

areas are also afloat. It is convenient to distinguish the parts which are afloat from those which are not. In English therefore there have arisen terms which permit this: "ice sheet" means the whole mass, "inland ice sheet" the part resting on rock, and "ice shelf" the part afloat. In Greenland, "ice sheet" and "inland ice sheet" are virtually synonyms, and the first is the one normally used.

With these terms Dr. Weidick presumably has no quarrel. He expresses concern, however, that the Danish *indlandsis* should not be regarded as the equivalent of "inland ice sheet" or "ice sheet", and prefers to think of it as a place name referring only to the feature in Greenland.

It is not for us to suggest Danish terms to Danes. But we would have thought that *indlandsis* could be a closely-fitting equivalent to "inland ice sheet". Historically, that in Greenland was the first to become known, so it is natural that the descriptive geographical term and the place name should be the same. This has been a normal development elsewhere. A feature which gave rise to a new geographical term has been found to occur in other regions. Not only has the original geographical term been applied wherever appropriate, but it has often been convenient to use it as the generic part of the place names required for these features. Examples are Larsen Ice Shelf, Ross Ice Front, Marr Ice Piedmont, Napier Ice Rise and Simler Snowfield. It frequently happens, as in the case of *indlandsisen*, that these geographical terms are used in the definite form when first used or when they refer unambiguously to a single specific feature, but they take the indefinite form when more widely applied. But we hope that this practice will not make Danish glaciologists feel obliged to find another term when they want to describe the inland ice sheet of Antarctica, or one in Pleistocene times. The French have felt no such need—perhaps because *l'indlandsis* does not have the same historical associations for them. But, we repeat, this is something which only Danish glaciologists can decide. Their decision will not affect the English terminology. That could only happen if the word *indlandsis* were to be adopted in English (which is not at all likely), and even then it might not happen, for loan-words often change their meaning.

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10 May 1967

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SIR,

About the use of the expression "Indlandsis": a reply

In reply to the comments on my letter on the term *Indlandsisen* (Armstrong, Roberts and Swithinbank, Bauer, Fristrup and Lliboutry, this issue p. 949–51), it seems necessary first to clarify one evident misunderstanding; the letter was not written on behalf of Danes in general or any particular group of Danes, but only to express a private opinion and proposal. Furthermore, when the word "Danish" was used, it was an explanatory term covering only (a) the origin of the word *Indlandsisen*, (b) the special grammatical problem involved in the definite article *-en* in this language, and (c) the nationality of a person (Steenstrup). This fatal word was not used to evoke any chauvinistic sentiments as presumed in the French comments and I deeply regret not having expressed this clearly enough.

The comments on the subject proper—the term *Indlandsisen*—at least serve to demonstrate the confusion which has arisen in the meaning of the word. To sort out the matter it seems necessary to look at three aspects of the problem:

- (1) the word "Indlandsisen" ("the Inland Ice", "l'Indlandsis") as a place name.
- (2) the expression "inland ice" (or possibly better "inland ice sheet") or *indlandsis* as a glaciological expression for a certain feature.
- (3) the use of the expression "inland ice" (*indlandsis*) for formerly existing ice sheets.

A fourth aspect is the use of synonymous words in foreign languages in general, but as I do not feel competent to extend the discussion so far (even to the problem of translating *indlandsisen* into Chinese which worries Bauer), it will be sufficient to restrict the discussion to the first three points and leave glaciologists elsewhere to find out an adequate terminology in their own language.

(1) There seems to be no trouble in translating the place name "Indlandsisen" into French as "l'Indlandsis" (Lliboutry) using a capital "I" in French. It was also thought to be easy enough to translate the word into English as "the Inland Ice". However, from the comments of Armstrong and others (1967), it does not seem clear whether in this context "the Inland Ice" is preferable in English to "Indlandsisen" (without translation), "the Inland ice sheet", "the Greenland inland ice sheet" or something else. When

I used "the Inland Ice" in my letter it was because of former Anglo-American translations (e.g. Matthes, 1942, p. 159; Sharp, 1956, p. 86), capital "I"'s emphasizing its being a place name. It is of course not for me to suggest English terms to the English, but I wonder if it is really necessary to use the translation "the Greenland inland ice sheet" for "Indlandsisen".

The proposal of Bauer to use *Sermerssua* as a place name (or as a glaciological name) is dubious in the form presented and in the present context. The proper place name in "nominative" (objective) form is "Sermerssuaq" (cf. Charlesworth, 1957, Vol. 1, p. 73; Bugge and others, 1960, p. 249). However, this place name (meaning "(the) great ice cover") can also be seen used for local ice caps and may therefore be ambiguous.

Otherwise, *Sermerssua* is a form meaning "'s great ice cover"; a sort of inverted genitive which requires an extra word indicating to what the great ice cover belongs (Kleinschmidt, 1851, p. 14; Schultz-Lorentzen, 1945, p. 19, 97). It would be the same if the word *nunataq* (meaning "a piece of land in it" (i.e. in the Inland Ice), cf. Schultz-Lorentzen, 1927, p. 297) was written *nunatá* ("-'s nunataq"). With regard to *Sermerssua* we could say *Kalâtdlît nunâta sermerssua* (meaning "Greenland's great ice cover") when "the Inland Ice" is meant, and from *Kalâtdlît nunâta sermitâ* ("the inland ice cover of Greenland") derive *sermitaq* ("an inland ice cover") as a glaciological expression. *Sermitaq*, proposed by R. Petersen, has an analogous construction to *nunataq* and is essentially the same as "inland ice sheet" in the sense of Armstrong and others (see below).

It must be admitted that the *-a* form *occasionally* can be seen alone, for example in the name of West Greenland (Greenlandic: "Kitâ", i.e. "its west side"), and I do not eliminate the possible use of *Sermerssua*. However, the official translation of West Greenland is *Kalâtdlît nunâta kitâ* (Bugge and others, 1960, p. 685).

This digression into the Greenlandic language is only for the benefit of Bauer and others who may wish to apply it. My thanks are due to Professor E. Holtved and mag. art. R. Petersen for checking my information.

(2) The conflict of opinions seems to be focused on the extent and use of the glaciological term "inland ice" (or better, according to Armstrong and others (1967), "inland ice sheet"), or in French, *indlandsis*. We can agree that the spelling without capital "I"'s is a distinction from the place name and I think that the classification of Armstrong and others, in which "ice sheet" includes both "inland ice sheet" and "ice shelf", is very consistent. With reference to French, my understanding is too poor to know if *nappe de glace* (Lliboutry) or *glace continentale* (Bauer) is an adequate term for "ice sheet".

According to the classification of Armstrong and others there are several "inland ice sheets" and "ice shelves" in Antarctica. The whole mass of ice in Antarctica includes both phenomena and is characterized as an "ice sheet". My main objection is to the use of "inland ice" or equivalent terms for "the Antarctic ice sheet" (with or without capital "I"'s) or any other ice sheets, and has nothing to do with eventual later classifications as for example by morphology (Ahlmann, 1948, p. 61) or by physical models such as those mentioned by Lliboutry and to which I will return later. When working in these problems I admit that the term "inland ice" or *indlandsis* is useful when the context (and the use or avoidance of capitals, as discussed above) indicates exactly what is meant.

(3) A consequence of the use of the distinction of Armstrong and others must be that we ought to know the exact extent and form of former ice sheets before classifying them as ice shelves or inland ices (or inland ice sheets). After all, not very much is known of the extent and form of even Wisconsin-Würm ice sheets (or whatever they ought to be called) and further serious problems arise when treating older ice sheets. It must therefore be reasonable to keep to the most neutral and general term for old covers of ice and use "ice sheets". Here also, I see no serious conflict of opinion between Armstrong and others and myself. It is not possible from the French comments to see whether the same argument may be applied in French.

As stated above, no real objection was raised to the use of *indlandsis* in for example physical classifications. However, an interesting problem arises in the comments of Lliboutry when he (if I have understood him correctly) links the term *indlandsis* strictly to an irreversible formation of ice sheets (Lliboutry, 1964-65, Tom. 2, p. 798-805). In the same work, he mentions "les indlandsis permo-carbonifères" (e.g. p. 801) and "les indlandsis de l'Éocambrien" (e.g. p. 921-22). How does Lliboutry distinguish the formation of these old "inland ices" from other glaciers on the basis of the deposits laid down by the ice? I think we must be satisfied with the evidence for glaciation in general, and not accept a classification of glaciers from these times.

It must be concluded from the comments given that the word *Indlandsisen* (the Inland Ice, *l'Indlandsis*) has been restricted in meaning to such a degree that it makes most sense if confined to a place in Greenland, and it is still hoped that my first letter will just make things easier, not more complicated.

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STR, *Non-earthquake origin of supraglacial debris on Martin River and Sioux Glaciers, Alaska*

Tuthill (1966) has suggested that former earthquake-avalanching was the primary source of the debris on the lower part of Martin River Glacier. This appears unlikely for the following reasons:

1. Source areas for large-scale rock-slide avalanches are absent in the lower valley where the debris is located.
2. If avalanching occurred in the lower valley, lateral moraines and medial moraines on the glacier would have been covered. This is not the case.
3. If avalanching occurred in the narrow tributary glaciers, many individual avalanches would be required to account for the deposit. Only one obvious large deposit of this nature has been identified in recent photographs of the glacier (Fig. 1).
4. A large avalanche deposit on any of the main tributary glaciers would cover other medial moraines present on the same branch. Only the deposit mentioned above appears to cover even one medial moraine.
5. Prior to 1964 several strong earthquakes with Richter magnitudes between 7.5 and 8+ have occurred in the general vicinity of Martin River Glacier. The largest of the close seismic events are the 1899 earthquake at Yakutat, one in 1896 near Valdez and another in 1928 in the vicinity of Middleton Island (Post, 1965, fig. 3). If Tuthill's concept is correct, previous earthquakes in this seismically active region should have left plentiful evidence of such occurrences in the form of avalanche debris in transit between the source area and the terminus comparable to the large rock-slide avalanches which occurred during the 1964 Alaska earthquake (Post, in press).

Some idea of the time involved for ice to move from the point where the 1964 avalanches occurred to the terminus may be determined from the number and spacing of ogives found in the ice derived from the main tributary. 40 of these ogives were plotted. Divided into increments of ten, these are shown by arrows on Figure 2. If the ogives were formed annually and the glacier flow is uniform, the ice moved 7 km. in this area in the past 40 yr. Air photographs indicate that between August 1964 and August 1965 ice in this tributary immediately above its juncture with the main glacier moved 260 m. An annual movement of 200 m. in the wider glacier where the ogives were mapped would thus appear to be in