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PERIGLACIAL STUDY IN THE PATAGONIAN ANDES

Abstract

This paper contains the results of a part of my study on periglacial morphology at the eastern slope of „Hielo Patagonico Norte” in the Patagonian Andes during the „Expedición Chileno Japonesa Andes Patagónicos 1958” which was done during January, February and March, 1958.

Having traced up the Rio Baker and Rio Colonia Valleys, we crossed the virgin waters of Lago Colonia to the unexplored shore where we set up our base camp at the edge of the Colonia Glacier at an altitude of 240 m. When our climbing group was engaged with the virgin peak of „Cerro Arenales” (3 437 m) I made several brief explorations around the base camp, and found an interesting small lake which we named „Lago Arco” in the lower part of the glacier.

In midsummer the lake-basin was empty with a huge moraine in the bottom of the basin, while it was full of water the air photograph taken by the Chilean Air Force early in spring, 1945 shows a half-moon-shaped island suggesting the top of the moraine.

I have heard of the mysterious flood which occurs once every summer along the Rio Baker, resulting serious loss of cattle. I proved the hypothesis that flood might be caused by water from the lake. Such is one of the characteristic features of the rapidly retreating glacier of the region, and I am particularly interested in analyzing many others within the Rio Baker Region by using several air photographs available.

This paper comprises a part of the periglacial study of the „Expedición Chileno Japonesa Andes Patagónicos 1958” of the period, January to March, 1958, of which the writer was the leader of the Japanese team, and the chief of the scientific researches.

Concretely, most of this paper is based on the writer's personal observations of the glacial ecology of the area around our base camp at the end of the Colonia Glacier, as well as of the glacial morphology of the valleys Rio Baker and Rio Colonia.

In southern Chile, there are two extensive Andean ice fields, the „Hielo Patagonico Norte” in the north and the „Hielo Patagonico Sur” in the south. Both are far more extensive than any other known. Specifically the former occupies an area of 3 104,8 km², and the latter an area of 11 301,6 km².

The main objectives of this expedition were to make the first ascent of the Cerro Arenales (3 437 m), which protrudes from the middle of the ice field as the third highest peak of the region, and to cross the ice field from the east to the west. The former aim was successfully accomplished, although the latter had to be abandoned because of transportation difficulties.

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The climate of the „Hielo Patagonico Norte” is very different on the west (Pacific) side and on the east. On the west the Cfb (Köppen) climate predominates, so that with heavy winds, precipitations increased on mountain sides, prove a thick snow cover in the Andes. On the other hand, the climate of the east is a variation of the Pampa type, and with a rather cool summer caused by wind sweeping down from the snow-covered Andes. This decidedly arid climate predominates as far as the end of the valley-glaciers along the eastern escarpment of the Andes. For example, the relative humidity often fell to 20% at our base camp, and the fluvio-glacial drifts have reached the desert, even causing dust storms during windy days.

The writer and his team landed at Chile Chico on Lago Buenos Aires, 1 600 km south of Santiago, Chile, and then proceeded up the Rio Baker (which connects the lake with the Pacific coast) and its tributary, Rio Colonia. We then crossed the virgin water of Lago Colonia to the unexplored far shore where we set up our base camp at the edge of the Colonia Glacier at an altitude of 240 m. From there our climbing party ascended the Colonia Glacier and the Arenales Glacier (so-named by us) and on March 6th, 1958 our first ascending party stood at the summit of the Cerro Arenales after having covered the 25 kilometers lying directly between this point and the base camp.

The height of the snow line on the Arenales Glacier is estimated at 1 300 m which we affirmed at our advance camp no 3. Beneath the snow line, is an extensive ice mass which melts constantly throughout the summer, and exhibits several characteristic features. The writer is particularly interested in comparing these Patagonian glaciers with those of the Alps and of Scandinavia with which he is somewhat acquainted.

Some of the characteristic features of the Patagonian glaciers are:

(A) These glaciers contain many streams of water both on and under the ice mass, so that very possibly some sizable sub-glacial lakes may exist, at least temporarily.

(B) The moraines are not well developed except for the older end-moraines which are 200 meters in height at the end of Lago Colonia. The end-moraines of the present glaciers are rather small, having only 5 or 6 meters in height.

(C) The tails of the present glaciers in this region do not look like tongues but more like snakes' tails from which huge delta plains consisting of glacio-fluvial drift have developed.

The drift-clay plains of the Colonia Glacier have turned into the desert because of the arid climate associated with the winds.

(D) When examining the ice-smoothed rocks, it is obvious that the mechanism of glaciation here may be somewhat different from that of the northern hemisphere. It may well be called „carving” rather than scouring, according to my observations of the drainlike sculpture of the granodiorite, which contains only slight striae. This leads to postulate that the mechanism was the mighty carving agent of the glacier-body itself rather than an ordinary scouring agent with gravels as a tool.

(E) The glaciers are retreating rapidly, a condition whose process in the last ten years can be clearly observed if one compares the present features with the numerous photographs taken by the Chilean Air Force. It is obvious that snow line lies higher in the east than in the west, and is rapidly moving upward.

(F) The Pampa-type arid climate is overwhelming the so-called „Clima del Hielo” of the region, and the forest cover represented by the *Nothofagus* family, is gaining ground against the glaciers. The data acquired by meteorological observations at our base camp, near the end of the Colonia Glacier, may serve to clarify the above mentioned problems.

Summary of the meteorological data, during Feb. 20 and May 9, 1960: Average highest temperature fluctuated between 18° C and 20° C, appearing at 2—3 p.m., while the lowest, 2° C and 5° C, at 6—7 a. m. Average highest humidity fluctuated between 39% and 45%, at 4—6 p.m., while the lowest, 17% and 21% at 2—4 a.m.

(G) The Rio Baker floods only once each summer. In searching for the cause of this, the writer travelled upstream and finally reached Lago Arco (also named by us), only to find it dry, although photographs taken by the Chilean Air Force in September 1944 show it completely filled with water. The lake is 4 kilometers long and 2 kilometers wide in the photograph, and a huge moraine I observed in the basin is shown in the photograph as a half-moon-shaped island in the lake.

There is a record of the previous floods according to local settlers:

Year	Date of flood	Local reporters	Remarks
1953	Jan. 25	Romero	no flood 50 oxen killed in Valle Grande
1954		Alarcon	
1955	Dec. 29	Romero, Alarcon, Cadin, Chavaria	
1956	Dec. 31	same as above	4—5 m higher water level at junction of Rio Colonia and Rio Baker
1957	date not remembered	same as above	
1958	Jan. 7	same as above	

At several places, I observed high water marks along Rio Colonia and Lago Colonia among which the highest examples were shown by drift woods resting on the lake-shore seven meters above the lake surface. So it is clear that the high waters in the lake cause the floods down-stream.

There are two glacier-dammed lakes upstream, both connected with Lago Colonia, one is called Lago Nef by us, the other is Lago Arco. As already mentioned, I have a photographic record of water-filled Lago Arco, and I have found it actually empty, so I have to admit that the flood once-a-year must originate from Lago Arco. The huge moraine occurring in Lago Arco is supposed to have been built by two glaciers coming together from different sources and after retreating of both glaciers, the lake was born around this composite terminal moraine. Here and there in the lake-basin are water-absorbed ice barriers which give me an impression of a drowned ice barrier just released by the recent sudden drainage.

The mechanism of the outburst of water from glacier-dammed lakes which Mr. Melvin G. Marcus explained in his paper¹ will be adapted to the case of Lago Arco.

I do not conclude that Lago Arco is the only source of periodical floods, because Lago Nef may produce smaller or more frequent small drainages during the warm season. Why should a big drainage occur only in Lago Arco? I think it may be the problem of sub-glacial gradiency, namely the greater difference of altitude between Lago Arco and Lago Colonia.

In conclusion, I believe that this kind of floods more frequently occurs in low level ice fields where the summer temperature is comparatively high, and the nature of glaciers themselves have turned to be in more favorable condition for this phenomenon.

It is my hope to get more informations of this kind in other part of the world.

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¹ M. G. Marcus — Periodical drainage of glacier-dammed Tulsequah Lake, British Columbia. *Geographical Review*, vol. 50, Jan. 1960.