Thus the Larsen Shelf Ice now extends north from Robertson Island into the southern end of the Channel. The position of its eastern edge, north of Robertson Island, is doubtful, but Taylor's party must have crossed it on their journey from Cape Longing to Snow Hill Island. They crossed some rifts when near Cape Foster which Russell says "might possibly open up and act as tide cracks," and it is most likely that the border between shelf and sea ice was somewhere in this area. In mid-September 1948 the edge of the shelf ice was observed to have broken back westwards to within about 24 km. of Cape Sobral.

In conclusion, Larsen Shelf Ice, at the present time, extends as one continuous homogeneous sheet of varying thickness, north-eastwards from its previously mapped northern limit near Robertson Island to the Sjögren Glacier tongue in the southern part of the Channel. Its seaward edge, whose position obviously varies from year to year, may be taken to run from Robertson Island generally north-east towards James Ross Island. North-east of the Sjögren Glacier tongue landfast sea ice covers the northern part of the Channel and often persists for several seasons.

I am indebted to Mr. J. M. Wordie, St. John's College, Cambridge, for much helpful criticism of this paper and also for the interpretation of the sea ice section. I also acknowledge with thanks the permission of the Colonial Office to publish this report.

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THE LARSEN SHELF ICE

By DOUGLAS MASON

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Paper read at a Meeting of the Society on 17 *November* 1949

ABSTRACT. Description of that part of the Larsen Shelf Ice traversed by the author when taking part in a sledging expedition which reached lat. 74° 42′ S., manned jointly by members of the Falkland Islands Dependencies Survey and the Ronne Antarctic Research Expedition 1946–48.

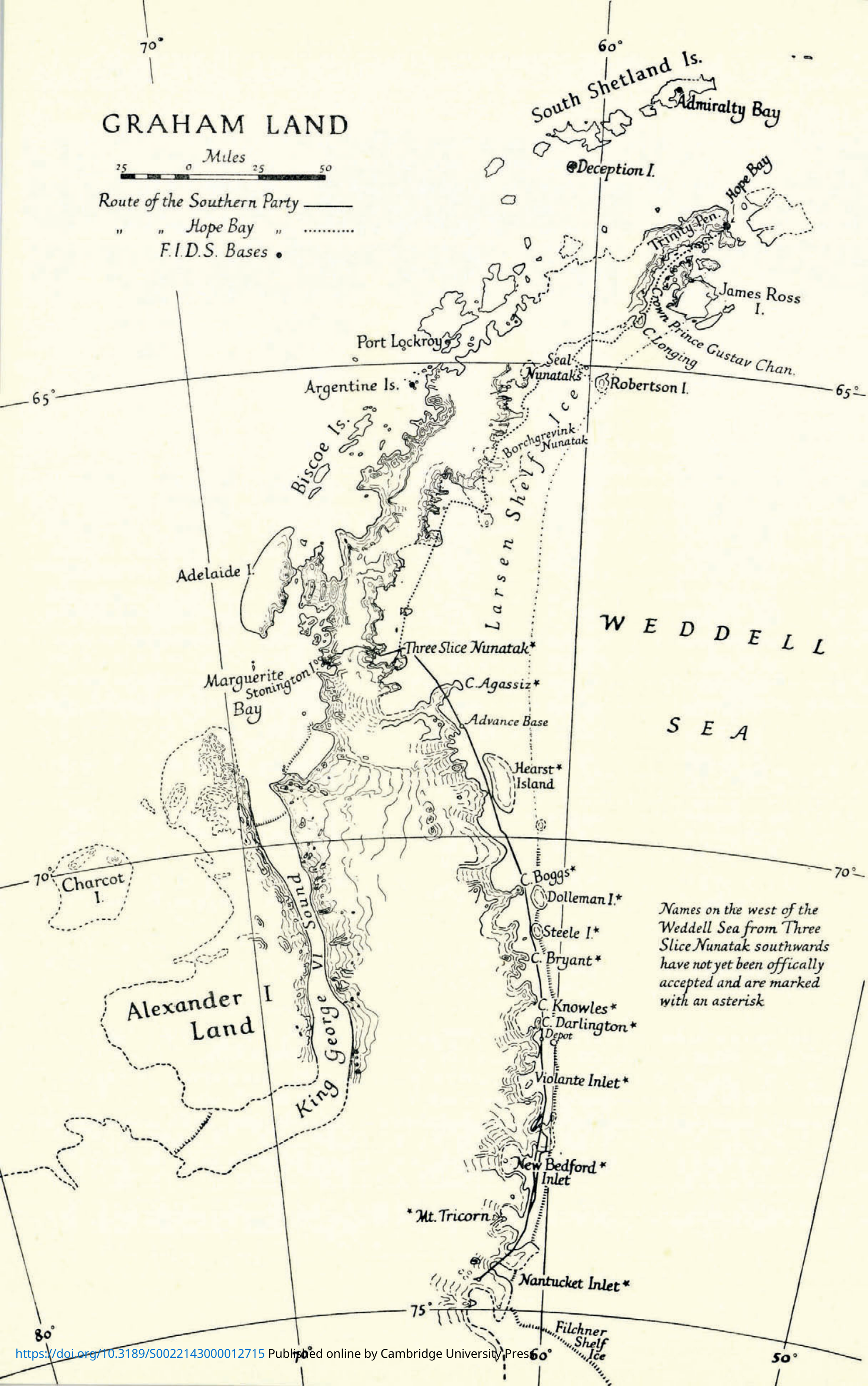
THE Larsen Shelf Ice forms one of the two great areas of shelf ice in the Weddell Sea; it extends, in a belt varying from 10 to 100 miles (16–160 km.) wide, down the coast on the west side of the Weddell Sea from near the northern tip of Graham Land, in lat. 63° 45′ S. for about 650 miles (1046 km.) to a peninsula in lat. 73° S. Two other smaller sections of shelf ice, one about 80 miles (128 km.) long, and the other filling a narrow inlet, exist on the western side of the Weddell Sea south of the Larsen Shelf Ice; and then in lat. 75° S. the Filchner Shelf Ice extends south-eastwards to Coats Land and forms the southern limit of the Weddell Sea.

During October 1947 to January 1948, two sledge parties traversed the Larsen Shelf Ice entirely from north to south. The first, from the Falkland Islands Dependencies Survey base at Hope Bay, sledged from the northern tip of Graham Land via the Seal Nunataks to Three Slice Nunatak in 68° S., then across Graham Land to the F.I.D.S. base on Stonington Island (see map on facing page). The other, of which the author was surveyor, was formed jointly from members of the base on Stonington Island and from the American Ronne Antarctic Research Expedition, which was then wintering on Stonington Island. This party sledged to Three Slice Nunatak, then south along the shelf ice, reaching lat. 74° 42′ S. and returning along the same route. It is with the portion of the shelf ice traversed by the latter party that this paper mainly deals.

The shelf ice to the north of lat. 68° S. is generally much thicker than that to the south; unfortunately the party from Hope Bay were unable to obtain any accurate heights of the surface of the ice. Comparison of heights of points of detail, referred to shelf ice level with those referred to barometric heights obtained on the peninsula in December 1946, seem to indicate that in about lat. 67° S. the surface of the shelf ice about 5 miles (8 km.) from the coast is between 300 and 400 ft. (91–122 m.) above sea-level; this figure is confirmed by a barometric height, the result of a series of readings extending over several days, of 360 ft. (110 m.) at Three Slice Nunatak. This party found extensive crevassing in the shelf ice near the ends of glaciers and to the seaward side of capes and nunataks (see photograph p. 420); generally there was a slight depression at the junction of the shelf and land ice, but no sign of a working tide crack anywhere, indicating that the landward side of the shelf ice is aground. Except near the northern end, where it is narrower, they did not see the seaward edge; it is believed to be up to 100 miles (161 km.) wide, and Commander Ronne, during a flight in November 1947, found it to be this width in lat. 69° S.

The first 60 miles (96 km.) south from Three Slice Nunatak were covered over gently undulating surfaces, with no sign of crevassing except to the east of the nunatak. No sign of a tide crack was found in descending from the peninsula to the shelf ice. A large number of holes in the ice, referred to by Knowles [1] as "lenticular holes," were observed from the air in the large inlet to the south of Three Slice Nunatak; these holes appeared to lie in a series of lines running in an east–west direction, and it is thought that they are formed along longitudinal cracks as the flow of ice widens towards the mouth of the inlet, and are caused by the settling of snow in the cracks, or by the collapse of snow bridges. One of these holes was examined on the ground in September 1947; it was only 15 ft. deep, 50 yd. long and 10 yd. wide (14×46×9 m.). It sloped gently on the northern side, but had a sheer drop on the southern. All these holes lay to the west of the sledge party's route; the one hole which was observed appeared to be of a different origin. It was quite isolated, about 200 yd. (183 m.) from north to south and 100 yd. wide; the sides dropped sheer about 70 ft. (21 m.) to a snow-filled bottom. No sign of sea water flooding could be seen, but it seemed to be very similar to holes seen by Ronne in King George VI Sound in 1940.[2] In lat. 68° 30′ S. a low, narrow ice-capped peninsula extends eastwards from the mainland into the shelf ice for about 25 miles (41 km.). Here, a shallow, wide depression was found at the junction with the land ice; this junction was marked by a series of very narrow cracks in the *névé*, barely half an inch wide, running parallel to the cape. No tide crack was seen.

Knowles in 1940 reported the finding of ice with a very high salt content at the bottom of rifts in the ice in lat. 68° 45′ S. These rifts were crossed by the party in November 1947, but no sign of staining in the ice was seen. South of these rifts the party travelled along the sound between Hearst Island and the mainland. Here the surface of the ice was almost perfectly level and uncrevassed. No rock exposures were visible on the island, which is completely ice-capped; rock crops out at many points along the mainland coast in the sound, and specimens were obtained at Cape Rymill in lat. 69° 30′ S. A deep depression was found along the foot of the cape, and this was filled in January 1948 by melt water caused by radiation from the dark rock cliffs of the cape. Here again there was no sign of a tide crack. Across the southern end of the sound, in lat. 69° 46′ S.



The results of the topographical survey made during the journey described in Mr. Mason's paper have been published by the Directorate of Colonial Surveys in their series of 1 : 500,000 maps of the Falkland Islands Dependencies. Upon these the map here shown by courtesy of the Royal Geographical Society is based

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a wide rift was found. It was about 400 yd. across and 50 ft. deep (366 × 15 m.), with sheer sides which were often drifted up (see photograph p. 420). The floor of the rift was level and was at sea-level, since an open crack containing sea water ran right up the rift. It was crossed about 8 miles (13 km.) from the coast on the outward journey, and 2 miles nearer the coast on the return; at the later point it was considerably narrower. Here, for the first time, it was possible to get an accurate height to the surface of the ice; on the north side, it was about 50 ft (15 m.) above sea-level, while on the south, it was a few feet lower. Another rift was crossed about 10 miles (16 km.) further south; a seal was killed at the open crack in this rift. Here the sheer ice cliffs, about 20 ft. (6 m.) high on the southern side, formed a diversion to the west until the rift narrowed enough to have a snow bridge; open water could be seen several miles to the east of the sledge route, but it was not visited.

South of Three Slice Nunatak the coastal topography undergoes a considerable change. North of the nunatak, almost up to the northern tip of Graham Land, there is a sheer rock escarpment, from 3000 to 5000 ft. (900–1500 m.) high, fringed by a narrow belt of piedmont ice and broken at intervals by steep crevassed glaciers. Around the head of the large inlet just to the south of the nunatak the topography is more broken, with many peaks and glaciers, large and small, flowing between them into the shelf ice; south of this again, in about lat. 69° S., these high coastal peaks disappear, and the land falls from the 8000 ft. (2400 m.) high interior in a series of broad, ice-clad terraces. This change in the topography appears to coincide with the narrowing of the shelf ice. South of about lat. 70° S. the shelf ice was observed from the air to be only about 10 miles (16 km.) wide, and this narrower portion would seem to be afloat. A wide lead near Cape Boggs in lat. 70° 33′ S., where the ice was only a few feet thick, showed no signs of flooding at its edges and a tide crack could be seen from a distance along the ice cliffs fringing the cape. A tide crack was definitely identified at Cape Bryant in lat. 71° 12′ S. A groaning was heard at this crack as the shelf ice lifted or fell with the tide, and diatomaceous staining was found in the low ice cliffs around the cape. A mile from the cape the shelf ice was 40 ft. (12 m.) above sea-level, and bergs, probably breaking off the piedmont of the cape before the ice formed, had weathered into fantastic shapes. A pool of water was found in a hole about 30 ft. (9 m.) deep in the same area; although largely formed by melt water, it was definitely brackish. Another tide crack was found in lat. 72° 20′ S. along the coast; the ice here was more undulating than near Cape Bryant, and the surface varied from about 20 to 80 ft. (6–24 m.) above sea-level.

South of the rifts off the southern end of Hearst Island, the nature of the shelf ice varies very little. Frequent open cracks containing sea water enabled the height to be determined in several places; these cracks were generally found in large flat areas where the ice was only a few feet thick with many bergs frozen into the ice. In the many inlets along the coast the ice is much thicker and in some of them it may be aground. Off the mouths of these inlets the ice was very undulating with bare ice slopes in places. These undulations were in an east–west direction, sometimes with subsidiary systems of smaller undulations running at right angles to them. The main undulations were up to 100 ft. (30 m.) deep from crest to trough, the distances between successive crests being from a quarter to half a mile.

In lat. 73° S. an ice-capped peninsula projects about 20 miles (32 km.) east from the mainland into the Weddell Sea and forms the southern limit of the Larsen Shelf Ice. About 10 miles (16 km.) north of the peninsula, the ice was very broken with many open cracks containing sea water. Some deeper cracks up to 5 ft. (1·5 m.) wide had a floor of sea ice. A tide crack was crossed, running eastwards from the coast, and south of this the shelf ice became much thicker. No tide crack existed along the junction of the shelf and land ice along the peninsula; this junction was exactly similar to that in lat. 68° 30′ S. and the shelf ice in an inlet on the northern side of this peninsula was 250 ft. (76 m.) above sea-level. From the summit of the peninsula the hummocky pack of the Weddell Sea could be seen with a narrow band of open water and new sea ice separating it 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*

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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.*