from the shelf ice. To the south the shelf ice was similar in nature to that between lats. 70° and 73° S. and little would be gained by describing it in detail. From another peninsula in lat. 75° S. a line of high ice cliffs was seen extending far to the south-east. These were the seaward edge of the Filchner Shelf Ice, which was flown over almost to its eastern junction with Coats Land by Commander Ronne in December 1947.

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SHELF ICE—A NOTE ON TERMINOLOGY*

By BRIAN ROBERTS
(Scott Polar Research Institute, Cambridge)

THE nature and origin of shelf ice was discussed by Wright and Priestley in their classic work on glaciology in the scientific reports of the *Terra Nova* expedition.[1] Two types are there distinguished, one formed originally by the outward extension of land ice and the other by the accumulation of snow upon persisting sea ice.

Much of the shelf ice on the east coast of Graham Land, which has now been described by Reece [2] and Mason [3] as a result of the work of the Falkland Islands Dependencies Survey, probably originated in the second of these two ways, but it is clear that in many places areas of shelf ice which have originated in both ways merge into each other. Wright and Priestley (*op. cit.* p. 162) accepted the term "shelf ice," originally proposed by Nordenskjöld [4] and also used by von Drygalski, as the best descriptive morphological term for this form of ice, rather than "barrier ice," a term derived from the designation "ice barrier" applied by Sir James Ross on discovering in 1841 the edge of the great ice sheet that now bears his name. Ross envisaged it as an obstruction to navigation and furthermore, strictly, referred only to its seaward cliff face, but the term came to be applied to the whole area in the place-name "Ross Ice Barrier." Joerg [5] first proposed the consistent use of the term "shelf ice" as a part of the place-name of each of the various occurrences of this phenomenon, *e.g.* Ross Shelf Ice instead of Ross Ice Barrier, Filchner Shelf Ice instead of Filchner Barrier, Shackleton Shelf Ice instead of Shackleton Ice Shelf, and so on. His practice has since been widely adopted in America and by many in this country, and this proposal has been officially endorsed by the United States Board on Geographic Names,[6] which recognizes the name Larsen Shelf Ice and rejects the various alternative names which have been used.

As new information is acquired, there is every probability that glaciologists will wish to define and classify the varying formations of shelf ice on the basis of their ideas about the origin and structure of the types of ice found in different areas. Whatever sub-types may eventually be defined, I would like to make a plea for the consistent use of the one descriptive morphological term "shelf ice" (not "ice shelf," "barrier," "ice barrier" or "barrier ice") for the whole range of formations. Such a term is essential for use in general works on the Antarctic where fine genetic distinctions find no place and where many features have to be described in the absence of precise information about their structure and origin. We also need a term which can be translated without ambiguity into other languages.

* Mr. Mason's paper has again raised the question of the most suitable terminology for shelf or barrier ice. Dr. B. B. Roberts's views were presented during the discussion of the paper and have since been elaborated into this article which is followed by an article by Mr. J. M. Wordie. The remainder of the discussion and any comments received on these two divergent views will be published in the next issue.—*Ed.*

With this object in view, the following definition was prepared for the *Antarctic Pilot* (1948 edition, p. 29–30) by the Bishop of Portsmouth, Professor Debenham, Mr. Wordie and myself:

> "Shelf-ice [Barrier or Ice-barrier.]—Shelf-ice is a descriptive or generic term used in a wide sense for ice formations with level surface which originate from accumulations of firn (or *névé*) layers either upon persistent sea-ice or upon the seaward extension of land glaciers, but now essentially nourished by annual accumulations of snow. The seaward edge is afloat. The initial sea-ice stage is called bay-ice. [Certain large shelf-ice formations of great extent are generally known as barriers or ice-barriers, typified by Ross Barrier.] Special features are the great horizontal extent and the vertical cliffs up to 150 feet in height on the seaward face, with prominent horizontal banding and clean-cut joint-faces from which tabular bergs periodically break off."

This was a compromise definition which could, in my opinion, be greatly improved by omitting the words which I have placed in square brackets and by stating frankly that in the past the three alternative terms have frequently been used synonymously. I do not think that an arbitrary distinction between large and small areas of shelf ice, restricting the term "barrier" to large shelf ice formations, is likely to survive in usage. It will be noted, however, that the morphological definition for all three terms is identical, a point to which I will return later.

Using this definition, we can stop the seemingly endless discussion of whether or not the Larsen Shelf Ice extends north of the Seal Nunataks and north-westward into Crown Prince Gustav Channel (between James Ross Island and Trinity Peninsula), and turn our attention to finding out more about the structure of the ice in the different areas. As I interpret the information now provided by Mr. Reece, Mr. Mason and their colleagues, the only really essential differences in the floating parts of this whole ice formation are in age and degree of pressure to which the different parts are subjected. In the more exposed areas a visitor may find newly formed sea ice. When this has persisted for more than a year, nourished by surface layers of snow and to a variable extent by accretion of fresh sea ice from below, it is convenient to call it bay ice, and at a still later stage it becomes thick enough to form shelf ice. At any time parts of it may break away, and the cycle starts again, leaving steps, which are gradually obliterated by snowdrifts, at the lines of fracture.

From the existing rough surveys and air reconnaissance, I estimate that nearly 8000 nautical miles, or roughly 50 per cent of the whole coastline of Antarctica may consist of shelf ice as defined above. I want to emphasize that it occurs as a very much more widely distributed feature than we used to think. I now come to the main point of these remarks. The feature which Mr. Mason [3] has described has been discussed in the past under the names "Larsen Shelf Ice," "Larsen Ice Shelf," "Larsen Barrier," or "Larsen Ice Barrier." (I will not here mention the five other names which have been used in English for parts of it, the curious results when all of these are mixed and translated into other languages, or the confusion which results from applying one meaning to "ice barrier" and another to "barrier ice.") This same variation in the form of the name is also found in the other *named* areas of shelf ice in the Antarctic, but I should stress that only some of the largest ones have yet been named. I think we are heading for trouble if we cannot agree with the United States Board on Geographic Names and reflect an agreed descriptive morphological term in the place-names. It will be most unfortunate if this divergence of use on American and British maps is allowed to persist, and I would like to know what members of the British Glaciological Society think about both the definition and the use which can be made of it in place-names?

There are two subsidiary points on which I would like to know the views of members; for we have to decided now what place-names are to be officially recognized and printed on the new maps of the Falkland Islands Dependencies. If we can agree to use "shelf ice" both as a descriptive morphological term and also as a geographical term compounded in place-names, I suggest that we also try to restrict the term "ice barrier" to the seaward facing cliffs of areas of shelf ice. It was in this sense that Ross first used it, and such a descriptive term is undoubtedly required, especially by navigators. The application of this idea to the place-names "Ross Shelf Ice" and "Ross Ice

Barrier" is well illustrated in the map facing p. 296 in the *Geographical Journal* for March 1937. This was a solution advocated by A. R. Hinks. In most regions, however, I think that the term "ice barrier," used in this sense, is only required for descriptive purposes where the edge of the shelf ice is described as a definite barrier to the navigation of ships. It may not be necessary to give place-names to a great many areas of shelf ice, especially at this stage when their limits cannot be accurately defined. It would, however, greatly clarify maps and charts if we could insert the descriptive terms "shelf ice" or "ice barrier" in the appropriate positions, especially where there are as yet no place-names. It is also desirable in each case to add the date of the survey, because it is clear that major changes are taking place.

Finally, we may consider the alternative to the suggestions which I have put forward as a solution to the place-name difficulty. It has been argued that in each case we should retain the original form of the place-name which was given by the discoverer or which has subsequently gained currency during the period before it was realized that all these different formations are essentially the same phenomenon. In the case of the Larsen Shelf Ice, for example, different additional names (Nordenskjöld Barrier, Philippi Ice Plateau, etc.) were given at different times for different parts of it. The Falkland Islands Dependencies Survey parties have, I think, shown conclusively that we are here dealing with one homogeneous feature which varies in age, thickness and structure, but which cannot logically be divided into arbitrary parts. The same difficulty arises further south in the Filchner Barrier or Filchner Shelf Ice, of which the eastern part was discovered and named by the German expedition in 1912. Its western part was discovered and first delineated by Commander Finn Ronne [7] in December 1947, and has since been named by him Lassiter Shelf Ice despite the fact that all his evidence shows that there is only one continuous, unbroken belt of shelf ice bordering the southern margin of the Weddell Sea. I think that the only solution here is to try to extend the area covered by each original name so that each is applied to a definable geographical unit. For the first time we now know enough about the geography of the Falkland Islands Dependencies to apply this principle with confidence along the whole coastline except in Coats Land and in the area west of Alexander I Land. Major changes may well occur in the future if large areas of shelf ice break off and drift out to sea leaving smaller areas isolated between headlands, or if the present areas of shelf ice grow and merge into each other. Fortunately, of these two possibilities, the former seems much the more probable during the next few decades; and there are reasons for supposing that in some regions at least, where it is aground, the average position of the edge of the shelf ice is not subject to great variation.

There are thus four problems for discussion. First, the proposed morphological definition of "shelf ice" and the question of whether or not we can eliminate the alternative terms as synonyms. Second, the consistent application of the selected morphological term as a geographical term compounded in place-names. Third, the precise meaning which I suggest should be applied to "ice barrier," distinguishing it from "shelf ice." Fourth, the problem of applying one rather than several place-names to each definable unit of shelf ice, regardless of its size or the date of discovery of its parts.

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