POLARIMETRIC ANALYSIS OF THE MARS' DUST STORMS AND CLOUDS. A. Dollfus, Observatoire de Paris, 92190 Meudon (FRANCE) and S. Ebisawa, Observatoire de la Recherche Planétaire, Tokyo (JAPAN).

The loading of the Mars atmosphere in dust and crystal particles was sensed by telescopic optical polarimetry.

The polarimetric analysis enables to detect and localize hazes of aerosols which are too faint to be observed by photometry or imaging. In addition, an unambiguous discrimination between the dust-clouds and the crystal hazes is provided by the nature of the polarization observed.

The planet-wide dust-storm display of 1971 and its precursor event were analysed in their location and time variation by mapping the degree of polarization of the light over the planetary disk, at the telescope, during the 9 months of the evolution. The two consecutive dust-storm events of 1973-1974 were followed polarimetrically in 5 wavelengths over 6 months.

The optical depth τ of the dust-layer can be deduced from the measurement of the apparent contrast C for surface features having a true contrast Co, by the equation :

$$\tau = -\frac{1}{2} \ln \frac{r \times C}{2\,C_o - \left[2 + (2+C_o)r\right]C}$$

in which r is the ratio of the luminance of a completely opaque dust cloud compared to the luminance of the light-hued martian surface areas, a value which was measured to be 1.15.

The time variation of the cloud opacity is globally described by the degree of anomalous polarization ΔP = P(observed) - P_o (undisturbed) produced in the UV at 0.352 µm. The evolution of the 1971 dust-storm is shown in the figure 1 with $\Delta P/P_o$ plotted versus time. The two storm of 1973-1974 are described by the plot of ΔP in the figure 2.

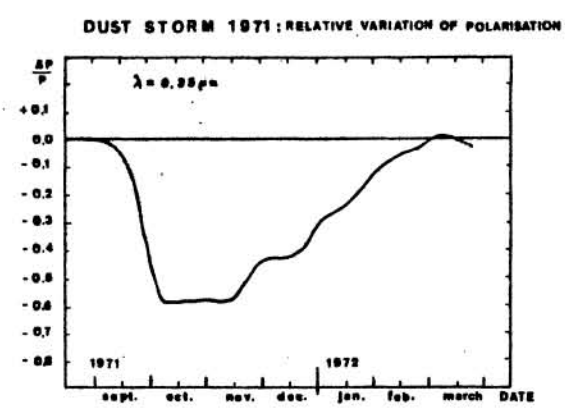

Fig. 1

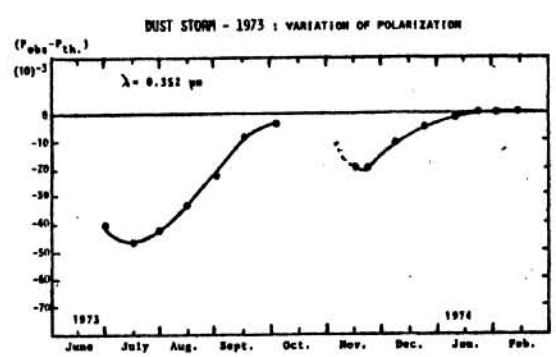

Fig. 2

POLARIMETRIC ANALYSIS OF MARS

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The regional localization of the atmospheric dust loading is given by mapping the polarization over the planetary disk. For example, the maps in five wavelengths are given in figure 3 for the period of maximum opacity of the second 1973-1974 dust event.

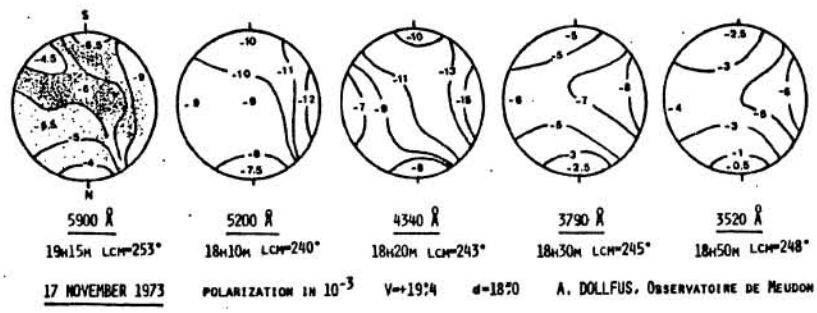

Fig. 3

In the absence of airborne dust, persistant morning and evening hazes of crystal particles are often detected. They remain localized along the limb or the terminator because they vaporize a few hours after sunrise or condense in the evening before sunset. During the period around perihelion passage where the major dust-storms preferentially occur, the large circular bassin Hellas Planitia remains often subjected to a permanent topographically localized dust-rising process.

From all the observations, a phase curve of the degree of polarization was derived for the dust-clouds at $\lambda = 0.59\ \mu m$ in the phase angle range from 1° to 46°. This curve is reproduced in figure 4 and is subjected to interpretation in terms of the dust-grains properties.

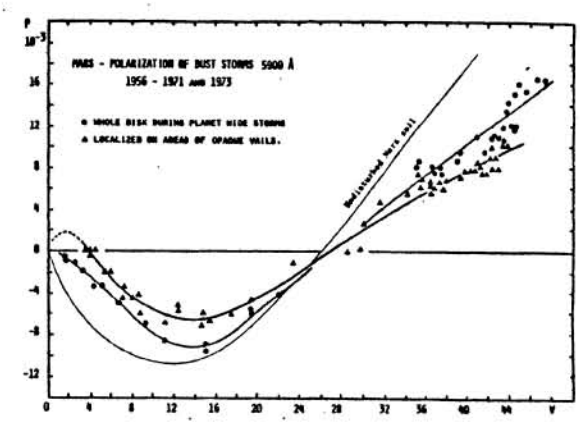

Fig. 4