appears that it is not the *change* of temperature, or mere low temperature, that cracks the ground; it is high *rates* of temperature change that do it. This is the implication of visco-elastic rather than purely elastic behaviour.

Dr. Lachenbruch goes on to consider the fracture process itself in detail. The area of stress relief due to a crack is an important factor in determining the spacing of the polygonal pattern. Here the latest developments in the elastic theory of brittle fracture are called in. To explain the details of the polygonal pattern, the angles at which the cracks meet and so on, is a general problem in the mechanics of contraction cracks; mud cracks, columnar jointing in cooling basalt, shrinkage cracks in concrete, and cracks in the glaze of ceramics are all aspects of the same problem. The theory of contraction crack patterns seems to be still in a fairly crude state, but, as this study illustrates, some principles are beginning to emerge.

This notable paper is a good example of the power of judiciously chosen simplified models to give insight into natural processes.

J. F. Nye

J. A. Heap. *Sea ice distribution in the Antarctic between longitudes 7° W. and 92° W.* London, Admiralty. Hydrographic Department, 1963. [iii, 144, iv] p. (H.D. 542.) £12 10*s*.

This sea ice atlas follows Swithinbank's atlas (1960) (reviewed in *Journal of Glaciology*, Vol. 4, No. 35, 1963, p. 643–44) in the series produced at the Scott Polar Research Institute, and the method it employs is essentially similar. There are 96 frequency charts, half of them covering the waters immediately adjacent to Graham Land, and half of them the South Atlantic and South Pacific waters to east and west of the peninsula. Each pair of charts covers a period of a quarter month, or roughly a week. The main feature of presentation is that isopleths indicating the limits of ice of particular concentrations at particular times of year are not used; that method is rightly judged to be misleading, both because of the large amount of interpolation required in the present state of knowledge, and because of the dangerous tendency, encouraged by the method, to think in terms of an "average" state of the ice. Instead, sector diagrams are used, which show the ice or open water actually observed in a particular area at a particular time of year, and reflect also the number of such observations. This last point is important, as it affects the reliability of any sector diagram. If it is required to know in which years these observations were made, the ice summaries, which occupy the remaining part of the atlas, supply this information. The user must then draw his own deductions. What the atlas seeks to provide, therefore, is the same as its predecessors of this type, namely the fullest and least distorted summary of all known observations of seasonal change in the state of the ice.

This information can be used for a large number of purposes, of which the most frequent are likely to be the planning of shipping or sledging routes, and the correlation of ice data with meteorological or oceanographical data in climatological or related studies. The method used has the further advantage that new observations may be incorporated relatively easily as they come to hand. Enough information on the compilation of the atlas is given in the one page of explanatory matter for the user himself to be able to recalculate the contents of a given sector diagram after adding, say, five years' new observations. The whole atlas could, and it is to be hoped will, be brought up to date every decade or so.

The atlas is the first application of the sector diagram method to southern waters. The area selected is probably the only one for which there were enough data when the work was started in 1955, Graham Land waters being the most frequented part of the Southern Ocean. The sources consulted, listed chronologically on four pages at the end of the atlas, fall into three groups: ships' logs, ice reports from shore stations, and (the smallest group) published accounts. Heap covers the period from 1898 to 1961, but probably three-quarters of his data relate to the last seventeen years of this. The volume of data will continue to increase,

as activity increases and aircraft reports (hitherto a rarity here) start to displace the others, as they have in the Arctic. Before many years, it is possible that the greater part of sea ice observation will be by satellite, and the volume of data will further greatly increase. None of this, of course, lessens the value of the information about the past presented here—quite the contrary. For the rest of the Southern Ocean, we rely still on the U.S. Navy Hydrographic Office's atlas (1957) (reviewed in *Journal of Glaciology*, Vol. 3, No. 27, 1960, p. 659–60)—an excellent compilation, but with the disadvantages inherent in an isopleth method of presentation. As more observations are recorded, the sector diagram method could be extended to cover other parts of the Southern Ocean.

The reader will by now be aware that critical comment on Heap's method is not to be expected from this reviewer, who must admit to having played some part in its formulation, and who will therefore not go beyond saying that he can think of no better method, and is delighted to see how effectively it has been applied to this area. The detailed working out, which includes introduction of a number of improvements and necessary modifications, has been carried out with extraordinary application, accuracy and patience, and it may surprise some to know that it is entirely the work of one man, unaided by any team of assistants. The Admiralty Hydrographic Department have made an excellent job of the printing. Criticism of their contribution may be restricted to two small points: absence of any pagination can be irritating, and binding in limp covers makes a work of this bulk (certainly the weightiest work on sea ice) difficult to handle. The price, which is fixed by the Stationery Office rather than the Admiralty, is excessively high; not that the work is not worth it, but it may deter many, and not only individuals, from finding out how good the work is.

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Swithinbank, C. W. M. 1960. *Ice atlas of Arctic Canada.* Ottawa, Defence Research Board.

U.S. Navy. Hydrographic Office. 1957. *Oceanographic atlas of the polar seas. Part 1. Antarctic.* Washington, D.C., Hydrographic Office. (H.O. Pub. No. 705.)

Spitsbergen: southern Ny Friesland. 1:125,000. [London], Royal Geographical Society, 1962. 10*s.* 6*d.*

THIS map has been compiled following surveys during a series of Cambridge Spitsbergen Expeditions between the years 1949 and 1958 under the direction of W. B. Harland and D. Masson-Smith. It is the first medium-scale map of much of the heart of Vestspitsbergen, incorporating in part details from a number of earlier charts and maps. The visual impression of the map is very pleasing. While clearly portraying the major features of the topography it also includes a wealth of detail; nunataks, ice margins, moraines, alluvial flats, mud-flats and huts are easily identifiable. Trigonometrical stations and the relative reliability of mapped features are indicated. Included on the map margin are a location map, triangulation diagram and a list of 181 new place-names used on the map. A minor criticism concerns the key, from which one or two symbols seem to have been omitted.

A paper by Harland and Masson-Smith (1962) describes in detail how the map was surveyed in the field and later compiled in Cambridge. It is fully documented and includes lists of previously published maps which overlap the area.

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Harland, W. B., *and* Masson-Smith, D. 1962. Cambridge survey of central Vestspitsbergen. *Geographical Journal*, Vol. 128, Pt. 1, p. 58–70.

W. A. BENTLEY *and* W. J. HUMPHREYS. *Snow crystals.* New York, Dover Publications, Inc.; London, Constable and Co., 1962. 266 p., illus. $2.95, 24*s.*

THE exquisite beauty of snow crystals, seen in the classical elegance of the simple geometrical