

meteorological factors involved. From these studies emerges the striking effect of the incidence and amount of snowfall on ablation. Snowfall is shown as an important factor inhibiting ablation to give marked differences between budget years. Another result is the demonstration of the high contribution of the snout section of the glacier to ablation and run-off totals; the great increase in ablation on the steep outfacing slopes of the glacier is very apparent. The roles of slush avalanche and superimposed ice are discussed. The former makes possible the transfer of mass, without net loss to the glacier, across the regional equilibrium line, and the latter complicates the assessment of net ablation and run-off. The author also deals with the accumulation and ablation on the Baby Glacier, concluding that this glacier is out of equilibrium with the present climate, and is wasting rapidly. The net loss in the 3 years 1959 to 1962 was considerable, and a well-marked trim line shows that this is no short-term effect. In a detailed consideration of the discharge from the White Glacier catchment, an important conclusion is that rainfall has a disproportionately great effect on the run-off.

This report, which is very well produced and illustrated, makes a valuable contribution to the measurement of run-off, and to the problems of relating run-off to ablation and of comparing net ablation with total discharge. The author is to be congratulated on his experimental methods in the field, for they show great promise for future work.

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THE ADMIRALTY CHART: BRITISH NAVAL HYDROGRAPHY IN THE NINETEENTH CENTURY. BY REAR ADMIRAL G. S. RITCHIE, DSC, HYDROGRAPHER OF THE NAVY. London: Hollis & Carter Ltd., 1967. 6 x 8¾ inches, 388 pages, including 12 maps and 10 plates. £4-4-0.

Rear Admiral Ritchie needs no recommendation when it comes to personal knowledge of his subject. I approached the review of this book with some trepidation as I know from long experience what a tedious job actual hydrographic operations are, and I could see little or no relationship to arctic waters. Charts of any value regarding the Canadian Arctic coast did not exist until 1955-56, and even these are very spotty to date.

However, what was expected as dull reading turned out to be a fascinating story and for the first time I realized that almost all,

if not all, of those hardy explorers of the British Navy entering the Polar Seas belonged to the Hydrographic Service of Their Majesties. There has always been the question in my mind of how the Navy commanders of the nineteenth century, with only sail, conned their ships through the arctic ice floes to almost every point that major ice-breakers have covered. The Admiralty Chart explains this fact by showing the calibre and training of the navigators involved. Such names as Ross, Parry, Franklin, Crozier, McClintock, McClure, Collinson, Kellet, Austin, Beechey, Meham, and Nares, as well as others, make up the roll call of those men who were primarily first-rate hydrographers and then entered arctic waters as explorers.

Rear Admiral Sir William E. Parry, one of the greatest arctic navigators, became Hydrographer of the Navy, as did Captain Sir Frederick J. O. Evans and Vice Admiral Sir George W. Richards, also of polar experience. Three out of the eight Hydrographers are of that era.

Reading *Admiralty Chart* leads one through most of the shallow waters of the world to the dangerous reefs and shoals, and finally, to the safe channels. But, first of all, it reveals the British spirit at its best and the tenacity of efficient charting; the rescue of ships; the pursuit of war and the old axiom that "in war, everything is possible; in peace, make do." It also reveals Fitzroy buying a ship on his own recognizance to carry out required hydrographic duties, and the Lords Admiralty ordering him to pay for it out of his own pocket.

You live the tedious but exciting existence of hardship and privation that were always attendant to these voyages, voyages that lasted for years, not months, and you see the forming of characters of these hydrographers who made hydrography a science rather than "by guess and by God." For instance, Admiral Belcher becomes wholly understandable when one knows his background and attitude. Commander, later Sir, George H. Richards, kept a diary on Belcher while with him in the Arctic. It is explicit: "If any person ever makes public the writings in this diary may he be haunted by my ghost in this world and the next!"

The Admiralty Chart should be required reading for any student of hydrography, and certainly it is a *must* for anyone who would study the impact of the British Navy in the exploration of the Arctic or who desires to become a knowledgeable arctic buff.

S. E. Alexander