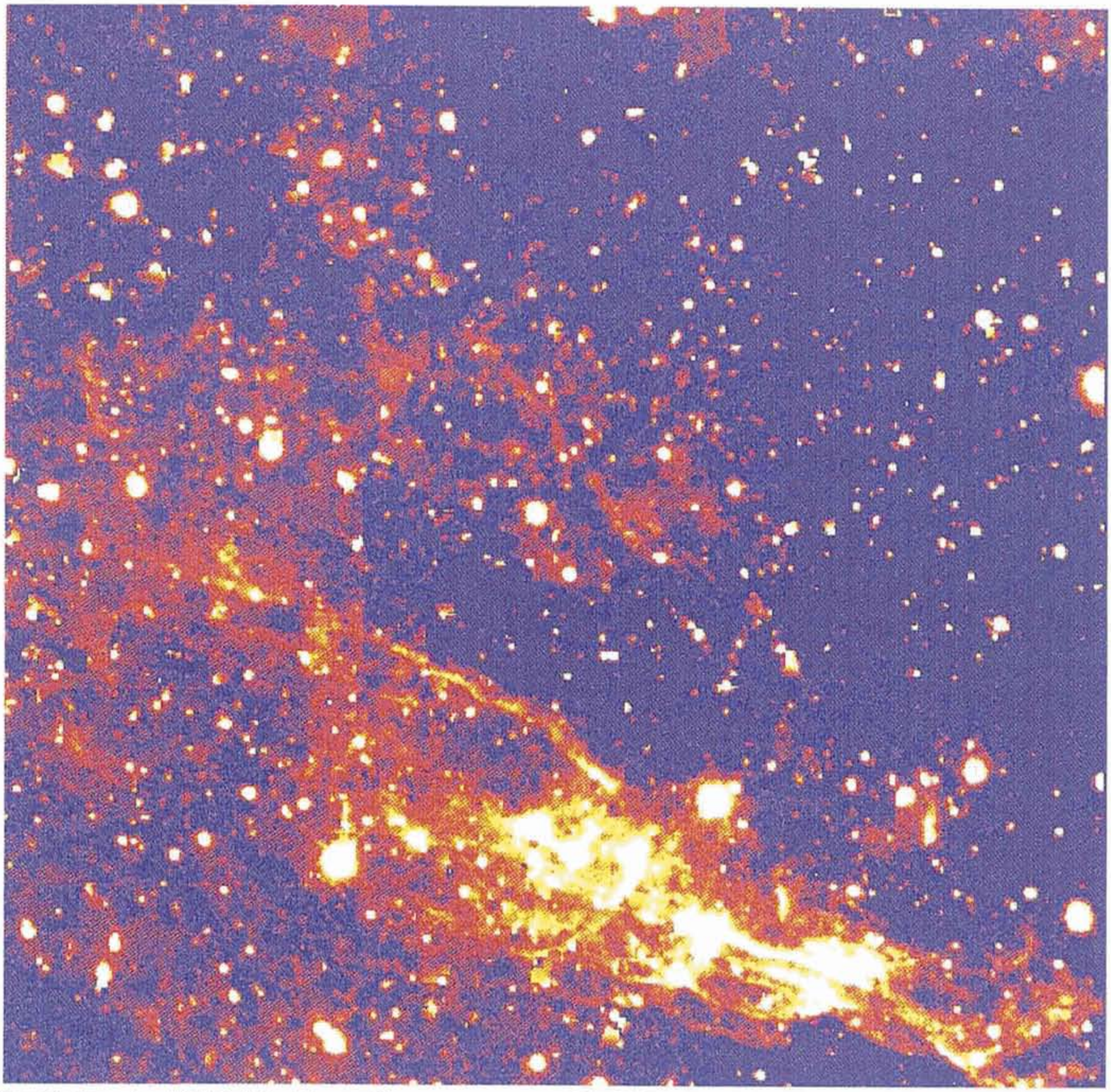

Figure 2: *Narrow band [FeII] (1.644 μm) image of the supernova remnant RCW 103. This is a mosaic of nine 4-min exposures combined to yield a field of 5×5′. N is at the top and E to the left. (Image processing; Reynier Peletier).*

The Influence of the Pinatubo Eruption on the Atmospheric Extinction at La Silla

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The atmospheric extinction is an important parameter for the reduction of photometric measurements. Besides daily, seasonal and other long-term variations (e.g. Rufener 1986) there are occasionally significant increases of the extinction coefficients due to major volcanic eruptions that induce large amounts of aerosols into the stratosphere at altitudes between 20 and 30 km. These aerosols are distributed over wide areas of the earth's surface by the stratospheric jet streams and subsequently influence astronomical observations even far away from the parent volcano. Examples of the influence of volcanic eruptions on the extinction have been given by Moreno and Stock (1964) (Mt. Agung, Bali, 1963) and Rufener (1986), Lockwood et al. (1984) (El Chichón, Mexico, 1982). Eruptions of a similar strength happen about 30 times per century, most of them in the geologically active zone around the Pacific Ocean.

On June 14/15, 1991 (JD 2448422), Mt. Pinatubo on the island of Luzon in

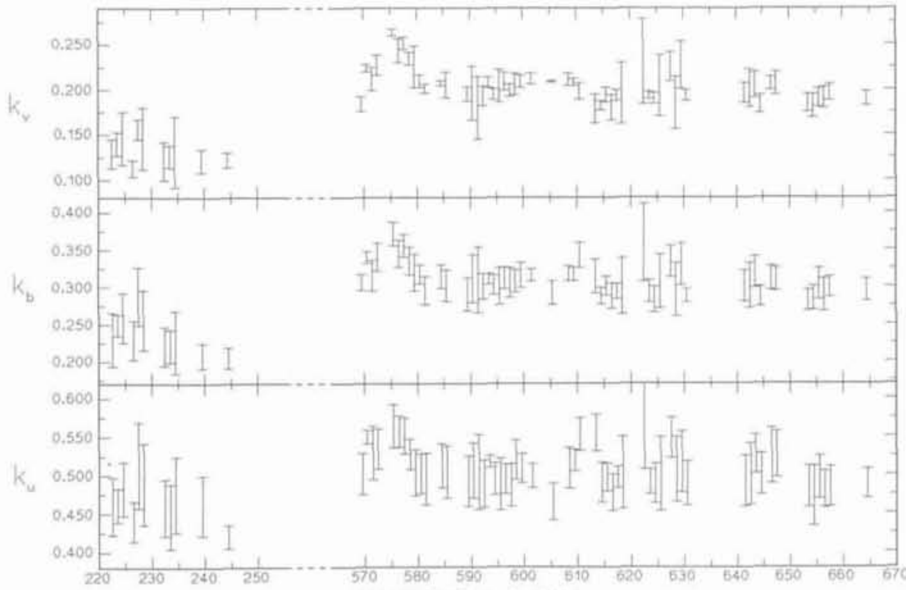

Figure 1: *Extinction variations.*

the Phillipines ($\varphi = +15°$, $\lambda = +120°$) erupted violently, throwing out in total 3–5 km^3 of dense rock (e.g. Bernard et al. 1991). it was amongst the largest eruptions of this century. The height of the Plinian column reached nearly 30 km on June 15, and ash falls were observed as far as Thailand and Singapore more than 2000 km away. The ejected SO_2 has been converted in the stratosphere into H_2SO_4 during the first two weeks and was distributed in a 2.5 km thick layer in about 18 km height (Kerola and Timmermann 1992).

As a part of an extensive photometric programme in the LMC we measured two long consecutive time series of UBV extinction coefficients (k_u, k_b, k_v) with the Bochum 61-cm Telescope at La Silla: one shorter series between November 26 and December 18, 1990, before the Pinatubo eruption, and a longer one from November 8, 1991 to February 13, 1992, after the eruption (Gochermann et al. 1992). This provides the opportunity to compare the atmospheric extinction at La Silla with and without the entry of volcanic aerosols into the atmosphere.

Figure 1 shows the variations of the coefficients k_u, k_b and k_v for both time intervals. The 1990 data fit closely to the standard extinction coefficients for an average photometric night sky at La Silla found from measurements at the Bochum telescope since 1969. There is, however, an obvious increase of the extinction in all three bandpasses in the 1991/92 data with respect to 1990. The typical extinction coefficients and the differences between the time averaged coefficients of 1990 and 1991/92 are listed in Table 1. Within the errors the discontinuities compare quite reasonably to the findings of Rufener (1986) concerning the El Chichón eruption in March/April 1982. Another confirmation comes from extinction measurements with the 20″ telescope at SAAO Sutherland in South Africa, also made between November 1991 and February 1992 (Kilkenny 1992). From these data we find the following Δk_{20} with respect to the standard extinction values: $\Delta k_u = 0.08$ mag AM^{-1}, $\Delta k_b = 0.07$ mag AM^{-1}, $\Delta k_v = 0.06$ mag AM^{-1}. At the Kitt Peak Observatory on the northern hemisphere Landolt (1991) found $\Delta k_u = 0.10$ mag AM^{-1}, $\Delta k_b = 0.12$ mag AM^{-1}, $\Delta k_v = 0.08$ mag AM^{-1}.

The additional extinction caused by the Pinatubo eruption seems to be wavelength independend within the errors at La Silla as well as at both other observatories. This relation yields a particle size of 0.35 μm calculated from the Mie theory (Kerola and Timmermann 1992) agreeing well with the particle size proposed by Rufener (1986) for El Chichón (cf. Bernard et al. 1991, Pallister et al. 1992).

No significant decrease in the high level extinction during the nearly 100 days of our 1991/92 campaign points towards an end of the volcanic contamination of the atmosphere. A possible decrease should be less than 0.01 mag AM^{-1} in 100 days for all bandpasses if the clear bump around November 13, 1991 (JD 2448574) is omitted. Seasonal effects as discovered by Rufener (1986) could, however, superpose a long-term decrease during our comparably short observation run. Furthermore, Rufener has shown that the removal of small volcanic dust particles from the stratosphere will probably take 10 to 20 years.

Our measurements reveal again that stratospheric volcanic aerosols substantially influence the extinction at all optical photometric bandpasses. The average extinction coefficients are increased by values of 0.05 to 0.08 mag AM^{-1} remaining on this high level for more than 100 days, probably even for several years. For a so far indefinite time, photometric measurements – at least at southern hemisphere observatories – should therefore not be corrected using the standard extinction coefficients. This is even more important as fluctuations (probably due to inhomogeneities in the volcanic dust layer) like the bump in November 1991 may increase the extinction considerably on a timescale of a few days. Peak values of $k_v \approx 0.3$ mag AM^{-1}, $k_b \approx 0.45$ mag AM^{-1} and $k_u \approx 0.6$ mag AM^{-1} can be reached in such bumps.

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Table 1: *UBV extinction coefficients at La Silla*

	Mean Extinction Coeff./mag AM^{-1}			Pinatubo 1991	El Chichón 1982[1]
Filter	Standard	1990	1991/92	$\Delta k_{\lambda,0}$/mag AM^{-1}	$\Delta k_{\lambda,0}$/mag AM^{-1}
U	0.459	0.457±0.022	0.514±0.028	0.057±0.036	0.070
B	0.212	0.232±0.019	0.314±0.025	0.082±0.031	0.055
V	0.125	0.130±0.014	0.208±0.023	0.078±0.027	0.048

[1] Rufener (1986)