A Distant View of La Silla

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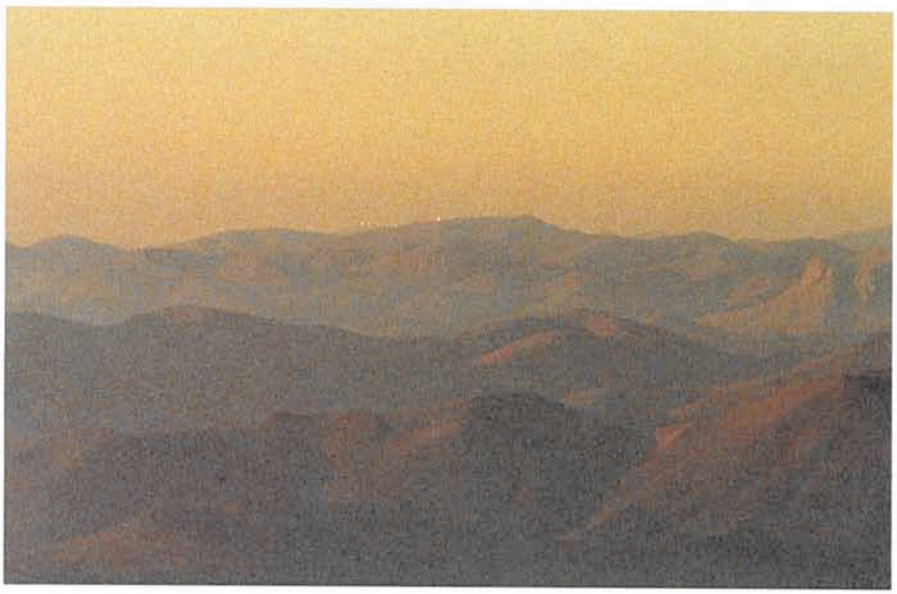
The domes and related structures on La Silla are prominent features of the Atacama landscape as seen for many kilometres, and would be for many more were it not for the intervening Andean foothills. Under proper conditions, they may be seen (with the unaided eye) for even greater distances. Possibly the most distant normally occupied vantage point (barring a *SPOT* image) is from the Inter-American Observatory on Cerro Tololo, about 103 km south-southwest of La Silla. For month-long periods twice a year (when the sun's declination is about −10°) the domes at ESO are prominent shortly before sunset, as shown in the photograph taken in mid-October of 1988. Five structures are prominent with another two visible on the original print. Part of La Silla is hidden behind a foreground mountain, identified in the *Mapa Fisico de Chile* as Cerro El Pozo (east of Almirante Latorre); its presence accounts for the greater difficulty of locating Cerro Tololo from La Silla, even using binoculars.



It is of some interest to examine the circumstances that make the ESO domes visible over such distances. Key clues are the time at which they may be seen, from about 15 to 10 minutes before apparent sunset at CTIO, and the 4–5-minute period over which they are seen. Such a short timespan suggests a specular or semi-specular reflection off a surface which is flat in at least one dimension. Reflections from the domes themselves are thus ruled out, since the brightness of such a reflection would change very little over most of the day. Reflections from the flat walls of structures such as the Administration Building would be prominent indeed, but could not be seen over a range of solar declination of more than 0.5 degree, in conflict with the observed month-long range of visibility. The cylindrical sides of many of the domes are the most likely source of short-lived reflections, but additional checks are needed to make sure their properties are fully consistent with the time of appearance and duration of the observed reflections.

Since CTIO and ESO are at comparable elevations, to a good approximation the condition for reflection off a vertical surface is that the sun should have an apparent zenith distance of 90 degrees at La Silla. This astronomical condition can be tested from the known situation of the observatories and the known time of visibility relative to the apparent sunset at Tololo. First, how long before apparent sunset at La Silla is the apparent sun horizontal, and second how much difference in the times of sunset is there between La Silla and Tololo?

The dip of the horizon from the altitude of ESO is about 1.6 degrees, and at this time of year the sun requires about 435 seconds to traverse this vertical distance solely from geometrical considerations. An additional time between the sun at 90 degrees zenith distance and apparent sunset is produced by atmospheric refraction, which produces a deceleration of the apparent sun amounting to about 160 seconds for typical meteorological conditions; most of the refraction seen at sunset arises in the last few degrees above the horizon. Finally, apparent sunset at Cerro Tololo is 80 seconds later than at La Silla due to the small longitude difference. Adding these up, the horizontal-sun condition is satisfied from about 13 to 11 minutes before apparent sunset on Cerro Tololo, in good agreement with what we actually see. The reflections are bright for somewhat longer than the 2 minutes expected from the sun's angular size and a perfectly smooth surface, presumably due to the roughness of the corrugated metal used for the cylindrical sections of some of the telescope buildings. (Unfortunately for sunset watchers on La Silla, most of the domes at Cerro Tololo have rectangular base structures and thus any reflections will be visible for only a couple of days each year; furthermore they are at unfavourable orientations for catching sunlight as seen from almost due north).

Examining the photograph once more, the 3.6-m dome is the brightest (far right), as befits the large size of the support building. One can also identify (left to right) the small cluster of domes dominated by the Dutch 90-cm, the ESO 1.5-m, the ESO 1.0-m and Danish 1.5-m (both rather faint), and the ESO/MPI 2.2-m. It is fitting that visibility phenomena of this kind may be understood with some of the astronomical observer's most basic methods.

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