Comments Following "Observations of two Colorado Thunderstorms by Means of a Zenith-Pointing Doppler Radar": A Wall Chart of a Severe Storm

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Battan (1980) discusses updrafts in thunderstorms and suggests that detailed observations might show that updrafts in "multicell' storms are similar in nature to those in "supercell" storms. In support of his arguments, I offer a radar wall chart of a severe Alberta hailstorm. This shows a succession of individual echo tops—a multicellular character, although the storm had characteristics commonly leading to the supercell classification.

The merits of a wall chart have been argued in Warner *et al.* (1980) in connection with a tropical cloud cluster. All available plan position indicator diagrams (PPI's) are laid out on a grid, with antenna elevation (height) increasing upward and time increasing to the right. The grid points are at a common horizontal location, with one PPI over each point. The PPI's have a common orientation, such that the direction of motion of the storm pattern is

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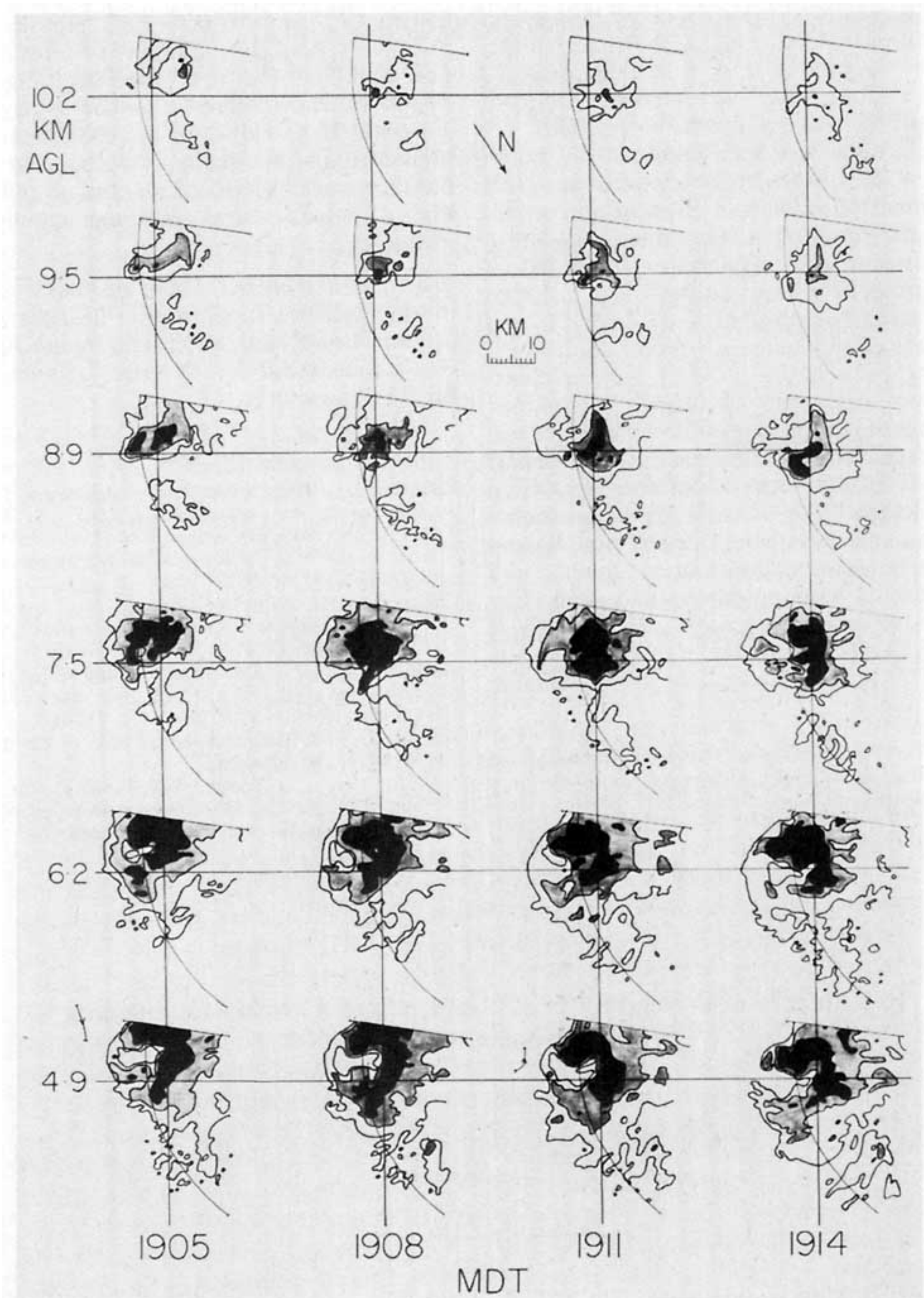

FIG. 1. 17 August 1972. Radar wall chart of an Alberta hailstorm. Abscissa: Mountain Daylight Time (MDT = GMT − 6 h). Ordinate: Antenna elevation, going upward through 7, 9, 11, 13, 14 to 15°. Corresponding heights above ground level at grid points are indicated at left. Additional fiducials are the line of azimuth 132° from the radar—at which advance of the film took place during photographic recording—and an arc at range 42 km. The PPI's are oriented on the chart so that the direction of motion of the storm pattern, from 213°, is down the page. An arrow shows the direction of north, and a distance scale is given. Reflectivity thresholds are in 10 dB steps of returned power. Threshold 1 corresponded to about 32.5 dBZ at range 42 km (30.6 dBZ at 34 km).

To the southeast (left) of two of the lowest PPI's shown are tracks of aircraft during seeding runs at 1906 and 1911 MDT. This treatment of flanking cumulus towers with silver iodide did not lead to any gross changes in the storm.

downward. This allows one to observe the motion of storm features by looking along the chart with an eye close to one side of it. A wall chart displays radar data in a complete and compact form. All structural features are exposed for inspection.

The Alberta radar has been described by Barge (1974). It has a half-power beamwidth of 1.15°. A small element of radar wall chart of an Alberta hailstorm is shown in Fig. 1. For 80 min, the storm showed a region of concentrated updrafts—a bounded weak echo region [or BWER (Chisholm, 1973)]. Reflectivities exceeded 56 dBZ for 4 h, and hail was produced of diameter > 5 cm. The BWER is visible at altitudes of 4.9 and 6.2 km in the chart. Its shape changed continuously. Above it, echo tops (updrafts) consisted of a series of individual pulses: Ordinary radar reflectivity data laid out in wall chart form can lead to inferences about updrafts which closely parallel the Doppler radar results presented by Battan. In common with the Doppler data, the top levels of Fig. 1 reveal updrafts of small scale and great variability. I have confirmed that such echo tops correspond to cloud towers (Warner, 1973; Warner *et al.*, 1980; Renick, 1971[1]).

Macklin *et al.* (1976) discussed the growth of large hailstones. They deduced that large hail grows in mid-levels, held aloft for many minutes in a concentrated updraft. This is a "supercell" characteristic. The storm shown here had a long-lived updraft and generated large hail—yet the chart demonstrates a fundamentally multicellular character. Can anyone produce a wall chart, of resolution comparable to Fig. 1, which shows a fundamentally different character?

[1] Renick, J. H., 1971: Radar reflectivity profiles of individual cells in a persistent multicellular Alberta hailstorm. *Preprints Seventh Conf. Severe Local Storms*, Kansas City, Amer. Meteor. Soc., 63–70.

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