

GLACIAR YANASINGA (CENTRAL PERU): 24 YEARS OF MEASUREMENTS

By U. PETERSEN,

(Department of Geological Sciences, Harvard University, Cambridge, Massachusetts 02138, U.S.A.)

L. SASSARINI and R. PLENGE

(Departamento de Geología, Cerro de Pasco Corp., La Oroya, Peru)

ABSTRACT. Glaciar Yanasinga (lat. $11^{\circ} 36' S$, long. $76^{\circ} 12' W$, 4 850 m a.s.l.) is probably one of the few glaciers in the equatorial region on which measurements have been performed during the last 24 years. These were carried out in the years 1944, 1945, 1946, 1947, 1948, 1949, 1957, 1963 and 1968. The results of these surveys are presented on a map and references are given for those interested in obtaining more detailed information.

RÉSUMÉ. *Glaciar Yanasinga (Pérou central): 24 années de mesures.* Le glacier Yanasinga ($11^{\circ} 36' S$, $76^{\circ} 12' W$, 4 850 m) est vraisemblablement l'un des rares glaciers de la zone équatoriale sur lequel des mesures ont été exécutées au cours de 24 dernières années. Ces mesures furent effectuées dans les années 1944, 1945, 1946, 1947, 1948, 1949, 1957, 1963, et 1968. Les résultats de ces études sont présentés sur une carte et des références sont données pour les intéressés désirant obtenir des informations plus détaillées.

ZUSAMMENFASSUNG. *Der Glaciar Yanasinga (Zentral-Peru): 24 Jahre Messungen.* Der Glaciar Yanasinga ($11^{\circ} 36' S$, $76^{\circ} 12' W$, 4 850 m) ist wahrscheinlich einer der wenigen Gletscher in der Äquatorzone, für den es Messungen aus den letzten 24 Jahren gibt. Diese wurden in den Jahren 1944, 1945, 1946, 1947, 1948, 1949, 1957, 1963 und 1968 ausgeführt. Die Ergebnisse werden auf einer Karte dargeboten und es werden Hinweise gegeben für diejenigen, die genauere Auskunft haben möchten.

INTRODUCTION

Glaciar Yanasinga is perhaps one of the few glaciers in the equatorial region for which measurements are available covering a period of 24 years (1944–68). It is desirable to call attention to this example because the behavior of glaciers in low latitudes relative to those in high latitudes is of interest to arguments concerned with the causes of glaciation and because the literature on this glacier is mainly in Spanish and in journals of limited circulation.

LOCATION

Glaciar Yanasinga is located on the southwestern slopes of Yanasinga peak (5 300 m a.s.l.), and terminates on the edge of Laguna Yanasinga (4 840 m a.s.l.). Its geographical coordinates are approximately lat. $11^{\circ} 36' S$ and long. $76^{\circ} 12' W$, being situated close to the point where the Transandean Highway (Carretera Central) crosses the continental divide in central Peru (Anticona Pass, Ticlio).

HISTORICAL BACKGROUND

In 1944 V. Oppenheim, G. E. Kruger, M. Iberico and P. Tinoco placed a reference pillar (*hito*) with an elevation arbitrarily set at 4 850 m above sea-level (by approximation with an altimeter) and measured the distance to the front of the glacier on both sides of the lake. Subsequent measurements have been made by various parties in 1945, 1946, 1947, 1948, 1949, 1957, 1963 and 1968. The senior author of this note participated in all these except the last expedition. The 1968 survey was carried out by the junior authors on 8 August.

Details concerning the results of previous expeditions are given in the documents and publications listed in the references. During most of these surveys photographs were taken from the same point (*hito*, 4 850 m), but unfortunately with different cameras. Only a few of these photographs have been published. Others may be obtained for comparative purposes by contacting the individual members who participated (for complete list of investigators see Petersen (1967)). The original copies of the maps should be in the Servicio de Geología y Minería of Peru, which inherited the files of the Instituto Geológico, of the geological branch of the Instituto Nacional de Investigación y Fomento Mineros and of the Carta Geológica. Ozalid copies of some of the maps are also in the files of the senior author of this paper.

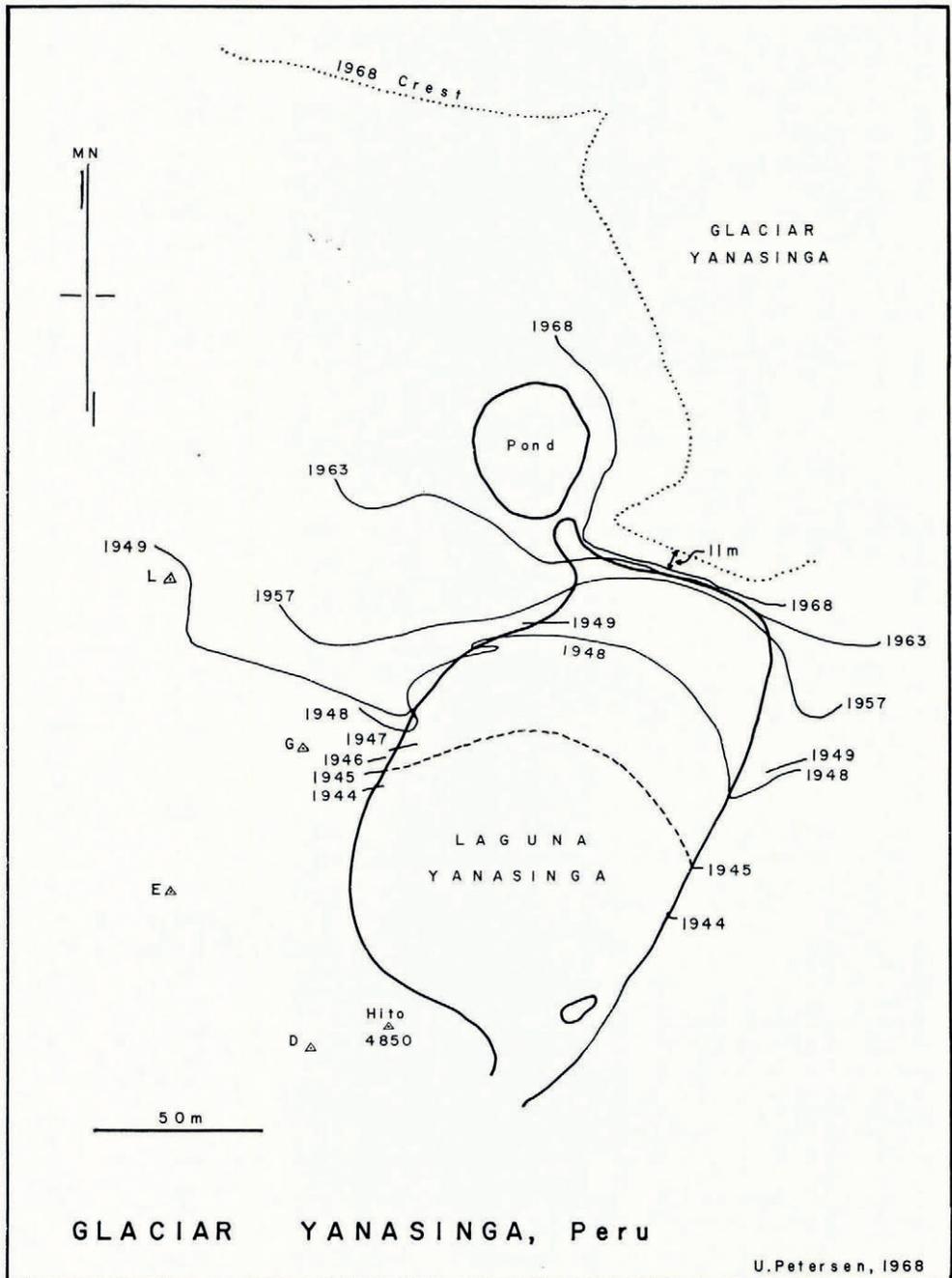


Fig. 1. Map of Glaciar Yanasinga, Peru, showing location of terminus of the glacier at the various surveys and also the crest of the frontal cliff in 1968.

TOPOGRAPHIC SURVEYS

Early surveys were made with tape and Brunton compass, but later expeditions used transits or range-finders (see Petersen (1967) for details). The 1968 survey was carried out with a rangefinder (at the distances involved, the error was in the order of 1 m).

All surveys used as a common reference the *hito* (4 850 m) point. The cement or rock pillars at this location have been destroyed more than once, but the place is so characteristic that it can be identified quite closely. Furthermore, additional rock pillars (D, E, G and L), the lake outline (constant because of overflow) and an island permitted correlation of successive surveys. Hence, they are deemed to be accurate to within one meter.

The results of the topographic surveys are summarized in Figure 1. The solid and dashed lines on it correspond to the intersection of the terminus of the glacier with the surface of the lake or its outline on land. In 1944 and 1945 one point was located on each side of the lake. In 1946 and 1947 only one point was determined on the west side of the lake. In 1948 several points were surveyed along the front, revealing its marked curvature. In 1949 the western side was located in detail, but only one point each was determined in the center and in the east. In 1957, 1963 and 1968 many points were located along the snout of the glacier.

While the glacier ended in the lake its terminus was a cliff. In 1968 the terminus barely reached the lake, but was still very steep in this part. The elevation of the highest point of this frontal cliff was measured in 1944, 1945, 1957 and 1968 (see results below). Additional points along the crest of the frontal cliff were surveyed in 1957 (see map published by Petersen (1967)) and in 1968 (dotted line on Figure 1).

RESULTS

The surface of Yanasinga Laguna was frozen in 1945, 1947 and 1948. During the other visits it was liquid and for the last three inspections there were no icebergs, the water having a green, milky appearance. The new pond formed to the north of the main lake was frozen in 1968.

The height of the front or face of the tongue was as follows:

| | |
|------|------|
| 1944 | 30 m |
| 1945 | 25 m |
| 1957 | 33 m |
| 1968 | 11 m |

Retreat has of course been variable along the front and sides. Figure 1 shows this clearly and evidently diverse values could be obtained by different investigators depending on the points selected. Using points on the sides of the lake one obtains an average retreat of 4.6 m/year for the 24 years of observation. However, the central part suggests an average of only 3.2 m/year for this period.

MS. received 18 March 1969

REFERENCES

- Oppenheim, V., and Spann, H. J. 1946. Investigaciones glaciológicas en el Perú, 1944-1945. *Boletín del Instituto Geológico del Perú*, No. 5.
- Petersen, U. 1967. El Glaciar Yanasinga, 19 años de observaciones instrumentales. *Boletín de la Sociedad Geológica del Perú*, Tom. 40, p. 91-97.
- Petersen, U. Unpublished [a]. [Reports to Instituto Geológico del Perú, 1946, 1947.]
- Petersen, U. Unpublished [b]. [Letter to Dr. Ing. J. A. Broggi, dated 26 August 1957. Information presented by Dr. J. A. Broggi to I.G.Y.]
- Rose, E., and Bottger, A. Unpublished. [Report to Instituto Geológico del Perú, 1948.]
- Spann, H. J., and Petersen, U. 1951. Algunas observaciones instrumentales en los glaciares de los Andes Peruanos. (*In Primeras jornadas de meteorología. Diciembre de 1950.* Lima, Sociedad Geográfica de Lima, p. 209-25.)