

REPORT ON ASTRONOMICAL CONDITIONS IN THE REGION ABOUT

COPIAPO.

- Dated 1909 -

By H. D. Curtis 190
rec'd from
C. D. Shane
Oct 2, '72
J. M.

Caldera, the port of Copiapó, is 390 miles north and two days by steamer from Valparaíso. It is a straggling, sandy little town in the midst of a desolate and barren tract of coast. The Harbor is fairly well sheltered, except from northwest storms. As at Valparaíso and all the northern Chilean ports, freight is unloaded by lighters. Boatmen's charges for landing are three or four pesos for one person with hand baggage, for a family with considerable baggage it would be twenty or thirty pesos. There are several places where lodging and meals can be secured; the best of these, the Hotel Suiza, is very bad. At Caldera are located extensive copper smelters and the repair shops of the Copiapó Railroad; these are well equipped and any castings, repairs or machine work could be executed there. There are two fair beaches for bathing at Caldera and numerous little bath houses which are rented to families spending a part of the summer there for beach and surf bathing.

A train leaves Caldera for Copiapó each day at 1.30 P. M. This railroad was the first one to be constructed in South America; its headquarters are located at Copiapó and the present Superintendent is Mr. J. D. F. R. Bugge. The road, which is owned for the most part by English capital, rarely if ever grants favors or passes even to managers of mines who ship much freight; it has a bad reputation in this respect and it is more than doubtful whether any favors, passes or reductions in tariffs could be secured for a scientific expedition. There are four classifications for freight, the two last applying only to heavy bulk freight, ores, etc. These prices are in Chilean oro, of 18 pence to the peso.

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	1st class	2nd class
Cald. to Copiapó	1.35	1.14 per quintal métrico
Cal. to Púquios	2.31	1.94
Copiapó to Púquios	1.07	0.91

There is a separate tariff for baggage, of which only hand baggage is free, and for small parcels, express, etc., Samples of this graded tariff between Copiapó and Púquios are:

To 20 kilos	0.50 oro	to 20 lbs	0.11
41-50 "	1.30	to 40 lbs	0.28
91-100 "	2.50	to 60 lbs	0.55
141-150 "	3.80	to 80 lbs	0.82

The daily train runs up as far as Pabellon (see map). Trains also start from Copiapó three times per week, Sundays, Tuesdays and Thursdays for Púquios, coming back the same day, generally by gravity only, unless the train be heavy. Trains also go on the southern branch three times a week as far as Tres Puentes, from here on to San Antonio the track was washed away some time ago so that San Antonio has not had railroad service for a year or two. The other southern branch of the line goes to Juan Godoi, formerly a rich mining region, now so nearly defunct that trains are sent over this branch but twice a month.

All these lines go up through very narrow valleys between rocky, entirely barren, and frequently rather precipitous mountains. After the road strikes the Copiapó River from about Piedra Colgada on to San Antonio there is plenty of water for irrigation, the valley is fertile and of pleasant aspect with its farms, vineyards and gardens, not unlike region around Santiago, though ~~more~~ rarely as wide as two miles. The cañons away from the river, as that traversed by the Púquios line after leaving Paipote, are absolutely sterile.

As for large towns, there is but the one, Copiapó.

All the other places are generally only small stopping places at various haciendas. Tierra Amarilla and Púquios are the largest, and a doubtful four hundred is claimed as the population of Púquios. San Antonio is said at present to contain only two large haciendas, one family with its peons and inquilinos occupying one side of the only street and the other estate the other. For reasons to be given later, excepting perhaps Púquios or vicinity, there would be no location offering more advantages than one close to Copiapó.

Copiapó, lat. 27° 22' S., 70° 22' E. long., is about 81 kilometers from Caldera, 1210 feet above the sea level, and has about ten thousand inhabitants. It is a pleasant little city, judged by Chilean standards, and, though dull, ought to be an agreeable place to live. Of the two hotels, Hotel Ingles and Hotel Atacama, the latter is the better and has fairly good service. There are located at Copiapó a Liceo de Niñas and a Liceo de Hom- bres, both pretty well equipped, and families are said frequently to come here from the northern ports for the education of their children. There is also an Escuela Normal, an Escuela Práctica de Minerología, a Museo Mineralógica, etc. An American Missionary, Mr. Jesse B. Smith, lives here with his family and has a small church building; most of the work in Spanish, but English services are held on Sundays at 4 P.M., average attendance fifteen to twenty. Mr. Garvin and family, close friends of ours in Santiago, had this post from 1904 to 1908, and from their experience and that of Mr. Smith, I gather that the cost of living in Copiapó is about the same as in Santiago, i. e., pretty high. Rents are cheaper. The valley produces plenty of fruit and vegetables with no outlet except Copiapó so that, in season, these are only half Santiago

prices. Servants are high, receiving 35 pesos per month at least. The water is good, but there is no water supply system; water is sold from tank carts at five centavos for two pails. A contract has just been signed for the installation of a water system. The town is clean, has never had any epidemics, and may be considered as healthful a spot as one is apt to find in Chile. There are pretty good stores and shops and most ordinary supplies, articles of clothing, ^{etc.} can be obtained here. Fresh meat is always available. There is no electric light or power in Copiapó.

WEATHER CONDITIONS.

Copiapó has a very large number of clear afternoons and evenings; were one to judge only by the statistics at 3 P. M. or 9 P. M. it would be a fine location. I heard bad reports of its weather on the steamer and wondered how these could be conformed to such published statements as I had seen. I took occasion to question many people after my arrival, in particular hack drivers, vegetable venders, policemen, etc., whose duties brought them up early in the morning. Their testimony and that of other residents seems practically unanimous that the mornings during the year when there are not thick clouds or fog at dawn are the exception. These clouds are driven up from the sea, sometimes low enough to be felt as fog, at other times higher, but almost always thick enough to cover all the peaks around; I watched it come or go on four occasions and there would be no elevation near by high enough to escape it, even supposing one cared to go to the expense of blasting a road out of the solid rock of the mountains, here rather precipitous. As to when this regular fog comes in there are no reliable records, but most people agree that it is from 10 to 12 P. M. in winter and generally later in the summer months.

A Liceo professor said that he thought it frequently did not get in till nearly dawn in summer; others say frequently at twelve or one o'clock even in summer.

The Liceo at Copiapó has kept good weather records. There were some kept as far back as 1869-75, then a break till the '80's. Through the courtesy of the Director I was loaned some of the books and have copied out some data which will supplement the data soon to be published of which copies ^{from} ~~of~~ the proof sheets are sent.

The records were taken at 7.30 A. M., 1.30 and 9 P. M. Cloudiness is marked on a scale of ten and only those dates marked five to ten, inclusive, are included in my count. Days having cloudiness 1-4 will add perhaps three or four per month, except to the summer records at 9 P. M. Nearly always at 7.30 A. M. the number is 10, frequently with the note "neblina" (fog) when low enough to be felt as such. Sometimes in the records of the first year or two cloudiness is marked 0 but "neblina" added; I have tried to include these cases as well and considered them as mark 10. The notes are generally "neblina", "neblina arrastrada", and frequently "heladd" in the winter months.

TABLE I.

Clouds or Fog 5-10 at Copiapó at 7.30 A. M.

Month	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	Aver.
Jan.	28	18	20	16	13	16	23	20	8	10 ¹	25	18	--	21	18
Feb.	19	19	22	--	20	10	16	20	18	16	19	16	--	14	17
March	22	27	23	--	23	16	19	21	20	13	20	15	14	28	20
April	17	16	16	--	22	15	18	24	20	19	--	19 ²	23	18	19
May	17	22	18	--	20	13	13	18	15	18	22	18	21 ⁶	--	18
June	15	14	16	--	15	14	14	18	14	20	23	22	21	--	17
July	16	8	14	11	10	10	18	13	15	19	16	16	18	--	14
Aug.	19	17	17	14	10	15	14	17	15	18	19	21 ³	18	--	16
Sept.	19	21	14	16	19	15	17	12	11	18	14	11 ⁴	11	--	15
Oct.	13	26	15	13	17	19	19	13	14	22	19	-- ⁵	13	--	17
Nov.	20	30	23	16	18	18	21	15	16	19	15	--	20	--	19
Dec.	21	20	16	15	16	13	22	10	17	21	14	--	24	--	17

Yearly average about 210 days, or 57%.

Notes to Table I.

- 1) 18 days only. 2) 5 days lacking. 3) 4 days lacking.
 4) 9 days lacking. 5) Oct. 1899 to March, 1900 is by a different hand and suspicious; perhaps a different scale; Oct. has 3 days 5-10; Nov. 5 days 5-10; Dec. is lacking; 1900, Jan. has 1 day 5-10 and 14 1-4; Feb. 9 days 5-10. 6) 5 days lacking.

TABLE II.

Clouds or Fog 5-10 at Copiapó at 9 P. M.

Month	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	Aver.
Jan.	8	0	0	0	0	1	0	0	0	0	3	3	-- ¹	0	1
Feb.	5	0	2	-	2	2	0	1	0	0	0	1	-	2	1
March	3	2	2	-	0	1	0	0	0	0	2	4	-	1	1
April	7	6	0	-	1	2	1	0	2	0	-	0	3	6	2
May	7	6	0	-	0	3	1	3	0	7	5	7	10	-	4
June	7	7	3	-	2	2	5	3	1	7	7	13	7	-	5
July	4	5	3	0	2	4	6	0	1	7	7	12	6	-	5
Aug.	9	1	3	4	3	2	6	4	1	5	6	14	17	-	6
Sept.	7	6	1	5	0	0	5	3	0	2	4	-	4	-	3
Oct.	9	2	3	4	0	1	2	0	1	7	2	-	4	-	3
Nov.	2	2	0	1	0	1	1	1	0	1	0	-	5	-	1
Dec.	2	2	2	1	0	1	1	1	0	0	3	-	0	-	1

Note 1) These months are omitted for the same reason as in Table I. Jan., 1900 has 9 days 5-10, 11 1-3; Feb. 2 days 5-10, and 16 1-3. The other notes of Table I apply to Table II.

The percentages in Table I should if anything be increased in my opinion. It is safe to suppose that some days marked 1-4 had clouds partly dissipated from a state of entire cloudiness at dawn, particularly in the summer months when the time of taking this reading comes two or two and a half hours after sunrise. If we assume that on some summer mornings the fog had entirely dissipated at 7.30 A. M. so as not to be recorded and include some of the days marked 1-4 for the same reason, it would be likely that thick high or low fog occurs at dawn at Copiapó 70% of the time.

At 9 P. M. about 10% of the nights would be more than half cloudy; even including nights marked 1-4, the average year would show perhaps 300 nights of which the first half, or the greater part of it, was clear, averaging up in this summer nights when the fog comes in later with the winter nights. What the seeing would be for an hour or two before the fog gets in I would not care to predict, but most likely bad.

As a whole the sky at Copiapó must be something like that of San José, with the regular night fog coming in from the sea.

Frequently this thick fog is ~~XXXXXXXX~~ accompanied by a fine mist or drizzle, especially in winter. Rain will average once or twice a year; there has been none for the past two years. The wind always blows up the narrow valley from the N. W.; generally light at night; sometimes brisk in the day. A few entries, "strong wind", "heat lightning seen toward Cordilleras" etc.

Many earthquake shocks, nearly always light, are felt in all this region. Frost not infrequent in the winter.

All reports agree with regard to the prevalence of sea fogs all along this coast from Valparaiso to Callao. We escape much of it at Santiago owing to our altitude; Valparaiso has a good deal. From mining and travelling men corroborative reports were secured of morning cloudiness equal to or worse than Copiapó in Vallenar, Vicuña, etc., to the south and at places at similar altitudes to the north. The only way to escape this sea fog seems to be to get above it.

A professor in the Liceo states that the extreme daily range will average close to 15° C., taking the average of a number of years; it is generally larger in the winter months which have warm days and cold nights. I give here this daily range for two years.

1868, Jan.	16.5° C.	1875, 12.4° C.
Feb.	16.6	12.3
March	16.1	12.0
April	14.1	13.3
May	19.9	11.8
June	16.2	11.0
July	21.4	12.3
Aug.	24.6	---
Sept.	18.4	13.0
Oct.	18.0	12.0
Nov.	18.2	12.1
Dec.	17.8	13.0
Average	<u>18.6</u>	<u>12.4</u>

Other data copied from proof sheets loaned by Dr. Ristenpart:

In 1906 and 1907 the direction of the wind at 3 P. M. was N. W. for 365 days of the year. At 3 P. M. during the year 1906 there were 291 days without a cloud, 25 days 1/4 cloudy, 32 1/2 cloudy, 10 3/4 cloudy and 7 entirely cloudy. Similarly in 1907 at 3 P. M. there were 298 days without a cloud, 20 days 1/4 cloudy, 31 1/2 cloudy, 7 3/4 cloudy and 9 entirely cloudy. The average number of kilometers of wind in 24 hours in 1907 was 87.9

In 1906 it was 103.8 km.

If one were satisfied with a site on the plain, several places could be found in the eastern outskirts of Copiapó; here the southern horizon would still be cut off to some extent, and the northern as well. On the northern side of the valley, a few kilometers east of the town, near the small suburban station of San Fernando, there are several easy elevations where a site could be placed at an altitude of 200 to 400 feet above the plain; these are not separate hills, but situations on ridges running south from the mountains on the north side of the valley. Road-building would not be difficult at this spot and the southern horizon would be least obstructed here, because of widening of the valley and the branching off of the southern valley. It seems to me, however,

that the data collected show that this is in no sense a suitable site because of the uncertainty with regard to the last half of the nights.

It will be seen from the map that the southern branch of the railroad offers no site at an elevation sufficient to ensure freedom from night fog, and all reports agree that these places have about as much morning cloud as Copiapó. Very laudatory reports were given me of the great clearness at Púquios, the northern terminus, 143 kilometers from Caldera. I went up there on April 8th; the trip takes about four hours 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. Accomodations 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 rugged mountains about. It has some small stores, a butcher shop, small drug store and a water supply piped down from the Llano de Varas. The water is quite hard, but all the inhabitants use it. The main life in the town comes from the trains of mule carts bringing in copper ore and carrying back coke and supplies, or trains of burros going and coming from the most inaccessible spots by narrow zig-zag trails. It has telephonic communication with Copiapó and Caldera.

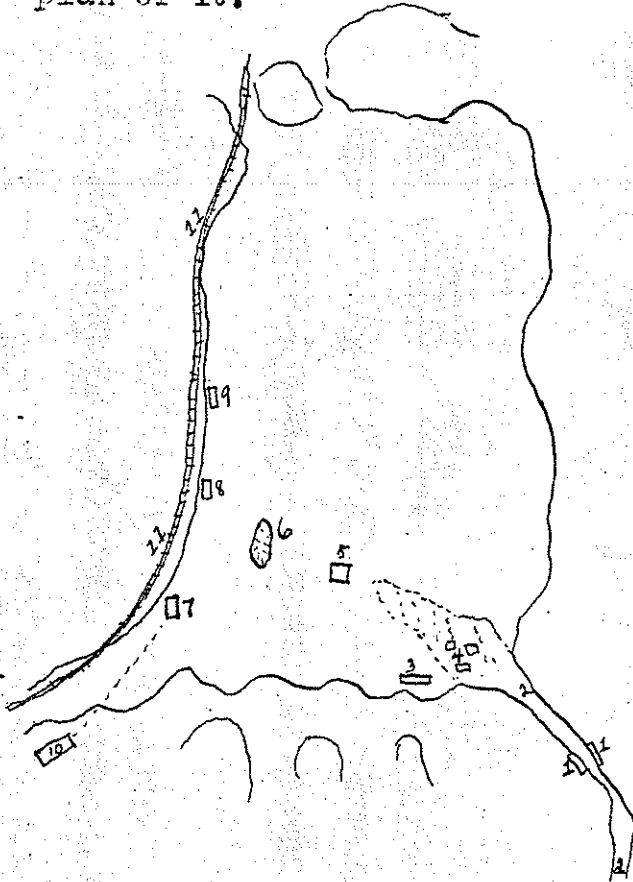
Because of the narrowness of the valley here it offers no good site for a station.

Clouds and fog are very rare, according to all reports. Occasionally the head of the Copiapó fog just manages to get up here by five to seven A. M., almost never earlier. It is 4060 feet above the level of the sea. A brisk wind up or down the valley is common in the days and less so at night.

Three quarters of a mile south-west of the town a mine is being developed, and probably a pretty good one. It is in charge of an Englishman, Mr. Stark, who lives here with his wife. He has lived everywhere from Dawson to Kimberley and finds life here very quiet; his neighbors are a "bit far" (four and a half miles). Neighbors (English speaking) within two miles are considered right at your door. He has lived here two years and lived several years near Johannesburg in South Africa. His unhesitating opinion was that Púquios was very much clearer than Johannesburg. Johannesburg is quite clear for eight or nine months and then there is a rainy, cloudy season.

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. The cañon walls are precipitous and high and in spots, in spite of the lack of verdure, the scenery equals all except the narrowest part of the Royal Gorge. 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, and I give here a rough plan of it.



Plan of Ilano de Varas.

1. Works of mine La Descubridora.
2. Cañon from Púquios.
3. Smelter, alt. 5100 feet.
4. Buildings, houses of peons.
5. Little hamlet, Posada del Gallo, Alt. about 5200 ft.
6. Small cerro, alt. of summit 5350 feet.
7. Mine station, El Ingenio.
- 8 and 9. Abandoned gold and silver mining mills. At 8 will be a station on the railroad to Inca, a rich mining district about 20 miles N.
10. Mine, la Dulcinea, alt. about 7000 feet.
11. Railroad under construction to Inca and Chanaral.

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 dotted area; a little alfalfa can be raised here, and I saw some squash and corn. One or two small outcrops of salitre south of 5), otherwise the soil is hard, ~~and~~ ^{and barren} sunbaked, but does not appear to be alkaline.

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; as stated above, it is pretty hard. At Posada del Gallo good sweet water is obtained from wells. Mr. W. L. Stevens, F. 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. They are contemplating

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putting in a softening plant. The Cerro is a small elliptical hill about 200 feet above plain and 250 above the smelter; it is perhaps 300 feet long and would perhaps furnish a site with sufficient atmospheric drainage. 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 little 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. Trains will probably run at least three times per week, and eventually a third rail will be added to the Copiapó railroad so that traffic can go from Inca to Caldera without change, at present necessary at Chulo. 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 $\frac{1}{2}$ 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 way 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. Mr. Stevens has kindly agreed to take simple records of the night cloudiness personally or through men on the night shift for the next three winter months and send to Lick. He will try also to obtain data with regard to the daily range in the same period. A number of Englishmen are employed here with one American and two English families.

Statistics show that, except for the sea fog, Copiapó would have a very large proportion of entirely cloudless days and nights, and these fogs almost never reach the Llano. The distance from the Cordilleras is such that ~~these~~ storms are not common. From these considerations and from the unanimous reports of residents, while I may be wrong, am inclined to prophecy that a site in the southern end of the Llano de Varas would average 300 clear nights per year.

It is true that such a site would be quite isolated, but the copper companies seem to have had no difficulties in bringing in their heavy machinery, and supporting eight or ten Englishmen and eighty to one hundred and fifty laborers from Copiapó as a base.

I am quite impressed with the possibilities of this plain and will give such data as I have been able to collect with regard to living conditions, etc., for a site in the southern end of the Llano de Varas, which may be of use in case it should ever be found possible to make a thorough test of the seeing here in a reconnaissance^s of three or four weeks.

POSSIBLE SITES.

1) There are several easy elevations near the smelter and to the south of it. Advantages: nearness to present freight terminus, to Americans and English as neighbors, and to water supply. Not

much road would be needed and that not of difficult construction. Even mining engineers could give but few estimates as to cost of road building here; it varies so much according as much blasting may be needed or not. Disadvantages; some southern horizon cut off; heated air from the southern mountain would make poorer seeing; work to the north might be hindered by the smoke from the smelter.

2) Site on the new railroad line at the west of the plain; the railroad cut is here on a gently sloping hillside; suitable elevations could be found, if desired, a few hundred feet above the track. Advantages; freight and living supplies from Copiapo delivered right at door. Disadvantages; if site were placed at the top of this ridge, more road making would be necessary than at any other place on the plain. Unless water were purchased from tank cars on the railroad, it would have to be brought by burro about one mile and a half from Posada del Gallo. It would be about three miles from the smelter, but freight and supplies from Púquios are brought over easily as far as the rope tramway station at El Ingenio by road and by ore railroad. Nearest English neighbors at the smelter.

3) Best location, in my opinion, the small cerro marked on the plan. Roads across the plain to the railroad at the west or to tap present road from smelter to El Ingenio would need only the scratching away of a few loose rocks, as the hard plain 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 permanent 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.

LIVING CONDITIONS, HOUSE, ETC.

Living supplies, meat, vegetables, fruit, etc., at present come from Copiapó via Púquios. Freight from Púquios to smelter can be contracted for at 80 ctavos per quintal métrico in quantities, and one peso in smaller amounts. Meat comes from Company's store at Púquios or the smelter; other supplies can be secured from the Company's store at the smelter in an emergency, canned goods, table waters, flour, beer, etc. May be cheaper and easier to use new railroad and not depend upon Púquios. The Company's ore wagons make two trips per day to Púquios, and ore cars run on track by gravity and mule power many times per day to the cable station at El Ingenio. One mozo at four pesos per day and two burros would be needed for carrying water and supplies. Burros live here mainly on the bracing atmosphere, kitchen refuse, coarse herbage at southeastern corner of plain, and some hay once in a while; the two would cost from 0 to 20 pesos per month according to the generosity of their owner. One, or better two, riding horses should be kept for a family as no one here, peon or English, thinks of walking a quarter of a mile provided he can get astride of something with four legs. Hay costs ten pesos per bab; the Company figure that a riding horse costs them 35 pesos per month to keep, a working mule 2 pesos per day, a peon's food four pounds per month.

Permission could doubtless be secured to tap Mr. Fergie's telephone line at Posada del Gallo or the Company's line to La Dulcinea, passing about one mile south. An entirely independent line it would have to be run on the telephone company's posts to Púquios. All supplies from Copiapó are ordered by telephone; no line needed if orders were sent from the smelter or El Ingenio. Servants are 35 pesos per month and not hard to get.

Lumber costs 30 ctavos per foot placed at Púquios. The Company now builds its better class houses of a strong 2x4 and 4x4 framework well wired and braced, with adobe filling for the walls.

Wide verandahs are generally built. Roofs are boards or a thin thatch covered with an inch or two of clay; no rains here to destroy this coat, which is a good heat insulator. Corrugated iron is sometimes used for roof and walls. Mr. Stark's house at Púquios is entirely of wood, except the roof, as is also the mess house at the smelter. Carpenters five or six pesos per day, common labor four. A lathe, drill, etc. will soon be installed for small repairs.

There is no doctor at the smelter, only a Chilean "practicante". The doctors at Copiapó are said to be good. Hand cars are always kept in reserve at Púquios and emergency cases go to Púquios, thence by hand car and gravity to Copiapó; fare at present exchange about forty pesos. In an emergency Copiapó could probably be reached in five or six hours from the smelter. Probably similar arrangements will obtain with the new line at the west of plain, but this is of different gauge so change would have to be made at Chulo. I am assured that the road from the west of the Llano down through Chulo to Copiapó is good all the way; don't know whether it is good enough for a buggy or an auto.

There is a little native school in the cañon at La Descubridora and another at Púquios, but not suitable for "white men"; in the educational way nothing nearer than the excellent liceos at Copiapó.

As to isolation; probably actually less isolated for an English speaking family than life at some small town ~~at~~ south of Santiago. To "live" at the same time with astronomical work there

is nothing in South America like Santiago; site near Copiapó would be a very distant second. The Llano would doubtless be much better than the nitrate desert. San Luis can not be a very lively spot, to judge from Mr. Tucker's letters; he expects 200 clear nights per year there.

Possible uncertainties with reference to a site in the Llano de Varas.

Copper is very low; all copper companies in Chile are barely paying expenses. A temporary shut-down not a remote possibility but doubtless for not longer than a year or two. The site would always have the two railroads to depend upon, but English speaking neighbors might be lacking in such a case.

If a site must be had near a center of population I doubt if anything in the southern hemisphere would be better than the present location on San Cristóbal. A site at some small town to the south might give less climbing, but it is my impression that an American family would find such a small town in reality about as isolated as any other location, as least for the first few years till entire command was had of the language. San Bernardo, 21 kilometers south of Santiago, might serve; there is a cerro near the town whose summit is about 930 meters above the sea; the town itself is a pleasant spot and serves as a sort of a summer resort for many Santiago families; abundant train and electric car service to Santiago. Do not see that any better conditions could be found there than at Santiago.

Copiapó is the last fertile spot for a thousand miles north except some cañons of the Andes in the Province of Tacna and these, according to report, have sea fog. A situation could be easily found somewhere on the nitrate pampas, but would have to be 4000 feet

or over in order to escape the sea fog which prevails all along the coast. Such a site would be as isolated as one in the Llano, with the advantage in favor of the Llano that it is 25 miles from a fertile spot and large town as a base of supplies. Even the next port north, Taítal, and its tributary towns in the interior, is entirely dependent for fresh meat, fruit, vegetables and all food stuffs upon Valparaíso or Peru, and living is said to be much higher there than from Copiapó as a base.

There is no suitable base between Copiapó and Santiago which would be any better as far as altitude and freedom from sea fog is concerned.

Tres Puentes, present terminus of the southern branch of the railroad from Copiapó, is 2810 feet above the sea; valley narrow; fogs about as frequent as at Copiapó; a very small place.

Molle, about ⁴500 feet above sea; trains twice a month; only a station.

Vallenar, end of line in from Huasco, 1240 feet above sea; said to have more sea fog than Copiapó.

Coquimbo and La Serena are right on the sea coast. La Serena has 20,000 inhabitants, good schools and stores; said to be unhealthful from poor drainage.

Vicuña, east of Coquimbo, is 2400 feet above sea level and has 2400 inhabitants; a dull little place from all accounts. Region around is fertile. I did not visit, but found out much from a gentleman who has lived there and at Ovalle for several years; climate more like that of Santiago; sea fog reaches here. Railroad is property of the Government.

Ovalle, end of southern line from Coquimbo, is 720 feet above

the sea and has about 7,000 inhabitants. Too close to the sea and too low to warrant a visit.

Andacollo, a little village south of line to Vicuña, is 3400 feet above sea; no railroad connection; I believe is reached by a stage line. Might be a little clearer than Santiago. In my opinion only a careful reconnaissance and test of seeing would warrant considering a change from present location.

OTHER OBSERVATIONS.

A temperature sheet is enclosed for the three days stay at Púquios. The thermograph was placed on the wall of a porch facing southwest. The average range is about 15° C. The sudden drop at 4 P. M. is due to "sunset" behind the mountain to the N.

Dr. Ristenpart loaned me a four inch telescope and tripod; low power ocular. It was of very little use, though I observed with it several nights at both Copiapó and Púquios, and I would be the last to attach any significance to it one way or the other. About all it was good for was to test at different times through the night the amount of boiling and unsteadiness at the limbs of Jupiter and the moon at varying altitudes. In general about as much unsteadiness at 25° altitude as would be expected; fairly steady nearer Zenith. Exception: one of these heated mountains a mile or two away is bad for steadiness and amounts practically to lifting the horizon just that much nearer the object in view. Twinkling seemed to be quite marked near the horizon; none noticeable at average zenith distances.

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.

SUGGESTED RECONNAISSANCE.

The selection of any site in the Southern Hemisphere for such exacting work as Dr. Aitken's is more or less a leap in the dark. Probably San Cristóbal is as good as most others if first two or three hours are not used. Ristenpart considers seeing on the plain rather bad, even after midnight, and is at present considering a site near San Bernardo, on the plain. Do not see that this would be much better except in freedom from vibration from cars and trains. San Luis has mountains in easy reach, Tucker's site is in a flat pasture region, and we know nothing yet of the seeing there for large apertures. As to number of clear nights, Santiago has had for the past three years more than any one man could very well use. Of course for a permanent large station the case would be otherwise; here one would need every possible night clear, and good seeing as well.

Should Dr. Aitken come south it would be an unexampled opportunity for an authoritative "seeing survey." preliminary to the selection of his own site and to settle once for all the question of a favorable southern site for all classes of astronomical work. From the exacting nature of his work and his experience with fine instruments at Lick he is ^{without doubt} ~~as good~~ as good an authority as can be found in the world today to pronounce on what "good seeing" really is. With the telescope Professor Hussey used in Australia and an eclipse outfit of tents and all living supplies, I believe one or two thousand dollars could well be spent in such a survey. If his family did not care for two or three months of camp life they would find life in Santiago very pleasant. I should think Arequipa could be cut out with a brief visit to see what they call

good seeing there, because of Pickering's known dissatisfaction with the amount of cloudy weather at this spot. A stay of three or four weeks at Pampa Central or some similar location in the nitrate pampas, and similar periods at Llano de Varas, San cristobal, and San Luis would settle authoritatively the question of the best possible site for future powerful installations in the southern hemisphere. Perrine could speak for Cordoba.

The best time would be from say November to February, as at this season the passage of the Cordilleras is easiest; the telescope only, in sections, would have to be transported across the Andes. Doubtless such a plan has long been considered, perhaps as a continuation with Carnegie funds of the work begun by Professor Hussey.

Two maps are enclosed of the region about Vallenar, Copiapo and Taltal.

C. D. Shane
Post Office Box 582
Santa Cruz, California
95060

Sept 29, 1972

Dear Nick:

Here are two copies of a site survey report by H. D. Curtis in 1909. He was at that time in charge at Cerro San Cristobal. Campbell hoped to establish the observatory in a more favorable location if he could raise money to make it a permanent institution. The money was never forthcoming.

Would you mind seeing that Victor Blau gets one of the copies? I don't know whether he is in Tucson or Chile. I do hope he is getting along alright now. He has surely had a rough time. Please give him my greetings.

Ron Watson died a couple of days ago. It was a heart attack. We are going to the memorial service this P.M. The Jeffers are coming up.

Otherwise everything goes well here. My hip is fine now. No cane necessary and no or practically no limp. It is about as good as new.

Love best to you and

Kay

Cordially Gerald

If Victor Blanco has time to register a reaction to this account, we would welcome comments or suggestions as to future direction of interest. We do hope his health continues to improve.

Now I must get off for the University. Time does fly.

We thank you both again for your visit and good luck in all ahead.

My love -

Mary (Shane)

NOTES ON THE DIRECTORS OF THE D.O.MILLS EXPEDITION TO CHILE

By Beverly S. Hard

Rec'd from
M. L. Shane
Sept 29, 57
97

Rec'd from
M. L. Shane
Nov 72

The history of the D.O.Mills Expedition to Santiago from the Lick Observatory of the University of California is part of the history of the life of that very remarkable man, William Wallace Campbell, Director of the Lick Observatory from 1901 to 1930, and President of the University of California from 1923 to 1930, the last seven years concurrently.

Dr. Campbell had been thinking in the latter years of the nineteenth century, as early as 1894, that it would be important to establish an observatory in the southern hemisphere to complement astronomical observations in the northern hemisphere with particular regard to the radial velocity^{ies} of stars. There were many distinguished observatories in North America, notably the Lick, the U.S. Naval Observatory in Washington, D.C., the Harvard College Observatory, and the Yerkes. But in the southern western hemisphere there were only the National Observatory of the Argentine Republic at Cordoba and Harvard's observatory in Arequipa, Peru, that could have been considered as of major importance.

Campbell was fortunate in finding a financier, Mr. D. O. Mills, interested in promoting such a project. In 1902 plans took shape, a Director for Chile was selected, W. H. Wright, and Dr. Campbell prepared to go with him to Santiago to select a site, erect a telescope and offices, and get things started. Most unhappily Dr. Campbell had an ^{accident} ~~bad~~ fall which severely injured his back and prevented his going. It must have been a bitter disappointment to him, and a real sadness that he never did get to see the institution which he so capably directed from California during all the years of its operation until it was sold, in 1929, to the Universidad Catolica, of Santiago.

Although Dr. Campbell had anticipated that the work of the observatory would last about three years, it actually operated for about 26 years, 19 of which followed the death of the original benefactor in 1910. This continuation was made possible through the generosity of his son, Mr. Ogden Mills, and a number of other interested citizens, whom Dr. Campbell tackled with unremitting energy.

Dr. Campbell was a strong and powerful character, and he held the reins firmly in the north and in the south, at home and abroad.

II.

For the period of the Santiago observatory's operation there was a succession of six directors in residence on the mountain known as Cerro San Cristobal. In the order of their appointment these were:

William H. Wright	1903-1906
Heber D. Curtis	1906-1909
Joseph H. Moore	1909-1913
Ralph E. Wilson	1913-1918
George F. Paddock	1919-1923
Ferdinand J. Neubauer	1923-1929

The first of these, W.H.Wright, had all the problems of finding a suitable site, high enough to escape the lights of the city or the fog, low enough to climb to, congenial in arrangements to the nuns of the Convent, from whom the land was leased, and safe from the blastings in the rock quarry below, and from a shooting range. And these fundamental arrangements Dr. Wright had to make without the present help of his injured leader, although in spite of his injury and his disappointment Dr. Campbell was able to advise Dr. Wright almost as if he had been present. He had an extraordinary ability to picture the place and the problems even at the great distance, carefully offering instructions throughout the years on measurements, building, planting, painting, insurance, janitor service, and transportation -- even the selection of a horse -- as if he had actually been at the site. And very soon, too soon for practical purposes in a mañana civilization, he was bearing^{down} on his astronomer in charge for plates, measurements, and stellar radial velocities.

Among the inevitable drawbacks which to some degree all of the directors had to undergo in getting adjusted to a new life were troubles stemming from homesickness; the problem of getting Chileans to move rapidly; the rising cost of living; domestic and political disturbances ranging from petty thievery to insurgent revolution; the scarcity of decent housing near the Cerro which constantly had to be climbed; and repeated family illnesses. Paradoxically enough, when all such difficulties had been met, endured, or overcome, the directors and their families developed such an affection for the place that when the time came for them to leave, they did so with real reluctance.

Dr. and Mrs. Wright arrived in Valparaiso on Saturday, April 18, 1903. He wrote Dr. Campbell immediately:

We found on landing that this country is enjoying some, if not all, of the blessings of an advanced civilization. All the lighter hands and cargo hands 'walked out' on a 'straique' during Thursday and Friday, and the port is tied up tighter than was San Francisco under similar circumstances....We landed the mirror on Monday by means of a row boat.

Dr. Wright had a very busy three years. Even in a strange country with baffling formalities and irritating delays all of the preliminary work in establishing the observatory was well on its way by the end of July. By September Wright and his assistant, Dr. Palmer, were busily observing. He reported this to Dr. Campbell by a cablegram which was a reply to an anxious cabled inquiry from his chief. Letters took six or eight weeks in those early days, delayed by such things as slow boats, missed connections, shipwrecks, and strikes.

Only rarely does Dr. Wright allude to their personal life in Santiago, though he spoke of their house at the foot of the Cerro and of a vacation trip on horseback to Valdivia with his wife and her sister. He also sent a packet of interesting photographs of the observatory and of the charming city. The Wrights had much to undergo in the way of riots, bandits, marauders, near-by murders, small-pox scares, and other such deterrent alarms. In a letter to Dr. Campbell late in 1904, however, Dr. Wright says:

From a non-astronomical standpoint I shall be somewhat sorry to leave the country, as I, in common with the rest of the party, have overcome the repugnance which we all felt at first regarding many of the customs and ways of South Americans. Look at the best Chilenos in the right light, and you will find much to admire and respect.

In Volume IX of the Publications of the Lick Observatory there is an "Introductory Account of the D.O.Mills Expedition" by Dr. Wright which gives a résumé of his term in Santiago, with personal impressions and with praise for many kindnesses received from friendly citizens of Santiago.*

* In this same volume is an account by Dr. Campbell of the "Organization and History of the Expedition" to March, 1906; and two additional articles by Dr. Wright, one entitled "Description of the Instruments and Methods of the D.O. Mills Expedition," the other, "Radial Velocities of 150 Stars South of Declination -20° ."

III

Dr. and Mrs. H. D. Curtis arrived in Santiago on February 21, 1906 with three small children and Mrs. Curtis's mother. They took over the Wrights' house and bought most of their furniture, so their domestic settling-in was comparatively easy. Dr. Curtis did not have the fundamental problems of locating a site and building the observatory which Wright, as the first director, had experienced. His letters, like those of his successors, reported astronomical findings to Dr. Campbell. There were, of course, the constant problems of upkeep, repairs, improvements, accidents, overseeing dilatory laborers, dealing with the owners of the site and with lawyers and with changing government officials, and with the problems of transportation. The slowness of mail, often caused by labor troubles and strikes, was a constant source of anxiety because of delays and damage to supplies shipped from California.

Dr. Curtis's anxieties were increased not long after his arrival by the terrible and incomplete news from San Francisco in April about the earthquake and fire. There was a smallpox scare in Chile in June 1906 and all the family were vaccinated more than once. After that unhappy experience the children had illnesses, not smallpox but pneumonia and other infections.

In August the great Chilean earthquake struck, of which event Dr. Curtis wrote the following lively description:

We had a very severe earthquake last night at about eight o'clock. There were two hard shocks a few seconds apart and lasting about four minutes. I started counting the seconds to time it, changed to a sudden wish to see the lamps put out, and ended in a rush for the rain-drenched patio. The din was very great and all around could be heard the shrieks of the natives. A great deal of damage was done and I send you some papers describing what all agree was a "terremoto" and not a "tembler." Several slighter shocks followed, at each of which we made a break from the kitchen where we had gathered out into the safe, if much wetter yard. When we came to take account of damages we found them quite extensive: a corner of the garden wall down, the rear wall of the house nearly all down on our house and entirely so on three other houses in the block, a five inch crack at the ceiling where the side wall of the dining room had nearly gone down besides fallen plaster and stucco everywhere. Nearly all Santiago

slept out doors that night, in spite of the rain. We were among the few who staid inside though none of us except my wife slept very much. The after effects of the quake have been remarkably persistent. I regret that I did not keep an accurate record of all the separate shocks, but the earth was literally in continuous movement for four hours after the shock. During all this time the parlor lamp kept quivering, with only an occasional intermission of rarely over thirty seconds. Every once in a while came a heavier tremble that sent us hurrying to the doors. After twelve o'clock there were longer times when there was no movement, but sharp shocks came at two and at four which got us all ready to jump again. This has kept up all day.

Santiago was pretty badly scared and slept in coaches or in the street cars or without protection. Still this afternoon the parks and the long Alameda are simply filled with people, there are long lines of coaches private and public where whole families are taking shelter, and every street car has its full quota of inhabitants, nearly all with their blankets. It has been cloudy and damp today but there has been no rain. While last night a pouring rain added to the discomfort. The above sentence was interrupted by another shock when I trimmed down the light and got ready to take Margaret out if it got worse. Poor child, she is in a pretty bad state nervously over the shake, and frequently expresses her desire to leave this country.

My first desire last night was to go at once to the top, but I was heavily out-voted. The tube of the telescope was left standing straight up, supported by jack screws, the big mirror had been placed where it would be practically impossible for the falling tube to hit it; but the good old prisms might have been broken, or the secondary fallen off the place I had left it. I went up the first thing this A.M. and found things all right, the tube was leaning at an angle of ten or fifteen degrees, held up only by one of the guy ropes; some bottles had fallen and a graduate smashed in the dark room. I at once straightened up the tube again and placed the secondary and the prism in a safer place. The stone wall against which the stable, store-room and watchman's ~~room are built suffered most and another quake would bring it down.~~ The telescope had been undergoing alterations. The mirror had been removed to a safe place and the resulting lack of balance of the telescope was compensated by means of jacks and guy ropes. Consequently there was no damage to the telescope or mirror.

I think it will hold with bracing, however. It has pushed the whole lean-to about two inches out of plumb. I have placed a strong 4x4 brace against it in the watchman's room and fixed his door so it would close. The road to the Cerro this morning is filled with rocks which have come down from the quarry dumps; two dead horses are in the road, killed in this manner, one piece of the road is filled with a rock slide and another piece has started down hill. But the electric line has stood, except that all four lines broke loose from the front of our house.

Since the shock fame has been suddenly thrust upon me. All day long people have been at my door, now roto women, another time army officers, policemen from this or that Comisaria, and two or three detachments from the chief himself; as I walk along the streets in this part of the city I am stopped again and again by children sent by their parents to interrogate me, and the climax was reached tonight when a brilliant aide-de-camp with a small lancer escort came bearing a note from His Excellency the President of the Republic. And they all had only one question to ask, "If you please, will there be another terremoto tonight?" I assured them all that there would doubtless be many slight and unimportant shocks tonight and tomorrow, but in all probability none sufficient to cause alarm. I hope I may prove to have been a good prophet, though I guess that that last shock a few minutes ago may have shaken the faith of some.

The funniest part of it, from the scientific standpoint, is the corroboration which the Chilean who works the Weather bureau has got out of it. The Moon still plays an important part in weather prediction here (wish I had some such prognostications to send you) and "atmospheric or seismic disturbances" were predicted for the 16th due to the conjunction of the Moon and Jupiter.

We have still tonight no news of Valparaiso or the other portions of Chile.

It is not surprising, near the end of his first difficult year in Chile, to find Dr. Curtis writing, on December 26th:

Wright's expressed preference for Santiago as a place of residence over any other city on the globe is beyond me, somewhere in the fourth dimension, I guess. Perhaps I may get in range

7

of his point of view in five years. I admit, however, the desirability of being near such a large center for a station like this one....

But I must say that my present opinion of Santiago coincides more nearly with what General Sherman said he would do if he owned both Texas and a Certain Place.

During the following year, on the anniversary of the earthquake, Dr. Curtis received two policemen who were sent to him as the authority who would know whether the populace might expect an anniversary recurrence of the disaster!

By 1909, however, the Curtis family had become accustomed to the place. The children were on the program in school entertainments, the life in Santiago was familiar, and they loved their home. In January Dr. Campbell was able to offer Dr. Curtis a much better job on Mount Hamilton, which he accepted with mixed happiness and sorrow. On June 15 he wrote:

Well, it does not seem any easier to leave now than it did at the first news of the change. We shall leave Santiago with very great regret. If we average up as happy and contented during the next three and a half years as we have been in the past, as I think we shall, we shall not regret the change. Moore finds our attitude toward leaving Chile as difficult to understand as I did Wright's roseate prophecies three years back.

Early in 1909 Dr. Campbell was considering the possibility of moving the site of the observatory to a more northerly point, provided that Mr. Mills was intending to continue his financial support. Dr. Wright, in 1903, had sent his assistant, Dr. Palmer, to look at San Felipe, fifty miles north of Santiago, and had regretted that there was no time to go to Copiapo, which is four hundred miles away, or other places farther north. But six years later, at the end of Dr. Curtis's term he discussed the possibilities of Copiapo, of Antofagasta, and Iquique, and even of Tacna, which is in southern Peru. It is interesting that ^{the port of} Coquimbo, less than three hundred miles north, is also a place he mentioned, because it is very near ~~the port of~~ La Serena, which is the headquarters for the Cerro Tololo Inter American Observatory which has been established by the Association of Universities for Research in Astronomy and supported by the National Science Foundation.

IV

Joseph H. Moore was the third director in Santiago, and served from June 1909 to August 1913. His wife, Fredrika Chase Moore, was his assistant, as well as George F. Paddock, who had been there with Curtis from 1906 and stayed until 1912. The Moores, and his mother who was with them, seem to have slipped easily into the life of Santiago, for as early as September of his first year Moore wrote to Dr. Campbell:

We are enjoying our life here in Chile, the climate is delightful, and evidently agrees with us as we are all well and

hearty. I like the work very much and the walk up the hill does not seem so bad as at first; in fact it gives me good regular exercise.

The Moores also enjoyed the cultural life of Santiago, and in 1911 Dr. Moore wrote:

We are having a real treat this season in grand opera. Mascagni is here with his large Italian company and an orchestra of eighty pieces. Mr. Sanford [who had arrived to replace Paddock as assistant] and we are making good use of cloudy nights in hearing as many of the operas as we can, for we shall probably not have an opportunity of this kind when we return to the States.

V

Ralph E. Wilson became the fourth Director of the Expedition and went to Chile with his bride in 1913. The Moores returned to Mount Hamilton in September, and Dr. Campbell wrote Wilson: "The Moores arrived ten days ago, and are practically settled in Cottage No. 2. I think they are glad to be back, although they speak of the genuine sorrow which they experienced on leaving Santiago."

The Wilsons were in Chile from 1913 to 1918, a most interesting time for them. On the way south they visited the Panama Canal which was nearing completion. They enjoyed seeing the Culebra Cut and the Miraflores and Pedro Miguel locks. Their son was born the next year, and Mrs. Wilson's mother and sister Eileen came to visit them. Eileen joined Dr. Wilson and Mr. Sanford in tennis tournaments, helping the Americans win over the Spanish and English, and upholding the honor of the D.O.Mills Expedition.

The World War began in 1914, causing great concern even on the west coast of South America. Dr. Wilson wrote Dr. Campbell on August 3rd:

Santiago is very much excited over the news of general war in Europe, a large percentage of the foreign population here being German and French. The streets are crowded with people reading the bulletins, business is at a stand-still and the German banks have suspended payments entirely.

He wonders about Dr. Campbell's problems as he travels in Russia for the eclipse. On the same day Wilson wrote Dr. Tucker on Mount Hamilton that business was stagnated in Santiago and that many of the large wholesale houses had stopped selling goods. Conditions grew worse; and by the end of the month Santiago was full of unemployed and starving people, and there was talk of a general strike. This was presently averted by the government's issuing paper currency and employing the unemployed on the streets.

The war years continued to be trying, especially because of inflation in Chile and at home, and frequent delays in supplies and mail. But in April 1917 Dr. Wilson writes of the excitement and satisfaction felt at the imminent entry of the United States into the war. In May he was asked to serve as one of the three American representatives on the committee of the Allies in Chile for raising war funds; and in July he reports that the American ladies in Santiago were busy at Red Cross work. At the end of the year the financial problems of inflation and the rate of foreign exchange caused a crisis in the Wilson family so that Dr. Wilson sent his wife and son home, sold his furniture, engaged room and board nearby, and resigned his position the following July.

He left his assistant, Mr. C.M. Huffer, in charge of the station. Huffer was a twenty-three year old graduate student under Professor Stebbins at the University of Illinois who applied in May 1917 for the assistantship open in Santiago. Dr. Stebbins's high recommendation resulted in Dr. Campbell's hiring the young man at once for a term of five years, with the suggestion that at the end of two years, when Dr. Wilson's term ended he might succeed Wilson as Director. Huffer first went to Mt. Hamilton where he made a very pleasant impression and received two weeks of intensive training.

He had a pleasant trip to Chile, was kindly welcomed by the Wilsons, and wrote cheerfully of his new life. He made a wide acquaintance among the Americans in Santiago, played tennis on Saturdays, took trips with friends into the mountains, and became engaged and married before his term was over. As things turned out, Dr. Wilson left Santiago less than a year after Huffer's arrival, and though Huffer was not appointed Director he was in charge of the observatory by himself for fifteen months owing to the delayed arrival of the next Director, George F. Paddock.

Of course Huffer had his troubles, which took the form of influenza, money problems resulting from inflation and the rate of exchange, the Cerro being changed into a municipal park with resulting vandalism to the

windows and grounds of the observatory, and difficulties arising from delay in receiving supplies. A shipment of necessary articles which left Mr. Hamilton on January 10th did not arrive until May 22nd. He survived these and other troubles, but was glad to turn over the major responsibility to Dr. Paddock, who arrived in September, 1919; and he was gratified at an offer from Dr. Campbell to continue his appointment in Chile for an additional year. However, he and his wife were eager to return home and meet each other's families and escape Chilean inflation, so he declined this complimentary offer. He reported his return to Dr. Campbell and expressed his thanks from Sandusky, Ohio and went on to Madison, Wisconsin to accept an appointment at the observatory there.

VI

George F. Paddock had been assistant to Dr. Curtis and Dr. Moore from 1906 to 1912. It is an interesting fact that Paddock, of all the personnel connected with the Expedition, served in Santiago longest, for beyond the years of his assistantship, his tenure as Director lasted from 1919 until 1924.

In addition to his duties as Astronomer he spent much time on painting and repairing the buildings and grounds during these years just following the Armistice, and in putting the observatory equipment in order. This was apparently a monumental task, which he seems to have performed with thoroughness, but which caused a slacking-off of astronomical duties to a degree quite disturbing to Dr. Campbell.

In May 1922 Dr. Paddock left Chile for an unexplained visit to relatives in Providence, Rhode Island, leaving what he called a "personal aide" in charge, -- a piece of intransigence which irritated Dr. Campbell,

1

to say the least. Intending to return in the following July, he did not appear in Santiago until September 14th. All was well. He remained until early 1924.

VII

meantime, however, F.J. Neubauer, Acting Astronomer, who had arrived in October, 1923, ~~had taken~~^{took} over Paddock's administrative duties on orders from Dr. Campbell, and continued as Director through April, 1929.

Dr. and Mrs. Neubauer and their daughter found the cost of living high in Santiago, but were soon comfortably housed, thanks to the help of friendly English people. They looked forward to enjoying their new life, although it was made somewhat difficult for them in their first months by Dr. Paddock's lack of cordial cooperation. The safe birth of their second daughter in December and the departure of Dr. Paddock in January made things easier for the Neubauers.

Economic problems were still great, however. Dr. Neubauer wrote Dr. Campbell that he could repeat what Wright, Curtis, Moore, and Wilson had said about the unexpected cost of living and the difficulty of adjusting to changed conditions. He said he paid twice as much for living in an inferior neighborhood as the cost had been to Curtis on a nice street. "The prices once up," he added, "stay up. The people get used to the higher figures."

Their personal life fell into a pleasant family pattern during the first year, with little Phoebe starting school and appearing in the school play "Curly Locks," which was the first "show" in Santiago to which her parents had gone.

For the Observatory, complications began to arise with the growth of the park on the Cerro. This expansion included an "ascensor" which brought larger crowds to the mountain top, to the restaurant, and visitors to see the Observatory and the zoological garden. The Park Administration urged a new and more attractive fence around the Observatory grounds to replace the unsightly barbed wire one. Dr. Neubauer agreed that it would look better and give more protection from the growing crowds, and was able to get an appropriation for the new fence from Dr. Campbell. The fence was completed in spite of four labor strikes including one of the little burros carrying the cement.

In 1925 the Neubauers had a nice, roomy new house, which made

things so comfortable for the family that in spite of its higher cost Dr. Neubauer wrote "Were I ten years younger I would want to stay here, and that is enough to express one's liking for a country." But the steadily rising prices caused him to reverse this warm feeling for Chile.

The Observatory with its new fence and garden began to look acceptable to the Park authorities, but its days as an outpost of the Lick Observatory were beginning to be numbered. The lights from the restaurant at night and the crowds asking to be allowed to visit began to be a source of annoying interruption. Progress was marching, including at times much quicker communication between Mount Hamilton and Cerro San Cristobal because of the kindness of "radio hams" on the wireless.

Funds to continue the station in Chile began to dwindle in 1926 and Neubauer was asked to dismiss his assistant, Mr. Fopp, and get along alone. Following a revolution the Chilean government became unfriendly to the Observatory, and Dr. Campbell ^{again} was trying to decide whether to move the station to a site more favorable to observation and to operation, provided additional funding could be found. The Harvard College Observatory had let a contract for the construction of a 60-inch mirror to be erected in South Africa.

In July 1927 Dr. Aitkin, Acting Director of the Lick Observatory, wrote Neubauer that Dr. Campbell had practically decided to close the Chile Observatory at the expiration of Neubauer's current contract. He hoped to sell all the equipment on the ground if he could get a good price for it. Dr. Campbell wrote the Consul General of Chile in San Francisco regarding the possibility of purchase by the Chilean Government. Then Dr. Neubauer discovered during the visit of a prominent astronomer from Spain, a Catholic, that the Catholic University in Santiago might be a likely customer, and as it turned out, the sale of the equipment was concluded with the University on July 1, 1928.

The Rector behaved handsomely toward Dr. Neubauer, making him a "Member, honoris causa, of its Faculty of Physics and Mathematics," and offering him the right to direct a special ^{course} ~~course~~ of Astronomy as Professor Extraordinary. Of course Dr. Campbell was pleased at these honors, and agreed to having Neubauer stay on until May 1929, serving on the faculty of the Catholic University, and continuing ^{ed} ~~ing~~ to pay his salary from the University of California.

The Neubauers, after these happy transactions, must have enjoyed their last year in Santiago, but they began to look forward to getting home

and to being there for the Fourth of July, 1929. Neubauer spent this last year finishing his astronomical tasks and training his successor, Señor Toro. He wrote, shortly before leaving:

It does seem our last year was the happiest here. Maybe being 'old settlers' among the colony accounts for it. The new American Ambassador, Mr. Culbertson, has been very nice to us many times, and Mr. Culbertson and Mrs. Culbertson invited us to tea several times. Tomorrow, May 12, the Ambassador gives to Mrs. Neubauer and me the farewell luncheon at the Embassy....All is well here. The children are happy, healthy, and anxious to go to Estados Unidos. We are also, of course, but we were very happy here just the same....

About fifty friends saw them off at the station in Santiago. Dr. Neubauer could not look toward Cerro San Cristobal for fear of crying like a child. It is good to read in Dr. Aitken's letters all signs of a warm welcome awaiting the family on Mount Hamilton.
