REVIEWS

EASTERN ARCTIC WATERS.

By M. J. DUNBAR. *Ottawa: Fisheries Research Board of Canada, Bulletin 88, 1951. 10 x 6½ inches; 131 pages, maps, diagrams and tables. $1.00.*

This very complete and much needed compilation and review of oceanographic information on the Eastern Canadian Arctic comes from a man who is primarily a biologist. However, Dr. M. J. Dunbar is no stranger either to oceanography or to the Arctic, and he has produced here a valuable summary of a very large subject, as the list of nearly three hundred references readily shows. The introduction mentions that knowledge of the oceans is still qualitative rather than quantitative, and the paper, therefore, is "largely descriptive and only in small part analytic".

A project such as this poses the perplexing, thankless, and oftentimes embarrassing problem of deciding what data to accept and what to reject. In the section on "Bathymetry", for example, the author has treated a sounding of 2,870 fathoms in Baffin Bay as being erroneously deep. Most authorities on the subject will agree with this. In the reviewer's opinion the author would have performed a better service for oceanography had he been more reluctant to accept data "showing" the water at 100 metres depth in Hudson Bay to be several tenths of a degree below freezing point. The water in question had an observed salinity of about 33.20 per mille which has a freezing point of approximately -1.8°C. Even allowing for the reduction of the freezing point by a tenth of a degree due to the pressure per 100 metres, it is still difficult to believe that the *Loubyrne* data of 1930, which describe temperatures as low as -2.2°C at 150 metres can be accurate. The author writes that the data might be inaccurate, but he also tentatively puts forth the possibility, by way of explanation, that conditions in 1930 were different from those today. This may well be the case, but it does not explain the sub-freezing water temperatures. The author also suggests that the water may have lost heat *in situ* to the overlying layers or to the bottom. The *Loubyrne* data show the overlying layers to be warmer, not colder, and the possibility of losing heat to the bottom, especially to the extent of lowering the water temperature to below freezing point, seems most improbable.

The section on "Circulation" describes the generally accepted current pattern based primarily on the data from expeditions of the *Godthaab* and the U.S. Coast Guard. There is also an interesting discussion of the "North Water" of Baffin Bay—that area which surprisingly appears to remain unfrozen throughout most winters. Many individuals have considered this phenomenon and several explanations have been put forward, few of which satisfy anyone except the originator. A suggestion by Kiilerich, that rapid vertical circulation is responsible for keeping the North Water ice-free, is given some priority in Dr. Dunbar's paper. This theory is controversial, but until winter field work is carried out in the area, no theory can be proved correct.

This section also includes a short discussion of "feed-back" circulation systems, the subject of a separate paper by Dunbar in 1950.[1] According to the concept held, the excess pressures which may be exerted during fluctuation peaks of the North Atlantic Drift, for example, will be absorbed temporarily in the circulation of another area such as the Labrador Sea. In turn, Baffin Bay and Hudson Bay will help absorb excess pressure from the Labrador Sea.

[1] "Feed-back systems and oceanography". *Amer. Sci.* Vol. 38, pp. 599–603.

Under the heading "Fjords and other inlets", Dr. Dunbar discusses the differences between Greenland and Labrador fiords. Fiords are defined as being "deep inlets in the coast, usually (but not always) with a threshold in the bottom configuration at the mouth, with steep sides, and formed either by the action of glacier ice or by movements of the earth-crust, according to the point of view taken". Although the Labrador coast is greatly indented, true fiords are much less common than in Greenland.

Some earlier work by Hartley and Dunbar on the "brown zones", which occasionally occur on the surface of some fiords at the glacier face is also discussed. The brown-coloured zones are open areas within the brash ice, with a surface current away from the glacier face in the order of half a knot, and are caused by upwelling water. Planktonic crustacea are brought up from below, providing food for the many sea birds which cluster around the area. Hartley and Dunbar suggest that the driving force of this system is chiefly the melting of the brash ice. This is said to produce a surface layer of very fresh water which, in pouring out of the area, "demands" a replacement current of salt water to flow in below. The heavier inbound current brings up mud from the bottom along the glacier face and, reaching the surface, causes the brash ice to be pushed away from the glacier face. The melting of the brash ice would undoubtedly result in a certain amount of fresh water being formed at the surface, but that this should escape so rapidly and in such a way as to induce a strong replacement current from below does not seem plausible. Also there appears to be good evidence that the "brown zones" persist during the winter, which invalidates any theory requiring the melting of brash ice as an essential part of the driving mechanism.

The discussion of "Seasonal cycles" is necessarily restricted to those areas where winter observations have been made. It emphasizes our woeful lack of wintertime information throughout much of the Canadian Arctic. The section on "Long-term changes" is more informative. The history of the west Greenland cod fishery is an excellent indicator of these changes. Atlantic cod were caught on the west Greenland banks in the 1820's and again in the 1840's. By 1850 none was found in the area, and it was not until 1917 that Atlantic cod again appeared off Julianehaab. The cod moved north year by year until by the 1930's they had advanced north of Disko Ø. It is not yet clear whether the recent warming has come to an end, but the subject is of utmost interest scientifically and of great importance to the economy of Greenland.

The delimitation of Arctic and Subarctic is interesting and well handled by the author. Any attempt to arrive at a line which will satisfy everyone, even within a single scientific discipline, is likely to be little more than an academic exercise. Terrestrial boundaries based on winter, summer, or annual mean temperatures, the tree-line, the permafrost limit, isohyets, or combinations of several of these have been used by many. No single line will serve all purposes. A boundary based on terrestrial factors does not necessarily join, at the shoreline, one based on marine factors even though terrestrial and marine environments influence each other. Using physical criteria, the marine arctic is described as that area where only arctic water is found (arctic water being that originating in the upper two hundred metres of the Polar Basin). The marine subarctic is composed of a mixture of arctic and non-arctic water. It is recognized that the boundary-line varies seasonally, yearly, and over longer periods, but it is difficult using present methods to detect the presence of a given water mass near the border-line.

Biological indicators may be the most useful criteria in the establishment of a line of delimitation. For example, Atlantic cod are found abundantly near, but not in, pure arctic water. Similarly, a number of planktonic forms thrive in an area where arctic and non-arctic waters meet. The distribution of some inter-tidal littoral forms is influenced by

the weather over the land, as well as by the water bathing the shore-line, but they may still be valuable indicators. Using the general biological picture, the author has drawn a line of delimitation showing the east coast of Greenland, from about Angmagssalik, down to Kap Farvel and up the west coast to Kap York, to be subarctic. The east coast of Baffin Island lies in the marine arctic, and also the territory west of a line extending from the western tip of Foxe Peninsula diagonally across Hudson Strait to the west side of Ungava Bay. Hudson Bay itself is marked by a large question-mark. This line, while it will not satisfy everyone, appears to be a logical one for many arctic marine biologists and oceanographers.

As a summary of present knowledge of the area including the Labrador Sea, Davis Strait, Baffin Bay, Hudson Strait, and Hudson Bay, 'Eastern Arctic waters' is an essential reference work for all oceanographers and marine biologists with arctic interests.

WILLIAM G. METCALF

NORTH OF 55°.

Edited by CLIFFORD WILSON. *Toronto: The Ryerson Press, 1954. 9 x 6 inches; 190 pages; illustrations; maps and folding map. $5.00.*

Four times a year for almost two decades Clifford Wilson has produced *the* magazine of the North, *The Beaver*. Every issue has been filled with authoritative and entertaining articles, and the illustrations have been uniformly superb. Circulating far outside the still circumscribed group of northerners it has done much to attract attention to the rapidly growing significance of the north.

'North of 55°', a volume in the Ryerson Travel Books, is a symposium on the Canadian Arctic and Subarctic by sixteen authors, all of whom are recognized authorities. Although each member of the team has followed his own plan, the hand of the editor shows in the unity of the volume. Following a useful introduction by the editor, who attempts to escape being called a northern expert, there are chapters covering the land surface, exploration, climate, native peoples, mammals, fur trading, fishing, flowers and forests, birds, cultivation, geology and mining, travel in the old days and now, administration, more particularly by the R.C.M.P., and finally defence. This stark list of topics fails to reflect the variety of treatment offered—as for example in the chapter on travel a generation ago by P. H. Godsell, and in Andrew Croft's on modern transportation including various over-snow vehicles.

The Northland is changing fast and any author can be excused for not being quite up-to-date. Dr. J. L. Robinson wisely based his discussion of the climate on a series of temperature and precipitation maps. Unfortunately for his discussion, new data have appeared since his maps were prepared, (*see* 'Climatological atlas of Canada' by M. K. Thomas), and quite radical revisions must be made in some of the established distributions, and explanations based on them. This chapter also shows some discrepancy between text and maps, as for example when we read that Hudson Bay is, in summer, "a large body of cold water" which has a "major influence" on the climate of the area, only to find the 50°F isotherm for July apparently crossing it undeviatingly.

A double-page map designed to show the contrast between the drainage patterns of the Precambrian Shield and the Interior Lowlands is also unsatisfactory. It is evidently a reproduction of information plotted on to the 8-mile sheets at the Defence Research Board and most readers will find that it does not show the intended contrast clearly. A difference in drainage pattern exists, but the change does not take place at the edge of the Precambrian Shield. Perhaps by selecting part of the map only, with suitable orientation and labelling, the story would be told more clearly. The editor has included sufficient maps to help the reader not familiar with the area. There is, for example, a good "physiographic diagram" type of map, which must have required considerable detailed work by cartographer P. G. Downes.