Secondly, I have no dispute with Ballantyne or Porter concerning the entrenchment of the term "pro-talus rampart" in the literature. My advocacy of Daly's (1912) term "winter-talus ridge" was based primarily on its primacy over the later terms "nivation ridge" and "pro-talus rampart". In the light of Porter's examples from the historical literature, this is no longer an issue. Ballantyne's (in press) forthcoming paper, as well as the process studies cited by Porter, clearly shed doubt on the genetic accuracy of Daly's term.

Finally, I completely agree with Ballantyne (1987) that the traditional definition of the term "pro-talus rampart" will eventually require revision and, in the light of Porter's comments, that the term "pro-talus rampart" remains a viable and preferred one. The definition I presented (Butler, 1986) was simply a summary of currently utilized working definitions. The works of Harris (1986) and Ono and Watanabe (1986), works not published at the time my previous letter was written, indeed illustrate the problems with a morphogenetic definition based solely on one form of genesis. I am not, however, at this time prepared to adopt Ballantyne's (1987) "more general definition", particularly in the light of recent studies which attribute glacial origins to features previously described as owing their genesis to pro-talus processes (e.g. Gardner and others, 1983, p. 171). As pointed out by Madole (1972, p. 122), "the polygenetic origin of talus makes it both the most complex and ill-defined facies", and as Porter states, much work obviously remains to be done before a thoroughly accurate definition will be available.

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SIR,

A computer program for glacier-surface plain-strain analysis

Established methods of determining surface strain on glaciers involve slow and cumbersome data analysis. We have prepared a simple program in BASIC, for use on micro-computers, which performs the analysis without the pitfalls of graphical manipulation and manual calculation, facilitating quicker, easier, and more accurate strain resolution.

Various methods have been used to determine strain-rates from the movement of markers on a glacier surface (Nye, 1959; Meier, 1960; Hambrey and Müller, 1978). The method outlined by Hambrey and Müller, (1978), and used subsequently by Hambrey and others (1980), determines strain from the deformation of triangular arrays of surface markers and the use of a Mohr circle construction. The procedure has been described more fully by Ramsay (1967), in a geological context, and it is on this description that glaciological work has hitherto drawn. However, this method involves a combination of calculation and geometrical construction which is time consuming, imprecise relative to field measurements, and prone to error.

We have reduced the procedure to a mathematical solution, and, in turn, to a computer program which takes raw field data as input, and presents as output the orientation and magnitude of the principal strain and elongation rates, the shear strain-rate, and the change in surface area. The program is written in BBC BASIC, but is sufficiently simple to be easily adapted to other programming languages.

Strain-rates within a prescribed area are determined from the deformation of a triangular array of stakes on the glacier surface. The data required are the lengths of each side of the triangle before and after deformation and the time interval between measurements. The method of resolving such data which Ramsay (1967) described can be divided into three stages. First, the angular and hence the absolute shear strains can be geometrically determined from the changing shape of the strain triangle during deformation. Secondly, strain and elongation parameters are calculated from the shear strain and from changes in the lengths of the triangle sides during deformation. Thirdly, these parameters are applied in a geometric Mohr circle construction which gives the magnitude and orientation of the principal strains effecting the deformation. The purely numerical solution to the procedure follows the same three steps but avoids the inaccuracy inherent in the graphical method. However, the lengthy set of calculations involved is more conveniently carried out computationally than by hand.

The graphical, numerical, and computer solutions have been described in more detail by Williams and Knight (1987). Copies of this paper, including a full listing of the program, are available from the Editor of the Discussion Paper series, Dr J.H. Farrington, Department of Geography, University of Aberdeen, Aberdeen AB9 2UF, Scotland.

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