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## DUST DEVILS ON MARS

P. Thomas, P. Gierasch, Laboratory for Planetary  
Studies, Cornell University

Large columns of dust have been discovered rising above plains on Mars. Between 1 and 6 kilometers in height and up to one kilometer in width, the storms are nevertheless such small features in images obtained by the NASA Viking orbiters that they have escaped notice until recently. The Viking orbiters photographed Mars between 1976 and 1980, and the thousands of pictures that were obtained are still being analyzed.

Mars is dry and dusty, and the storms are probably analogous to terrestrial dust devils, but their size indicates that they are more similar to tornadoes in intensity. They occur at locations where the soil has been strongly warmed by the sun, and where the surface is smooth and fine grained. These are the same conditions that favor dust devils on Earth. Warm gas from the lowest atmospheric layer converges and rises in a thin column, with intense swirl developing at the edge of the column. In desert regions on the Earth dust devils usually reach heights of only a few hundred meters and although they are interesting phenomena, the vortices are not of great importance.

On Mars the situation is different. In the absence of liquid water, wind erosion is a major geological force, and transport of dust and soil by wind is the major process that changes the face of the planet. The newly discovered storm systems may produce wind speeds in the same class with tornadoes, and can clearly lift large quantities of

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dust from the surface. Geologists have been puzzled by many long markings on the surface of Mars where layers of dust appear to have been scoured away, and it now seems likely that these markings are the tracks of dust vortices, much as the track of a tornado leaves a long narrow arc of destruction across the Earth.

Only a small fraction of the Viking images were obtained at sufficiently close range to reveal features like these, but the storms appear not to be rare in those that were taken near midday and at low latitudes, where the sun is high in the sky and surface heating is intense. In particular, there are vortices visible during four different days in the northern hemisphere summer. In one area a mosaic of images shows 97 vortices in a three day period. This represents a density of vortices of about one in each 900 square kilometers. Thus these vortices, or dust devils, may be important at some seasons in moving dust or starting other dust storms. The atmospheric conditions implied by the presence of dust devils will be useful in guiding further studies of the general characteristics of martian climate and weather.

Dust devil activity on Mars was first predicted in 1964 by J.A. Ryan (now at California State University, Fullerton). At that time it was thought that the global dust storms known to occur every few years on Mars might be caused by fields of small dust devils. It is now known from spacecraft observations that these huge storms are truly global phenomena, caused by planetary scale wind fields. Furthermore, the newly discovered vortices were observed in northern summer on Mars, whereas the global dust storms begin during southern summer.