THREE MARS YEARS OF SURFACE CONTRAST CHANGES SEEN AT THE MUTCH MEMORIAL STATION (VIKING LANDER 1). E. A. Guinness and R. E. Arvidson, Dept of Earth and Planet. Sci., Washington Univ., St. Louis, Missouri 63130.

Viking Lander 1 touched down on Mars on July 20, 1976 and Lander 2 touched down on September 5, 1976. Lander 2 was turned off in February, 1980 because of mechanical difficulties. However, Lander 1, since renamed the Mutch Memorial Station, was commanded to an automated state in March 1979. The station operates on a 37 sol cycle, with scheduled radio transmissions to Earth every 8, 8, 7, 7, and 7 sols. On these sols approximately 0.64 x 10**6 bits are transmitted to Earth, consisting of engineering data, an image of the surface or sky, and atmospheric temperature, pressure and wind velocity measurements. Observations have now been acquired through three full Martian years, providing a relatively long time period data base with which to understand the relationship between Martian weather systems, seasons, and the efficacy of redistribution of surface materials by winds.

Imaging observations during the first Mars year (669 sols) have been reported in detail elsewhere (1,2). Two global dust storms that peaked on sols 210-222 and 312-314, respectively, were major events of the first year (3). The opacity of the atmosphere over the Lander was tracked closely by imaging the sun and using Beer's Law to obtain optical depth. The optical depths at maximum opacity exceeded values of 5 to 8 (4). In addition to the global storms, a local storm passed over the site on sol 423 (5). The surface surrounding the landing site was discernably brighter and redder after the storms had cleared, probably because of deposition of a fine layer, perhaps micrometers in thickness, of dust. The site also appeared to be mantled with bright material in Viking Orbiter frames acquired after the dust storms. The presence of the dust was best indicated by comparing images acquired about a year apart so that incidence, emission, and phase angles were the same. These images were called repro images in Jones et al (1). Two sets of repro images have now been obtained over the second and third years and provide the most important data for interpreting surface contrast changes.

Both repro sets cover regions that were disturbed by sampler activities after the two global storms of the first year. These disturbed areas are evident in the frames acquired at the end of the first year as darker regions. By the end of the second year, however, these darker disturbed regions had lost most of their contrast relative to surrounding regions. This observation suggests an addition of a thin layer of bright dust, perhaps via dust storm fallout. It is interesting to note in this regard that Leovy (6) speculates, based on diurnal pressure variations, that the second winter might have been subject to a global dust storm, but one of lower intensity as compared to those that occurred during the first year. The visual impression gained by comparing frames acquired at the end of the second and third years is that the contrast had returned and the scene became darker sometime during the third winter. This impression can be qualified by examining brightness histograms for the two sets of images. The histograms show that the mean brightness value of the surface increased after the first year dust storms. However, since that time the mean value has decreased and the spread of the histogram has increased.

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Minimum brightness values, which occur in shadow regions, are indications of the magnitude of skylight, i.e., light scattered by atmospheric aerosols such as dust particles. The minumum brightness value is similar for each member of the two sets of repros suggesting that atmospheric opacities were similar and that contrast variation between the frames are due to real variations in the reflectance of surface materials.

The three years of repro images, histograms, and the statistical parameters suggest that: (a) the first year was dominated by deposition of a thin, bright dust layer, (b) the second year included some dust deposition, but more importantly, much of the contrast returned to the scene and (c) during the third year the scene became darker and the contrast increased again. If these observations are interpreted as deposition and removal of a thin layer of dust, then erosion dominated the second and third years. There is no indication in the data for a major dust storm activity and accompanying dust deposits during the third year. Thus, the third year may have escaped the global dust storms associated with dust deposition that certainly occurred during the first year and that may have occurred during the second year.

References: (1) Jones, K.L., et al. (1979) Science 204, 700-806. (2) Guinness, E.A., et al. (1982) J.G.R. 87, 10,051-10,058. (3) Ryan, J.A. and Henry, R.M. (1979) J.G.R. 84, 2821-2829. (4) Pollack, J.B., et al. (1979) J.G.R. 84, 2929-2945. (5) Ryan, J.A., et al. (1981) G.R.L. 8, 899-901. (6) Leovy, C.B. (1981) J. Atmos. Sci. 38, 30-39.