

## CORRESPONDENCE

The Editor,

*Journal of Glaciology*

SIR,

*Comments on "Regime of an Afghan glacier"*

In the paper by Gilbert and others (1969, p. 58), the passage "The greater snow to the east in the Karakoram mountains produces a lower snow line, e.g. 4 000 m on the Chogo Lungma Glacier (Untersteiner, 1957) . . ." is incorrect. In fact, the snow line on the Chogo Lungma Glacier is 700 m higher and therefore hardly lower than on the Afghan glacier discussed in the paper.

The altitude of the snow line was *not* given in the Untersteiner (1957[b]) reference quoted in the list at the end of the paper by Gilbert and others, but in an earlier paper by Untersteiner (1957[a], p. 5) it was given as 4 800 m, according to Wissmann. The snow line of the Chogo Lungma area has been discussed in detail by Kick (1964), who gave an altitude of 4 700 m, but generally in the Karakoram it is 5 000 m and higher.

Gilbert and others have undoubtedly been misled by Untersteiner's (1957[b]) reference to "firn" at an altitude of 4 000 m, but in this case "firn" meant old winter snow that had not melted in June. According to "Mass-balance terms" (Anonymous, 1969, p. 6), "firn" is defined as snow which has passed through one summer. If only Untersteiner had followed this definition, this misunderstanding would have been avoided; hence such an error may demonstrate the value of clearly defining glaciological terms. But in spite of this, the usage of "firn" for old winter snow in spring time will continue, since this term—even in a definite physical sense—is fixed in common language for all people in Alpine countries and for millions of skiers. This term should not be defined in a totally different manner for its scientific application.

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15 March 1969

W. KICK

## REFERENCES

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Gilbert, O., and others. 1969. Regime of an Afghan glacier, by O. Gilbert, D. Jamieson, H. Lister and A. Pendlington. *Journal of Glaciology*, Vol. 8, No. 52, p. 51-65.  
Kick, W. 1964. Der Chogo-Lungma-Gletscher im Karakorum. II. *Zeitschrift für Gletscherkunde und Glazialgeologie*, Bd. 5, Ht. 1, p. 1-59.  
Untersteiner, N. 1957[a]. Glazial-meteorologische Untersuchungen im Karakorum. I. Strahlung. *Archiv für Meteorologie, Geophysik und Bioklimatologie*, Ser. B, Bd. 8, Ht. 1, p. 1-30.  
Untersteiner, N. 1957[b]. Glazial-meteorologische Untersuchungen im Karakorum. II. *Archiv für Meteorologie, Geophysik und Bioklimatologie*, Ser. B, Bd. 8, Ht. 2, p. 137-71.

SIR,

*Reply to Dr W. Kick's comments on "Regime of an Afghan glacier"*

I am grateful to Dr Kick for questioning a statement in our paper (Gilbert and others, 1969, p. 58) and particularly for his further references on height of the snow line in the Karakoram. There is difficulty in gleaning this from expedition papers; any error in interpretation is the authors' and not Untersteiner's. "Firn" is generally understood but the problem is really one of interpreting the snow line in the field, particularly in these subtropical ranges of marked relief. Dr Kick's point is very

pertinent, especially during the International Hydrological Decade with widely dispersed observers facing similar problems.

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27 March 1969*

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## REFERENCE

Gilbert, O., and others. 1969. Regime of an Afghan glacier, by O. Gilbert, D. Jamieson, H. Lister and A. Pendlington. *Journal of Glaciology*, Vol. 8, No. 52, p. 51-65.

SIR,

*The stress dependence of the secondary creep rate at low stresses\**

The claim has been made in the past, and more recently (for ice) by Mellor and Testa (1969[a]), that the stress dependence of the secondary creep rate (that is, the steady-state creep rate) changes at low stresses. We have pointed out before (Weertman, 1967) that experimental creep rates cited in favor of such a claim usually can be dismissed because they clearly do not correspond to true secondary creep. Our argument is the following: In order to be certain that, at a given stress, it is true secondary creep which is being measured rather than transient creep, it is necessary to obtain the creep rate over a total creep strain of at least the order of 0.1 (10%). Thus the smallest steady-state creep rate that can be measured reliably in a year-long laboratory test is about  $10^{-8}/s$ . In Mellor and Testa's (1969[a]) work the tests used to show a different stress dependence involved creep rates in the range of  $10^{-10}/s$  to  $10^{-11}/s$ . These creep rates were described as secondary creep rates. (The  $0^{\circ}C$  tests (Mellor and Testa, 1969[b]) led to very much faster creep rates. The authors pointed out, however, that the  $0^{\circ}C$  tests had the complicating factor of grain growth. These particular tests need not be taken as proof of a change of stress dependence of creep rate.)

It should be emphasized that Mellor and Testa are well aware of the difficulty of obtaining a true secondary creep rate at low stresses. They point out that their conclusion about the stress dependence at low stresses is not conclusive because of this difficulty. The purpose of our letter is to point out that although Mellor and Testa used creep tests that ran for almost one year, the time duration of their tests is, nevertheless, many orders of magnitude too short to establish a true secondary creep rate at low stresses. Therefore, no conclusion at all can be made of the stress dependence of the secondary creep rate at low stresses.

An example can be cited to prove that the stress dependence of the creep rate can be quite different at very small creep strains from what it is at large creep strains. In a microcreep experiment (which repeated Chalmers' original experiment) on tin crystals Harris and others (1966) find (as did Chalmers) that the creep rate is proportional to stress. The test temperature was room temperature and the stresses ranged from about 1 to 20 bar. The total creep strain displacements were so small that an optical interferometer technique was required to measure them. Yet in this same stress range creep experiments on tin single crystals which were carried out at about  $200^{\circ}C$  and which extended to large strains led to creep rates proportional to the stress raised to about the 5th power (Weertman and Breen, 1956).

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9 May 1969*

J. WEERTMAN

## REFERENCES

Harris, A., and others. 1966. Microcreep in tin crystals with 0.001% to 0.44% lead, by A. Harris, R. L. Hines and E. R. Peck. *Acta Metallurgica*, Vol. 14, No. 9, p. 1115-19.

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