

This month – March 1999 – sees the 90th anniversary of the first expedition in northern Chile to search for a good site for an astronomical observatory: the Curtis expedition.

Halfway from La Silla to Paranal – in 1909

H.W. DUERBECK^{1,3}, D.E. OSTERBROCK², L.H. BARRERA S.³ and R. LEIVA G.⁴

¹Brussels Free University (VUB), Belgium; ²Lick Observatory, University of California, Santa Cruz, California, USA;

³Instituto de Astronomía, UC del Norte, Antofagasta, Chile;

⁴Facultad de Ciencias, Universidad de Atacama, Copiapó, Chile

1. Prelude

Chile's national observatory was founded in 1852, with instruments left by the United States Naval Astronomical Expedition (1849–1851). Its head, Lt. James M. Gilliss, had set up its 16.5-cm refractor and a meridian circle on Cerro Santa Lucia, a hill in the middle of Santiago, to measure positions of Venus, Mars and southern stars, to improve the solar parallax (Gilliss 1855, Keenan et al. 1985).

A German scientist, Carl (Carlos) W. Moesta, became the first director of the new Observatorio Nacional, which had by then moved to downtown Santiago. He held this position until 1865 when he returned to Europe to become the Chilean consul in Dresden. His successor as director was his former assistant, José Vergara. After Vergara died in 1889, his assistant, Hubert (Huber) A. Obrecht, an Alsatian trained at the Paris Observatory, became director. He drifted more and more into teaching, and did little observing. Then Pedro Montt, a new president of Chile who was personally interested in astronomy, appointed the German Friedrich (Federico) W. Ristenpart as the new director, charged with reorganising the observatory. He took over at the end of 1908.

Meanwhile, in 1903, Lick Observatory established an observing station on Cerro San Cristobal, then near the outskirts of Santiago (Osterbrock et al. 1988). At Mount Hamilton, the new Lick director, William W. Campbell, had already begun a pioneering radial-velocity programme, which he realised required all-sky coverage. From Darius O. Mills, a California and New York banker, he obtained the funds to build a 0.94-m reflecting telescope and spectrograph, optimised for this programme, and to erect it in the southern hemisphere. This telescope remained in operation under Lick auspices until 1928, and more than ten thousand radial-velocity spectrograms were obtained with the Mills spectrograph there (Osterbrock 1984). A report on the more recent state of the San Cristobal

Observatory can be found in a previous *Messenger* article (Sterken and Vogt 1982).

The first Lick astronomers to go to Chile were William H. Wright and his assistant, Harold K. Palmer. Heber D. Curtis, a professor of Greek and Latin turned astronomer, and Campbell's assistant at Lick Observatory since 1902, replaced Wright in charge of the southern station in 1906. He was to stay in Chile for three years. George F. Paddock, a University of Virginia graduate student, succeeded Palmer, also in 1906. During Curtis's term in Chile, Ristenpart took over as director of the National Observatory. In 1909 he offered Curtis a position as head of "astro-

physics" (spectroscopy), but the American astronomer decided to return to Lick instead.

Just as Curtis was ending his term in Chile, Ristenpart's two new assistants, Richard Prager and Walter Zurhellen, arrived from Germany. They had been appointed to head the "Section of Calculations" and the "Section of Astrophotography", respectively. (After Curtis declined it, the "Astrophysics" position was never filled in Ristenpart's time.) Joseph H. Moore, sent down from Lick to relieve Curtis, reached Santiago a few weeks later; a rare photograph documents this early meeting of North American and European astronomers on Chilean soil (Fig. 1).



Figure 1: Lick and Observatorio Nacional astronomers at Lick Southern Hemisphere Station, June 1909. Standing, left to right, W. Zurhellen, F. W. Ristenpart, R. Prager; seated, H.D. Curtis, J.H. Moore, G.F. Paddock (Shane Archives).



Figure 2: Section of a map of the region of Copiapó, issued in 1909, at the time of Curtis's trip. The railway Caldera–Copiapó–Puquios runs from west to east. The north-south railroad system “Longitudinal”, also depicted here, was under construction. Curtis's favourite site is in the upper right corner of the map, in the Llano de Varas (marked Llano), next to the railroad station “Carrera Pinto” (see Fig. 4). Of the many mines shown, only *Dulcinea* is still operating.

The fate of the European astronomers in the picture was a sad one. In 1912 Zuhellen resigned because of personal problems with his director. He joined the staff of Berlin-Babelsberg Observatory, only to be interned while on a solar eclipse expedition to Russia in 1914, just after the outbreak of World War I. Released a year later, he was killed in action in France in 1916. Ristenpart encountered more and more obstacles with the Chilean authorities. He knew his appointment would not be renewed, and became so frustrated that he committed suicide in 1913. The National Observatory, which under his directorship had moved from the downtown Quinta Normal to the southern suburb of Lo Espejo, remained there till the early 1950s, when it was moved to its present location on Cerro Calán. Prager, Ristenpart's faithful assistant, also went to Berlin-Babelsberg, where he remained for twenty-five years, preparing and editing a monumental variable-star bibliography. In the Nazi era he was forced to leave Germany and emigrated to the United States, where he found a position at Harvard College Observatory. He died there in 1945.

Curtis went back to Lick in 1909 to take charge of the 0.9-m Crossley reflector, to continue the survey of nebulae that James E. Keeler had begun. Curtis came to realise, from the direct photographs he obtained with it, that the spiral “nebulae” were really “island universes”, or galaxies as we say, composed of stars, real nebulae, and “occluding matter” (dust), responsible for the dark lanes seen especially well in edge-on spirals like NGC 891 and in our Milky Way. He left Lick Observatory in 1920 to become director

of Allegheny Observatory at the University of Pittsburgh. Ten years later he moved on to the University of Michigan, his alma mater, as director of its observatory (McMath 1942; Aitken 1943). Curtis is best known today as a participant in the “Great Debate” with Harlow Shapley, which took place at a meeting of the National Academy of Sciences in 1920. While Shapley was closer to right about the true size of the Milky Way, Curtis was correct in his concept of the Milky Way as a galaxy, and of the nature of spiral “nebulae”.

2. The Curtis Report

Before deciding to locate the Lick station in Santiago, Campbell had considered possible sites in Australia, but the available climatic records and all the reports he obtained from astronomers indicated that Chile would be better for observing. He had decided to erect the Lick station in or near Santiago, where supplies, living quarters, food, and other necessities were readily available. In the early 1900s light pollution was not yet much of a problem, particularly with the slow photographic plates of those days which made spectrograms of sixth-magnitude stars the limit of convenient exposure times. But Campbell told Wright and then Curtis to collect information from travelling businessmen, mining engineers, and ranch owners on conditions elsewhere in the country where more clear weather might be expected. All three of them were well aware of the climatic analogies between California and Chile, both with high mountain ranges near their Pacific coasts. Wright, within a few weeks

of his arrival, was already writing Campbell about the “land of little rains” around Copiapó to the north, more or less equivalent to San Diego and Baja California in the northern hemisphere. Curtis, who became well integrated into the Chilean community, learned much more about these regions and Campbell directed him to make a brief reconnaissance of the most promising area before returning to Lick. At that time, Campbell was considering sending visual double-star observer Robert G. Aitken to the southern hemisphere also, with a 0.6-m refractor, to complete his survey of the entire sky. Curtis's 22-page typed report on his hurried site survey, illustrated with photographs he took, still exists in the Mary Lea Shane Archives of the Lick Observatory.

It is interesting to compare Curtis's requirements with those of today. Of course, a good site had to be in a region with a clear climate, uninfluenced by the coastal fog and clouds. It had to have a good seeing and be somewhat shielded from bad storms. But it also had to be reasonably accessible in a period when cars were rare and airlines unknown. And it needed to have a supply of water, living supplies, and electricity. Curtis travelled by ship from Valparaíso to Caldera, the port of Copiapó. There he took the first Chilean railway, connecting Caldera, Copiapó, and several mining stations further inland (Fig. 2). These stations to the east of Copiapó were higher and beyond the range of the coastal fog. Curtis's first choice as a potential observatory location was a little hill (cerro) in the Varas Plain (Llano de Varas), easily accessible on foot or horseback from the nearest station, sur-

rounded by higher mountains. To our knowledge, this hill has no name; we refer to it as "Cerrito Curtis" in the following.

In his report to Campbell, Curtis (1909) wrote:

Very laudatory reports were given me of the great clearness at Púquios, the northern terminus [of the railway], 143 kilometers from Caldera. I went up there on April 8 [1909]; the trip takes about four hours [from Copiapó] and is up through a barren valley-cañon all the way. I remained there or in the vicinity for three days, till the next train back.

Púquios is the center for a number of copper mines; is a little town of perhaps four hundred inhabitants. It lies in a sandy plain not more than a mile in width and with precipitous mountains rising two or three thousand feet higher to N. and S. Accommodations were very primitive; though this region is almost destitute of flora and fauna large involuntary entomological collections were made. Púquios looks much like some Arizona adobe town stripped of its sage brush surroundings and with higher and more ragged mountains about. It has some small stores, a butcher shop, small drug store and a water supply piped down from the Llano de Varas. [...]

On the 9th I left for the smelter of the Copiapó Mining Co., known here as La Compañía Inglesa de Minas de Copiapó. It is distant about three miles by road from Púquios. The road is quite good, used constantly for mining freight, and an automobile ought not to have any trouble with it. The road passes up through a very narrow cañon to the northeast of the town. [...] Near the end of the Cañon are the mines and houses of la Descubridora. Farther on the cañon debouches into the southern end of the great Llano de Varas, a fine plain some ten miles long by three broad, sloping gently toward the west. It averages about 5200 (by barometer) feet above the sea [...]

The general effect is that of a shallow basin. Mountains not much higher, generally rounded and not precipitous. Some coarse herbage grows in the S. E. corner [. .]

In the southern end of this plain water is obtained for the mines and for the town of Púquios, probably by seepage from the distant Cordilleras [...] At Posada del Gallo good sweet water is obtained from wells. Mr. W. L. Stevens, M. I. T., is in charge of the smelter and lives here with his family; he uses condensed water, and would furnish same to a station, for drinking purposes only. [...] The Cerro is a small elliptical hill about 200 feet above the plain and 250 above the smelter; it is perhaps 800 feet long and would perhaps furnish a site with sufficient atmospheric drainage [see photograph, Fig. 3]. Water would have to be brought from Posada del Gallo or from the smelter. All the mines, etc., of this plain are in telephonic communication with Púquios, Copiapó and Caldera, and one telephone line passes almost through Posada del Gallo. The lit-



Figure 3: Cerrito Curtis, seen from the east. H.D. Curtis photographed this small, dark hill (to the right of the middle of the picture) and recommended it as a potential observatory site (Shane Archives).

tle Cerro is about one mile distant from Posada del Gallo and from the other railroad now in construction, which will reach this spot in five or six months more; this line is planned as a link in the proposed longitudinal railway system [...] Eventually freight can be brought more easily to the western edge of this plain from Copiapó than via Púquios.

The horizon from the Cerro is good, maybe 5° is cut off at one point at the south. The smelter has a dynamo and might be willing to furnish a small amount of electricity at night.

The night fogs of Copiapó almost never reach here, according to all reports. Not a cloud was visible day or night during my stay here and at Púquios; on all these days fog or cloud was present at Copiapó, coming in at twelve or one o'clock at night; on the day I was at the Llano the clouds were so thick at Copiapó that rain was hoped for and the clouds did not clear away till noon. Wind is generally light at night, sometimes brisk in the days, and almost always either northwest or southeast. In eight months residence Mr. Stevens states that he has on about three occasions seen the sky thickly overcast with clouds; the impression of all with whom I talked is that the overwhelming majority of all days and nights are perfectly clear [. .]. [I] am inclined to prophecy that a site in the southern end of the Llano de Varas would average 300 clear nights per year.

[. .] Best location, in my opinion, [is] the small cerro [. .]. Roads across the plain to the railroad at the west or to tap present road from smelter at El Ingenio would need only the scratching away of a few loose rocks, as the hard plane can be traversed in any direction. A road up the cerro not long nor hard to make, as the slope is easy. Good horizons, and sufficiently far from smelter so as not to be disturbed by its smoke. About one mile from wells of sweet water; for a perma-

nent station might pay to drive a well, as there is evidently water under this plain. About one mile from the railroad from Chulo, so that it would be easier to use this road than to bring in supplies via Púquios [...]

The sky at the Llano impressed me as very blue and pure; no whitening toward the horizon. The night sky at Copiapó about as usual; at Púquios very transparent and clear.

Three of us used Curtis's description and maps to identify it on the spot in 1997. About Púquios, the booming mining town of 1909, the modern tourist guide says: "at km 59 and 60 you can see the ruins and the graveyard of Púquios". Nowadays, the Llano de Varas is more easily accessible over the well-paved route 51, connecting Copiapó and Diego de Almagro in the north. A road branches off to Carrera Pinto, and after a few hundred metres, one can see from the distance the southern end of the plain and a few hills, the most prominent being Cerrito Curtis, being at 69°55.27' W. 27°6.31' S, altitude 1760 m (Figs. 3 and 4). Our pickup truck could not get to the top, and we had to walk up the last 100 m on foot. From the top of the hill there is a marvellous view into the multicoloured, barren Llano de Varas stretching to the north, and the rugged mountains that surround it from the east through south to the west. Traces of mines and the ruins of the smelter can be seen; a few people still live in the mine near the railroad station Carrera Pinto (Fig. 4), and in the tiny hamlet, La Posada.

Although Cerrito Curtis was without doubt a better site than San Cristóbal, Curtis advised Campbell that he and his assistant were getting more clear nights there than they could use effectively, and that unless several more observers were sent down there would be no point in moving the Lick station. It would be much



Figure 4: Cerrito Curtis, seen from the west. The buildings to the right are the railroad station Carrera Pinto (in the NE corner of Fig. 2). The hill is seen as a small brownish elevation, in front of the higher mountain range, between the road sign in the middle and the telephone pole at left.

more expensive to supply the desert site, and few educated people, especially astronomers with families, would consider living there for years. A move would have been costly; Mills, the prospective donor, died in early 1910, and Campbell never succeeded in raising the money to send Aitken south with a refractor. Curtis's report was filed and almost forgotten. The Lick radial-velocity station remained on Cerro San Cristóbal until it was bought, in 1928, by Manuel Foster and donated to the Universidad Católica de Chile.

3. The Aftermath

The Lick experience was important when planning began for the large European and American southern-hemisphere observatories in the 1950's. Although Curtis's report languished in the files, Lick astronomers knew of the excellent observing conditions in Chile, and Walter Baade, a strong proponent of the ESO idea, had become well aware of them by word of mouth. In correspondence and certainly also in talks with Jan Oort, he insisted that the Europeans not rush into South Africa before carrying out serious site tests in Chile (Osterbrock 1998). But only after AURA had cast their dice for a Chilean mountaintop in the early sixties, ESO, with detailed climatological data of several South African sites at hand, changed its mind almost "at the last moment". ESO's earliest Chilean site tests of 1962 focussed on the mountain La Peineta (about 40 km north-east of Cerrito Curtis), as well as on two mountaintops in the neighbourhood of Cerro Tololo, near La Serena. In 1964, La Silla was chosen as the site for the European Southern Observatory (Blaauw 1991).

The observatories La Silla, Cerro Tololo and Las Campanas were erected in the mountains north and east of La

Serena. These sites are about halfway from Santiago to the Llano de Varas; it in turn is about halfway from La Silla to Cerro Paranal and the VLT, as well as to Cerro Armazones where the observing station of the Universidad Católica del Norte is located. The whole region is still as clear, as dry, and probably even more deserted than it was when Curtis saw "his" Cerrito and envisioned an observatory ninety years ago.

We are grateful to A. Blaauw for his helpful comments on the manuscript, to the Mary Lea Shane Archives of the Lick Observatory, University Library, University of California, Santa Cruz, for permission to quote from Curtis's report, and to reproduce the three early photographs from its collection. H.W.D. acknowledges

support from the German Academic Exchange Service (DAAD) which made his stay in Chile possible.

References

- Aitken, R. G., 1943, Heber Doust Curtis, 1872–1942, *Biog. Memoirs Nat. Acad. Sci.*, **22**, 275.
- Blaauw, A., 1991, *ESO's Early History*, European Southern Observatory, Garching.
- Curtis, H.D., 1909, Report on Astronomical Conditions in the Region about Copiapo. Typewritten manuscript, dated April 17, 1909, in the Mary Lea Shane Archives of the Lick Observatory, University Library, University of California, Santa Cruz, CA., USA.
- Gilliss, J.M. 1855, The U.S. Naval Expedition to the Southern Hemisphere, Vol. I. Washington: A.O.P. Nicholson (Printer); House of Representatives, 33d Congress, 1st Session, Ex. Doc. No. 121.
- Keenan, P.C., Pinto, S., Alvarez, H., 1985, The Chilean National Astronomical Observatory (1852–1965), Facultad de Ciencias Físicas y Matemáticas, Universidad de Chile.
- McMath, R.R., 1942, Heber Doust Curtis. *PASP* **54**, 69.
- Osterbrock, D.E., 1984, James E. Keeler, Pioneer American Astrophysicist. Cambridge University Press, Cambridge.
- Osterbrock, D.E., Gustafson, J.R., Unruh, W.J.S. 1988, Eye on the Sky: Lick Observatory's First Century, University of California Press, Berkeley.
- Osterbrock, D.E. 1998, Walter Baade, *Observational Astrophysicist* (3): Palomar and Göttingen, 1948–1960 Part B. *JHA* **29**, 345 (see esp. 363 and note 120).
- Sterken, C., Vogt, N. 1982, Radial Velocity Observations with the 36" Telescope at Cerro San Cristobal, Santiago, Chile, *The Messenger* **28**, 12.

Hilmar W. Duerbeck <duerbeck@stsci.edu>
Don Osterbrock <don@ucolick.org>



Figure 5: Three of the authors on top of Cerrito Curtis (from left to right: R. Leiva, L.H. Barrera, H.W. Duerbeck).