CLOUD PHOTOGRAPHY AND CLOUD PHYSICS RESEARCH

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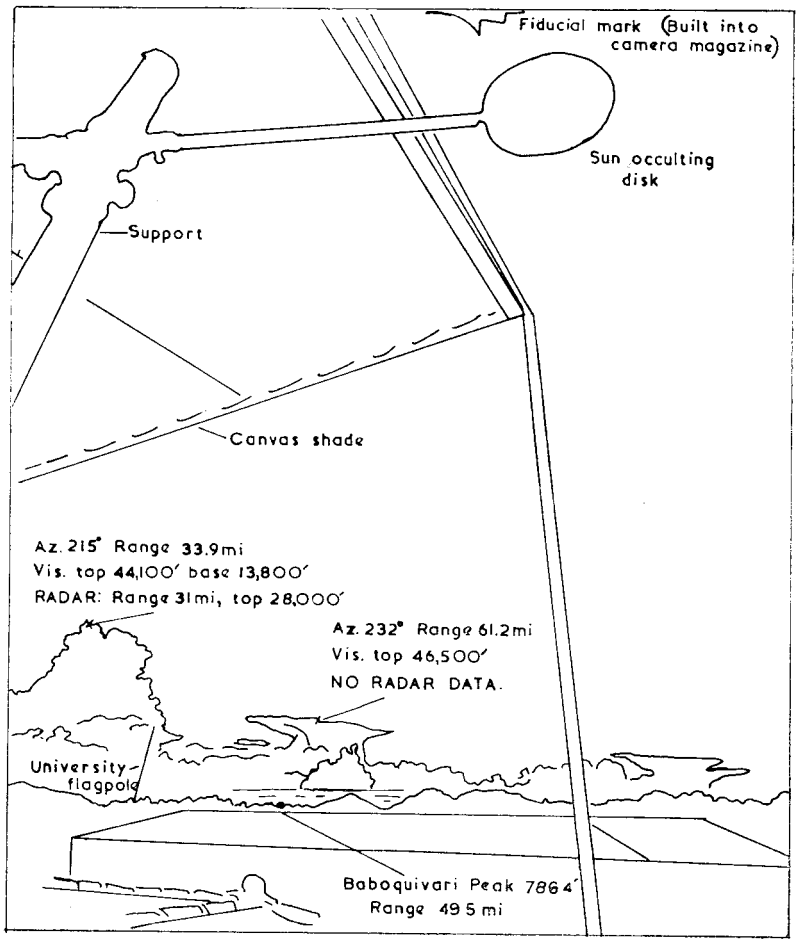
STEREO-PHOTOGRAPHY is a technique proving to be of great value in the cloud physics research of the Institute of Atmospheric Physics, University of Arizona. The photograph on page 249 is a specimen of a series taken with one of the stereo cameras, and besides having a pleasing composition of light and shade, shows two striking examples of cumulonimbus anvils.

A tracing of the photograph on which I have entered comments explaining various items of a prominent nature will be found on page 248. The photograph was taken from the Institute observatory, Tucson, on the roof of the Engineering Building on the University campus at 1432 MST, 14 July 1955. The camera was a surplus US Air Force K-17 aerial mapping camera with six-inch focal length. The negatives are 9 in. square and are of Kodak Aerographic film (low shrinkage type). The exposure was 1/50th sec at f:16, using a red filter to enhance cloud-sky contrast. The optic axis of the camera was elevated thirty degrees from the horizontal, hence verticals in the object field appear to radiate from a point (apical point) lying above the photo. The University flagpole at lower left, and the vertical pipe supporting the sun-tarp show this convergence of verticals.

On the tracing I have entered azimuth and range information for two of the prominent clouds (kindly provided by L. L. Sims of the Institute staff), and also radar-echo information for one of these. The radar echo data were obtained from the Institute's TPS-10 3 cm RHI radar. The range and height data for the clouds were obtained photogrammetrically from analysis of this photograph and of its mate (taken with another identical K-17 camera fired by remote control 1·3 mi south-east of the site of the published photograph). This stereo-photo system, which yields range and hence height-accuracy of about five per cent at 40 mi (better at shorter range, poorer at greater range) has been described in detail by A. R. Kassander and L. L. Sims in a paper entitled ' Cloud photography with ground-located K-17 cameras ', *Journal of Meteorology*, **14** (1957), pp. 43–49.

The cumulus at the left edge of the photograph, whose tops had not yet spread into the characteristic anvil shape at 1432 MST, is, as is true of virtually all large cumuli of the Arizona summer rainy season, an *orographic* cumulus and lies directly over the Sierrita Mountains which show dimly in the photo. The pair of anvils nearer the centre probably formed over the Baboquivari Mountains about 50 mi south-west of Tucson and have drifted westward if the

photogrammetric range may be trusted. Since the range accuracy falls to only about 10 per cent at 50–60 mi, it is possible that the calculated range is too high and that these clouds actually lay only slightly west of Baboquivari Peak, which may be seen in the photo at the point marked on the tracing.



Tracing of photograph on opposite page

British readers, accustomed to visual ranges rather less than those typical of an arid, sparsely inhabited area such as Arizona will perhaps be surprised to see Baboquivari Peak is still well within visual range despite its distance of almost 49·5 mi.

Finally, that the anvil tops built up to within 3,000 ft of the tropopause (49,600 ft and —73°C) on this day is also of passing interest.

Orographic cumulonimbus in Arizona

Photograph by Institute of Atmospheric Physics

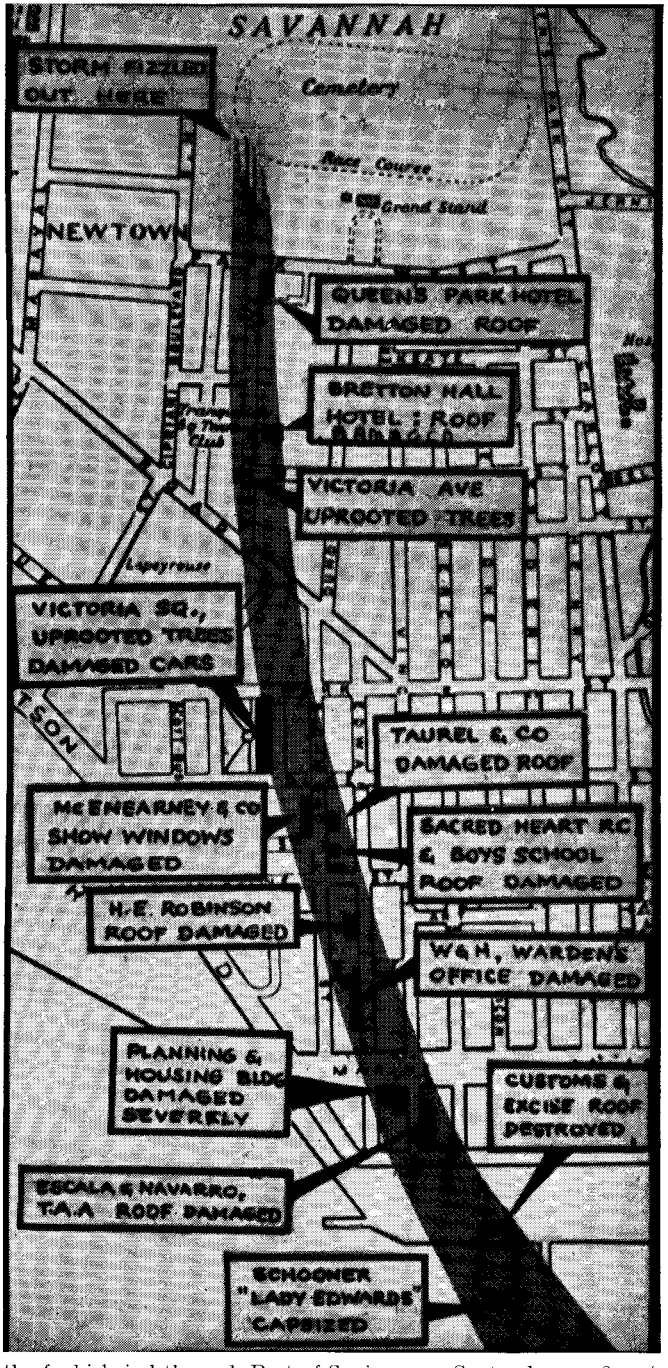


Fig. 2. Path of whirlwind through Port of Spain on 11 September 1958. (1″ = $\frac{1}{4}$ mile)
(*See article on page 253*)

Fig. 3. Whirlwind damage to wooden structure in Port of Spain on 11 September 1958

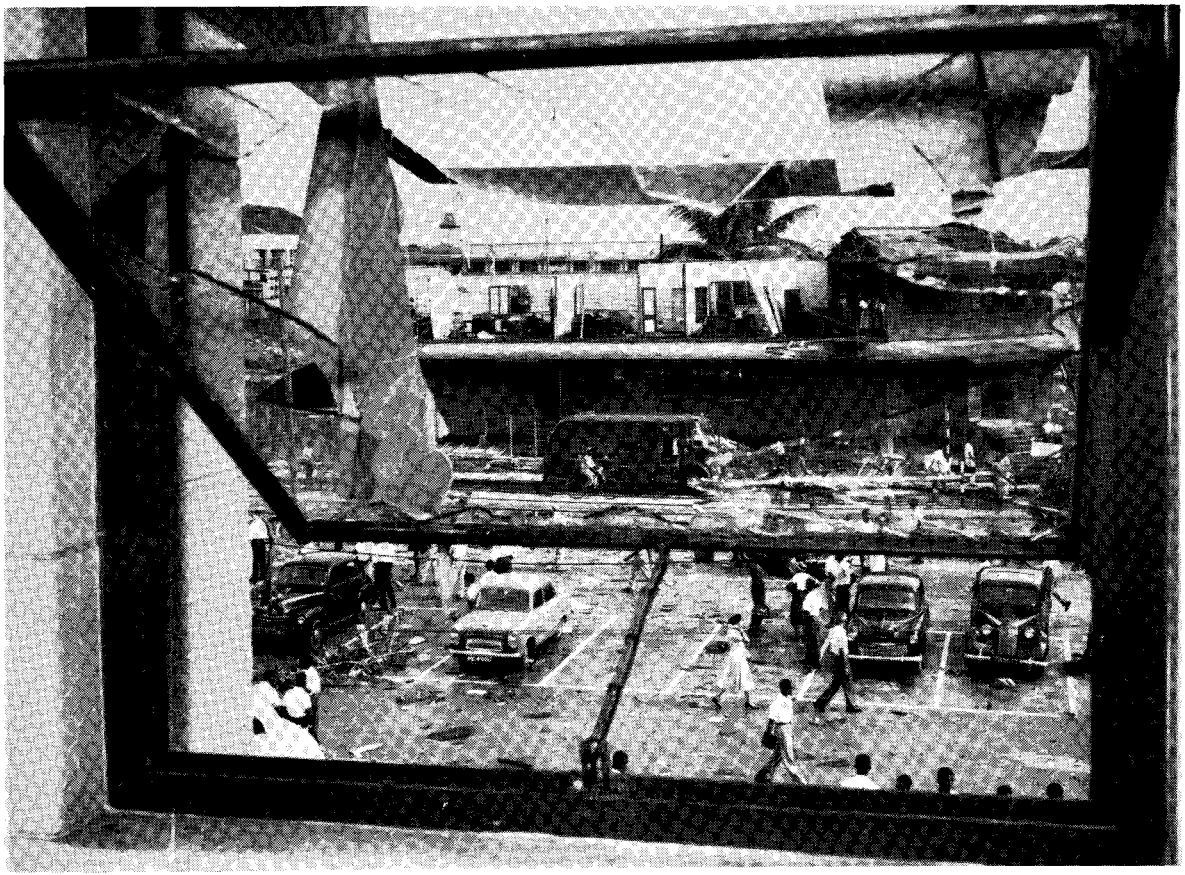


Fig. 4. General view of whirlwind damage in Marine Square, Port of Spain on 11 September 1958