# II. — CHILI

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I believe it is very difficult to make any recommendations or give any advice for site survey expeditions except of a very general nature. When you start out anew, then, as Dr. Scorer has already stressed very strongly, the first thing you have to do is to contact the meteorological office or the local meteorologist. There is no need to go into detail for I think you all realize that the statistics presented by the weather bureau do not serve our purpose. They are made for a different purpose than ours, and you will always have to go back to the original records and pull out from them the data that may be useful. Suppose you have done this, and you have located either on a world-wide scale the country that is the most promising, or within the country the most promising place as far as cloudiness is concerned. Then what are the next steps ?

It is practically certain that a good observatory for night-time work will be on a mountain site. So the problem that you have to solve is what kind of mountain to select. The first thing to do is to select the altitude, and the altitude which is advisable is determined by two factors : the lower limit is determined by the inversion. The temperature inversion has been mentioned a number of times during this symposium and its effect on seeing has been demonstrated, so there is no need to go into that again. In one picture that Dr. Scorer showed the inversion was clearly shown as the top of a thick haze layer. This is one of the easiest ways of getting information on the inversion, particularly in the early morning when dust, haze or smoke, is confined below the inversion until adiabatic conditions are re-established. So in many instances, the haze layer marks very well for you the level of an inversion. Of course, it depends on the existence of scattering particles, which in exceptional cases may not be present in sufficient quantity to be visible. In that case you will have to make temperature measurements. Pilots can often tell you at which height the inversion can be found and usually they also know how it depends on the season, and so on; so you can get this information quite quickly. From my experience, at least in semi-arid areas, it is always between, say, 1200 and 2 000 m. That seems to be at least the most common range of inversions. So you certainly want to be above that by a safe margin.

The *upper limit* is set by two factors, or possibly by three. In the first place you may not have any mountains higher than the inver-

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sion. In most countries under study now, there are mountains up to many thousands of meters, 6 000 m or more. Then you have to determine what is the human limit, and on this there may be very wide disagreement. I think you may have as many opinions as you have astronomers on how high you can go. Another more technical consideration comes in also. Speaking on very general terms, wind speed increases with height of a mountain peak, although this is not necessarily so in special cases.

With these considerations you may be able to decide more or less in what range of height you want to be. The next step is then to select a site of suitable local topography. It is very important, for a number of reasons which have been mentioned already, to select a site which is isolated from neighbouring mountains of similar or even higher elevation. So you need an isolated peak. Ideally it should be a pinacle of 2 000 m elevation which does not disturb the free atmosphere at all. Of course this is unattainable, since the peak must have some surface. In most cases you will want to instal there not one telescope but a number of instruments, so you need a considerable area and must consider what shape it should be. However, one thing is certain : the surface of your mountain top must be as small as possible.

One consideration — there may be many others — that may guide you, is the following : let us imagine a ridge with the wind blowing at right angle to its length; as the air-stream passes over the ridge, it has of course to be compressed and the result is that, at a distance above the surface which will depend on the actual shape of the ridge, the air velocity may be considerably higher than that in the free atmosphere. From a few experiments which I have tried myself, it turns out that this may occur within the height of our buildings or telescopes. So, if there is a predominant wind direction, one should select a mountain which extends along the direction of the wind and not across it.

Once you have all these data you are actually ready to select your sites and this is the stage we have reached in Chile. We are only a few people and are even more limited with instruments. Furthermore there is very little meteorological information available in the country. So we had to go step by step and actually it has turned out that we have begun near Santiago and are slowly working our way north.

The general weather conditions are such that there is a very strong gradient of cloudiness with latitude. In fact, between about 35° and 25° latitude, there is a very simple relation : one gains about ten clear nights per year per degree latitude as you move North. This meant that we had to go as far North as possible. On the other hand, we wanted to establish a southern observatory. From pilots we learned that the average wind speed is at a minimum around 30°S. So it appeared that in the neighbourhood of 30°S or a little North or South of it, we might find a good compromise.

The last two stations out of ten which we have investigated are located one at 30°S and the other at 27°30′S; their elevations are 2 200 and 3100 m respectively. The minimum desirable elevation, taking into account inversion effects, was 1800 m. Regarding wind, we also found one interesting thing : in one area we had two sites, one at 3100 m and another at 2 400 m. We found that for low wind speeds the higher site had the lower wind speed, whereas when the wind speeds became high, 30 miles/h or more, then this site would begin to gain over the other. This is probably because the low wind speeds are determined by local factors which have greater influence at the lower than at the higher level.

Now, I think it might be interesting for you to see a little bit of the two sites which we still have under study. Plate XIV *a* is so to speak the " discovery picture " of Tololo (the name of the mountain); it is a very well isolated site. The valley in front has an elevation of about 600 m above sea level. The mountain itself has 2 200 and is about 25 km from this valley. The peak is surrounded by steep drops on all sides. Plate XIV *b* is a view of Tololo from nearby peak. There is some inversion, very well below the top. Plate XV *a* shows the top and some of the instrumentation we have been using. To the left is an 8-inch reflector with which estimates on the Danjon scale were made. To the right is one of the earlier models of the double beam telescope. When the conditions observed with these two telescopes turned out to be very promising we developed the site a little more. Now we have a 16-inch reflector mounted on the mountain (*plate* XV *b*). You see also some high cumulus formations over Argentina, towards the high Andes. We have a number of buildings up there, electric power and all of this. You may wonder how we get to the site. Well, we built a little piece of road of about 9 miles ourselves and with this you get within 25 km of the mountain top, the remaining 25 km including an almost 2 000 m climb has to be done on horse back or on foot if you wish. This is to say that the equipment, the telescope and the buildings, werre carried up by pack animals. Now views down. The Chilean coast is almost always covered by low clouds with the top always well below 1000 m and under certain conditions these clouds move, of course at a very low level, up to 100 km inland in the valleys. Looking down from Tololo down into the surrounding valleys you see fog with a top at about 800 m (*plate* XVI *a*). On a view towards the coast, about midday (*plate* XVI *b*) you see the coastal fog over the plain. The coast is about 40 or 50 km away from the mountain top. We have a very strange situation there which is actually quite common. Whenever there is one of these bad weather periods which come only during the winter and are very short, then you get the high cloud cover over the land, while at the same time the coastal fog over the ocean disappears and the ocean is clear; this means that shortly before sunset, the Sun will pass over a very narrow slit of clear sky, just over the horizon and then it will illuminate with red light some of the mountains so that you get a fantastic appearance. Now I want to mention the local airports from which most of the weather information comes. Of course they are at sea level, or very near sea level. So they have a very different weather situation and their daily report is very different from the one that interests us.

**Fig. 72. — The top of La Peineta.**

Figure 72 shows La Peineta where we have a site under study. In this picture you see about one-third of the mountain. It has a very steep drop, to the right, towards the coast; there is for about 50 m a gentle slope up to the East and then begins a much steeper slope. However, the ground is all gravel, so we were able to bring a road up and you see all our vehicles.