CORRESPONDENCE

THE EDITOR,

British Antarctic Survey Bulletin

SIR,

Ice Calderas

I have read with considerable interest two recent papers on "ice calderas" in Graham Land (Aitkenhead, 1963; Koerner, 1964) and I am prompted to comment as follows.

The term "caldera" is not entirely appropriate because, although in its more usual context of volcanism it commonly describes a collapse feature, it may also be applied to a crater produced by paroxysmal explosion. The "doline" of karst topography, which is usually due to the collapse of the roof of a subterranean chamber, is more analogous. However, I would apply the highly confused and duplicated nomenclature of limestone scenery to the field of glaciology only with caution, even though the features produced by the melting of ice are in certain conditions very similar to those caused by the solution of limestone. "Cauldron" used in the geological sense of "cauldron subsidence" is reasonably apt.

Basic requirements for the formation of the feature appear to be (1) stagnancy or only very slow ice movement, (2) a supply of melt water, and (3) thin ice.

Optimum conditions are probably found on a stagnant temperate glacier with a drift-covered surface, and the feature has been described in these conditions in Norway (Stokes, 1958) and in abundance in Alaska (Clayton, 1964). In these examples the origin of the feature was clearly due to the collapse of the roof of a subglacial cavern.

Lack of movement is necessary if the feature is not going to be destroyed before it has a chance to form; sufficient melt water is required to form a subglacial tunnel or chamber; and the ice of the roof must be thin in order that collapse may occur. The effect of a mantle of drift on the ice surface is to decrease the general surface ablation and preserve the stagnant glacier, allowing time for enlarged subglacial tunnels to form and collapse to occur.

In both examples recently described from Graham Land, ice movement was slight or lacking. In both locations abundant melt water would be available in the summer months and under föhn conditions. These "calderas" occurred in association with nunataks, suggesting thin ice and a catchment area for melt water and rain which would probably flow underneath the ice at the foot of the exposed rock. Their mode of formation could well be identical to that of those described in northern latitudes.

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REFERENCES

AITKENHEAD, N. 1963. An Ice Caldera in North-east Graham Land. *British Antarctic Survey Bulletin*, No. 1, 9–15.

CLAYTON, L. 1964. Karst Topography on Stagnant Glaciers. *J. Glaciol.*, **5**, No. 37, 107–12.

KOERNER, R. M. 1964. An Ice Caldera Near Hope Bay, Trinity Peninsula, Graham Land. *British Antarctic Survey Bulletin*, No. 3, 37–39.

STOKES, J. C. 1958. Flatisen, Norway. Some Geomorphological and Glaciological Observations on the Glacier. [Unpublished report in the library of the Glaciological Society.]

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I agree with Mr. Stokes that none of the terms so far proposed—ice caldera, doline and cauldron—are entirely satisfactory for descriptive purposes. Used by itself, the word "cauldron" brings to mind the non-geological and literal sense, but when used together with the qualifying adjective "subsidence", it has the appropriate connotation.

According to Williams (1941), calderas formed by the paroxysmal explosion of volcanoes are extremely rare and the fundamental cause of almost all calderas is engulfment following withdrawal of magmatic support at depth.

Although I agree basically with the requirements given by Mr. Stokes, I am convinced that in the case of the ice caldera near Mount Wild the hydrostatic forces of water dammed up in the caldera and the disruptive effect of sudden drainage are important factors in the mechanism of formation. It is difficult to envisage exactly what Mr. Stokes means by "thin ice", but it should be pointed out that the ice forming the walls of the ice caldera near Mount Wild was over 100 ft. (30·5 m.) thick.

Contrary to Mr. Stokes's suggestion, melt water is not necessarily abundant in Graham Land in the summer months, and a particular example of this is the summer of 1960–61.

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REFERENCE

WILLIAMS, H. 1941. Calderas and Their Origin. *Bull. Dep. Geol. Univ. Calif.*, **25**, No. 6, 239–346.

ERRATUM

British Antarctic Survey Bulletin, No. 4, p. 15, line 29. *For* "... about 200 yd. (180 m.) east ..." *read* "... about 700 yd. (630 m.) east ..."