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Astronomy at 6000 m!?

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High-altitude Observatories

The astronomer and the mountain have always been good friends, the first knowing well that the higher he mounts on the second, the clearer and the more transparent is the sky he can study . . .

During the past century, high altitude observatories have sprung up in various places of the globe. They are real eagles' nests, the objects of cult and dreams of amateur astronomers: Pic du Midi (2870 m above sea level), Gornegrat (3100 m), Jungfraujoch (3580 m) and recently the famous Mauna Kea which now has the world record at 4210 m elevation.

As a science journalist and amateur astronomer, I was impressed during my visit to La Silla last year by the efforts which ESO currently invests in the VLT site selection. At that time I learned that at La Silla (2400 m) and Cerro Paranal (2660 m), and also at even higher places, very advanced meteorological research has been going on in the hope of finding a site with ideal sky conditions.

At that time a crazy idea germinated in my amateur astronomer's mind, envious of the large telescope observatories: why not try to install under the Andean sky a temporary astronomical observing station at extremely high altitude, indeed the "highest observatory in the world"?

This idea became reality this February, thanks to the studies undertaken by ESO in the Atacama desert and the experience by La Silla Andinist specialists Christian Gouiffes and Bertrand Kohler. Together with seven amateur astronomer friends and four French and Chilean high mountain guides, I was able to transport an equatorially mounted telescope through the Atacama desert to the slopes of the Ojos del Salado volcano, whose peak is the highest point in Chile at almost 7000 m altitude.

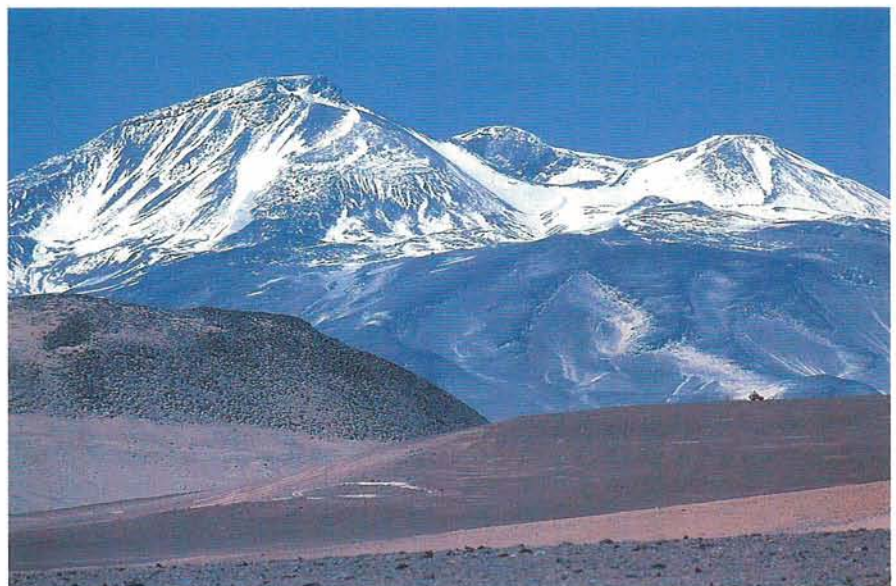


Figure 1: Nevado Ojos del Salado in the Atacama is the tallest volcano in the world and the second highest peak in the Americas.



Figure 2: "The highest observatory in the world". At the second camp, 5200 metres above sea level, all members of the team gather proudly behind the telescope.



Figure 3: *The Small Magellanic Cloud, observed from 5200 m altitude. Taken with a piggyback 135-mm f/2.8 lens during a 10-min exposure. This photo was obtained by Jean Vichard; the others accompanying this article are by the author.*

Our goal was multiple: first of all to try to determine whether the sky at very high altitude, visually spoken, is more beautiful and allows deeper limiting magnitudes than for instance the sky at La Silla. We were also interested in trying to profit from the natural "hypersensitization" conditions in the high altitude desert, that is the intense cold and virtually zero moisture content of the thin air. Finally we wanted to obtain sky photographs with our telescope, a Celestron 8; it is a veritable small, transportable observatory in which the electrical equatorial motion is fed by a battery which in turn is charged by solar cells. It also has a control system for the exposures and the guiding, interference filters, etc.

The Conditions Above 6000 m

Altogether, the expedition lasted three weeks and we installed the observatory at increasing altitudes in order to acclimatize ourselves to the thin air at 4500 m, 5200 m and finally 5800 m.

Unfortunately, our rather ambitious programme could not be entirely fulfilled. The climatic conditions in the high Cordillera are clearly less optimal than in other areas of the Atacama desert. In particular, the wind, the thunderstorms and finally the heavy snowfalls severely perturbed our expedition. Quite apart from the purely meteorological problems, the altitude in itself is quite hostile to the human organism. Above approximately 4500 m, it is difficult to reconcile an intellectual and technical activity (optical alignment, pointing of the telescope, making exposures, etc.) with simple survival, that is the fight against fa-

tigue and also the various symptoms of high altitude sickness, which has been known to cause death in severe cases.

What concerns the sky over Atacama . . . Having at the end of our expedition attempted to ascend Ojos del Salado, we were able to admire it with the naked eye from altitudes between 6000 and 6600 m. In the *daytime* it appeared to me that the sky at high altitude possessed an extraordinary clarity and transparency, much more so than at any other astronomical site in the world, including La Silla and Hawaii. However, during the *night* it appeared less good than at La Silla. It should be

noted, though, that according to medical specialists, the altitude degrades the visual acuity.

Finally, after having experienced the fascinating but hostile environment of the high altitude desert, our small group was very happy to sample the joys of the regained civilization: the La Silla oasis and the warm welcome which we received from the entire ESO staff!

For us, who took part in this adventure, one conclusion was obvious: with the exception of possible, short-term expeditions dedicated to extremely specialized studies, it is not possible to seriously envisage the permanent installation of an astronomical observatory above 4000–4500 m altitude. Mankind (even astronomers!) has not been made to live at that extremity of our planet . . .

Acknowledgements

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Figure 4: *The ultimate photo, obtained at 5800 m altitude during a 90-min exposure. It shows the Milky Way and the Magellanic Clouds turning around the celestial South Pole, just above the summit of Nevado Ojos del Salado. Two things that this picture cannot show are the intense cold and the lack of oxygen at this altitude . . .*