Fig. 1. Vertical aerial photograph of two small glaciers at the head of Beacon Valley, Victoria Land, Antarctica, showing stranded lateral and terminal moraines, and the form and distribution of sand-wedge polygons. Well-defined polygons cover the outer wall of the most recent arc of the fourth (compound) terminal moraine. U.S. Navy Aerial Photograph Antarctic run 16, No. 189; 15,700 ft. [4,785 m.]

CORRESPONDENCE

The Editor,

Journal of Glaciology

SIR, *Recent moraines of a lobe of the Taylor Glacier, Victoria Land, Antarctica*

The argument advanced by Messrs. Blake and Hollin on pages 792-93 of the October issue of the *Journal of Glaciology* depends on the premises that the patterned ground is all of one age and has taken a long time to develop. Both are assumptions of very doubtful validity. Apparently it has been assumed that the polygons showing in the photograph are ice-wedge polygons of the kind found commonly in Arctic regions and elsewhere, but Péwé has shown that they are quite distinct and has called them sand-wedge polygons.[1]

We have concluded from observations at many localities around the western and south-western sides of the Ross Sea that, under the present climatic conditions, sand-wedge polygons are forming and changing continuously and rapidly. They show a large range in radius, depth of trough, shape of the profile of the central core area, relative activity or stability, degree of infilling by wind-blown material, and other characteristics which can be related to site, to size, depth and lithology of superficial fragmental material, to a probable cycle of development through youth, maturity and old age, and to other factors some of which are not understood. Preliminary detailed studies of sand-wedge polygons by a number of colleagues are being prepared for publication, and their results appear to support our opinion that these polygons can form in less than 50 years, and possibly in only a few seasons. As noted by Péwé they even form in stagnant ice.

The dry valley shown in our photograph on page 652 of the March 1960 issue has been named Beacon Valley by McKelvey and Webb.[2] The photograph, which shows a small part of its lower end, is deceptive in indicating a *uniform* development of the polygons, for it was noted in the field and has been checked by inspection of a U.S. Navy vertical aerial photograph (0156, run Ant. 4) that there are considerable and important changes in the nature of the patterned ground up-valley from the terminal face of the glacier lobe. Between the ice-face and the nearest moraine ridge the polygons are well-defined and fairly regular in shape, and have a relatively constant radius, but even in this sector of the valley floor they have an increasing vagueness with increasing distance from the ice face. Between the moraine ridge that is nearest to the ice front and the one farthest from it the polygons are less well-defined, less regular and of variable radius. Beyond the farthest (fourth) distinct moraine ridge, there is an increasing vagueness and irregularity of shape with many very large polygons. We take these changes to represent mainly stages in a cycle from youth towards maturity, and to indicate that the youngest polygons are those closest to the ice front.

It is clearly desirable to have a greater understanding of sand-wedge polygons but in the meantime we favour the tentative working hypothesis of our original letter in preference to the stimulating alternative advanced less tentatively by Messrs. Blake and Hollin. Naturally, for the phenomenon is common in temperate regions,[3] we consider that each terminal moraine could represent a minor advance superposed on a general period of retreat.

Our preferred hypothesis is supported by the occurrence in the middle and upper reaches of the Beacon Valley of moraines which were not mentioned in our original letter, partly because that locality was being described by colleagues,[2] and partly because we had viewed them only from a high point at a distance of several miles. We have obtained recently, however, a copy of a U.S. Navy aerial photograph (0189, run Ant. 16) of the head of the Beacon Valley which shows that the trunks of two small neighbouring valley glaciers are each bordered by four distinct loops of stranded lateral and terminal moraines (Fig. 1, p. 946). The fourth or latest loop is compound, and wraps around a tongue of moraine-covered stagnant ice continuous with active ice farther upstream. These closely-matching sets of moraines have a striking resemblance to nineteenth-century and present-day moraines of some temperate glaciers, such as those of the Hooker Glacier in New Zealand,[3] and they provide a much more convincing suggestion of several phases of recent retreat than do those of the unusual glacier lobe reported in our original letter.

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SIR,

Discovery of a volcano in the Patagonian Icefield

In two previous publications [1, 2] I reported that 1946 aerial photographs of some glaciers issuing from the Patagonian Icefield showed three melt borders of volcanic ash, the highest being located at the firn limit. I observed similar borders on Glaciar Viedma, in 1952, from the air, the highest also being located at the firn limit.

The striking similarity to Crater Grimsvötn, in the middle of Vatnajökull in Iceland, induced me to say that a zone in the middle of Glaciar Viedma was a volcanic crater. Carlos Keller had arrived at the same conclusion after studying the same photographs. But this crater would only have accounted for the ashes on Glaciar Viedma. So I attributed the ashes found on nearly every glacier between lat. 49° 10′ S. and lat. 48° 20′ S. and the other signs of volcanic activity to the existence of a second volcanic centre near Cerro Lautaro, and even possibly a third one. The Cerro Lautaro is Point 3370 at the top of the chart, in the *Journal of Glaciology*, Vol. 2, No. 13, 1953, p. 171.

But Eric Shipton went to this spot in 1958/59 and studied the zone free of ice in the middle of Glaciar Viedma. He noticed that this was not in the least volcanic. However on his walk to this zone he had collected pumice stone from a moraine of Glaciar Viedma. And as a new proof of the existence of a volcano further north, I have just received the following letter from him:

"A year ago I had the pleasure of meeting you in Grenoble, where we discussed the question of volcanic activity on the southern ice cap of Patagonia.

"I have recently returned from a second visit to Patagonia, and I thought you would be interested to know that we found an active vent about 100 m. below the summit which you named 'Lautaro' on the Cordón Pio XI.

"I am sending you a photograph of 'Lautaro' taken just after an eruption of ash from the vent.

"We made a collection of rock specimens from the outcrops on various parts of the mountain. These have been examined by Señor Oscar Gonzalez (?) of the University of Chile.

"I am hoping to return to the same area next season 1960/61. . . ."

That is one more mystery elucidated by this brilliant explorer.

Cerro Lautaro looks so little like a volcano that the Argentine expedition which went by it and named it with the name of an Araucan hero did not acknowledge it as such. [3] This new volcano lies on a straight line with Volcán Burney, Volcán Macá, and other volcanoes of Patagonia.

The discovery of big fragments of pumice stone on Glaciar Viedma seems to prove that this glacier drains the ice from the south-east slopes of Cerro Lautaro. Reichert in 1933 thought that he saw "Glaciar Hicken" flowing down northwards from the "Paso de los Cuatro Glaciares" ("Pso. de los 4 Gl." in the aforementioned chart). In fact it would be a continuation of Glaciar Viedma flowing in the opposite direction, southwards. Therefore the interoceanic ice divide would be more to the west.

The Argentine expedition of 1952 made levellings in this area, but did not publish the results.

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14 October 1960

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