TABLE IV

Extinction, absorption, and scattering coefficients for Saharan dust with Saharan particle-size distribution

Wavelength (microns)	*Refractive index*	*Extinction*	*Absorption*	*Scattering*	*f*
0·44	1·56 − 0·006*i*	1.63×10^{-3}	2.67×10^{-4}	1.36×10^{-3}	0·196
0·44	1·575 − 0·011*i*	1.63×10^{-3}	3.80×10^{-4}	1.25×10^{-3}	0·305
0·55	1·56 − 0·006*i*	1.65×10^{-3}	2.37×10^{-4}	1.41×10^{-3}	0·168
1·65	1·56 − 0·006*i*	1.70×10^{-3}	1.16×10^{-4}	1.58×10^{-3}	0·073
1·65	1·543 − 0·003*i*	1.70×10^{-3}	6.39×10^{-5}	1.63×10^{-3}	0·039

All values are absolute for a path length of 1 km and a particle density of 1 cm^{-3}.

TABLE V

Extinction, absorption, and scattering coefficients for volcanic dust with volcanic particle-size distributions

Date (1982)	*Wavelength*	*Extinction*	*Absorption*	*Scattering*	*f*
May 19	0·44	2.06×10^{-4}	8.34×10^{-6}	1.98×10^{-4}	0·042
May 19	0·55	2.08×10^{-4}	7.06×10^{-6}	2.01×10^{-4}	0·035
May 19	1·65	2.44×10^{-4}	2.77×10^{-6}	2.41×10^{-4}	0·012
Oct 23	0·44	1.10×10^{-3}	1.48×10^{-5}	1.08×10^{-3}	0·014
Oct 23	0·55	1.17×10^{-3}	1.21×10^{-5}	1.16×10^{-3}	0·010
Oct 23	1·65	6.11×10^{-4}	3.30×10^{-6}	6.08×10^{-4}	0·005

All values were computed using a refractive index $m = 1.53 - 0.001i$. All values are absolute for a path length of 1 km and a particle density of 1 cm^{-3}.

We conclude this article by considering volcanic dust clouds. The refractive index[10] for ash particles from the El Chichón volcano was $m = 1.53 - 0.001i$. Particle distribution functions for the El Chichón cloud were determined[11] on two dates, 1982 May 19 and October 23. We performed Mie calculations for both dates. On the assumption that the cloud consisted of dry ash particles with distributions equal to the measured functions we obtained the results in Table V; our values for each of the dates have been normalized to a particle density 1 cm^{-3}. The results show that the extinction and scattering are nearly grey in the visual region. The absorption has a modest dependence on the wavelength, and f is quite small: on 1982 October 23, $f = 0.01$ at 0·55 μm. Patterson[12] measured the imaginary part of the refractive index for Mount St. Helens ash, obtaining 0·002*i* at 0·55 μm and 0·003*i* at 0·44 μm. If we had used those values and the El Chichón particle distribution of 1982 October 23, then f would have been approximately 0·02 at 0·55 μm and 0·04 at 0·44 μm.

The previous paragraph applies to volcanic ash clouds. However, many volcanic clouds are believed to be composed of droplets of liquid sulphuric acid, of strength perhaps 80 per cent H_2SO_4 and 20 per cent H_2O. Some of the droplets may have condensed on ash particles, but most are thought[11] to have condensed from supersaturated vapour without any condensation nuclei. The particle distribution functions observed are interpreted as showing the evolution of the droplets through vapour accretion and coagulation. The absorption coefficient of sulphuric acid at visible wavelengths is very low, the refractive index[13] being roughly $1.43 - 10^{-8}i$. We therefore expect that scattering by a cloud of droplets will be similar to that for a cloud of ash particles with the same size distribution, but the absorption for liquid droplets (with or without