

PICTURE OF THE MONTH

Thunderstorm Outflows: Different Perspectives over Arid and Mesic Terrain

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A few months ago in this journal, Charba (1974) presented detailed information on the internal structure of squall-line gust fronts. A characteristic aspect of large thunderstorms, these organized downdrafts of cold air result from the evaporative cooling effect of falling rain. As the dense cooled air descends and flows out the bottom of the huge cumulonimbus convection cell that produced it, it generally moves out in front of the major rain-producing sector, undercutting the lighter warmer air of the surrounding ambient environment. Over well vegetated mesic¹ terrain, this gravity or density current is usually invisible. Its presence is often betrayed, however, by a low-hanging roll cloud that forms just over the leading edge of the outflow (see Fig. 1, upper portion), where the warm environmental air is lifted to its condensation level by the advancing wave of heavier cold air. In drier arid areas, the cold air outflow is itself

often made visible by the great amount of surface dust and sand swept up by turbulence within the onrushing density current head, as in the lower portion of Fig. 1. Visually, the two situations present quite different appearances, yet they are produced by essentially one and the same phenomenon. Other examples of roll clouds are given by Livingston (1972) and Roberts (1972), while S. B. Idso *et al.* (1972) and C. W. Idso (1973) include other perspectives of squall-line duststorms.

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¹ Webster: Moderately moist (Ed.).

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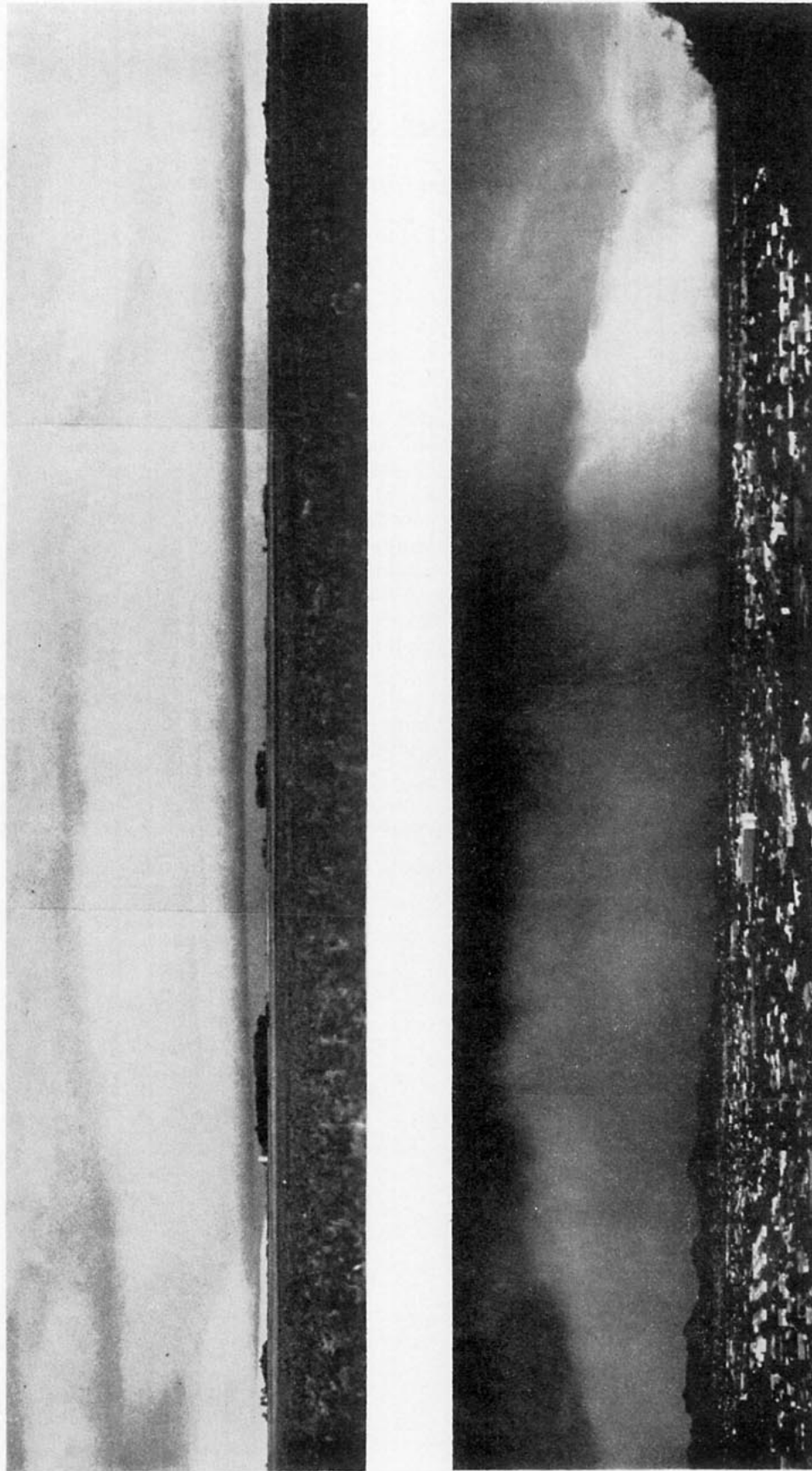


FIG. 1. Top: Over the fertile farmlands of southwestern Minnesota, a large rain and hail storm is producing a vigorous outflow of cold, dense air. As it rushes toward the observer, it lifts the lighter warmer air of the surrounding environment to its condensation level, whereupon a long roll cloud forms over the thunderstorm outflow's frontal boundary. (Photo by the author.) Bottom: Approaching Phoenix, Arizona, near sunset, a vast cloud of dust sweeps in from the surrounding arid regions. It is formed when the cold air outflow from a following thunderstorm churns up the loose material of the dry country-side and mixes it throughout the confines of the onrushing density current. (Photo by Con Keyes—EPA DOCUMENTA.)