east. Wind 240/15 at radar; wind change had not reached area of fires. Radar range 120 Nm.

Smoke Echoes – Mount Gambier
Plate 1