HYDROLOGICAL ASPECTS OF ALPINE AND HIGH-MOUNTAIN AREAS. Edited by J.W. GLEN. Proceedings of the Exeter Symposium organized by the IAHS International Commission on Snow and Ice with the support of UNESCO. IAHS Publication 138, 1982. 350 + ix p. US$30. (Order from: Office of the Treasurer IAHS, 2000 Florida Avenue, N.W., Washington, D.C. 20009, U.S.A.; or IUGG Publications Office, 39ter Rue Gay Lussac, 75005 Paris, France.)

Fulfilling what its title promises, these proceedings lift the reader to the highest mountain regions of the world, and to the sources of rivers that pass through much of civilization. The journey is to the Alps, the Carpathians, the Caucasus, the Rockies; the ranges of Scotland, Japan, Norway, New Zealand, India, Central Asia, and China; to the Karakoram; and up the slopes of Everest. This truly international adventure consists of 34 rather short papers (about ten pages each) on a variety of subjects, but never too far from a pervading and unifying theme — to predict the discharge of mountain basins. For this was largely a meeting of water resource people.

Although the co-convenors (Drs. Glen and Roots) divided the conference and its proceedings into seven parts, the reader quickly senses that the unifying theme overwhelms the division. In retrospect, perhaps it is the *size scales* of the problems and basins that form a more natural way to approach a discussion of these proceedings.

First prize for achieving the largest-scale study (global mountain hydrology) could be awarded to Dreyer *et al.*, who present part of their *World Atlas of Snow and Ice Resources*, which is being compiled by the Institute of Geography, USSR Academy of Science. Stream-flow maps on scales $1:10^6$ and $1:10^7$ are given for the Tien Shan, Pamirs, Hindu-Kush, Karakoram, and Canadian Rockies. On the large scale, the reader also finds contributions on satellite-aided hydrology by Rango and Martinec who extend the concept of "snow depletion curves", by Tom Andersen who uses image analysis to refine snow mapping for optimization of Norwegian hydro-power resources, by Kotlyakov and Krenke who made use of Soyuz-11 space imagery of seasonal snowlines, and by Tarar who first provides an overview of some hydrology problems in Pakistan, and then develops some predictive equations for the Upper Indus Basins from Landsat imagery.

Three contributions from the People's Republic of China (Kang *et al.*, Lai, Yang) show that it is possible to predict discharge from immense basins that have strong glacial components, and that it is possible to relate the dimensionless "coefficient of variation" of runoff to air temperature and other practical indices. These Chinese papers and the Soviet Tien Shan papers (Makarevich, Konovalov) convince the reader of the importance of the glacial discharge component (30 to 56% of the runoff) to Central Asia, especially during long arid periods.

Precipitation is clearly the dominant component in the monsoon-affected Himalaya. Higuchi *et al.*, explore precipitation patterns for some of the most extreme topography of the world in the Everest region. Bagchi shows how precipitation increases with elevation up to about 4000 m in the Western Himalaya near Manali, India, and then decreases with further elevation increase.

As the emphasis shifts from the Asiatic giant basins to the smaller experimental basins of the world, the reader may sense that loss of size is replaced by quality of data and attention to details. The work (Baker *et al.*) on the Vernagtferner, a ~10-km² experimental basin in the Austrian Alps, and on the 23-km² Peyto Basin in Alberta (Young) are careful, thorough, and well written analyses of discharge from smaller glacier basins. Using the concept of "linear reservoirs", Baker *et al.*, have succeeded in hourly predictions that have reasonable agreement with observations. Lundquist also uses "linear reservoirs" (in series and parallel) to model glacier discharge for hydroelectric optimization.

Prediction of basin snowmelt is addressed in papers by Bálint and Bartha (Danube and Tisza flow through Hungary), Fitzharris and Grimmond (New Zealand), Morris (Scotland and Switzerland), Pereira and Keller (Switzerland), and Martinec *et al.* (Switzerland). The last paper uses 15 years of isotope tracing data to support the startling conclusion that groundwater in long-time residence (~5 years) is *forced* to discharge during the relatively short period of snowmelt. Since the groundwater discharge is sometimes as high as 60% of the total discharge, a mechanism which explains how meltwater "forces" the discharge needs to be determined; this is a challenging problem for future research.

A contribution from the World Meteorological Organization (WMO) announces that results from a "World Cup competition" which sets 11 snowmelt models against six data sets is to be published shortly.

At a still smaller scale, the reader who is interested in the thermodynamics and physics of flow will find a collection of six relatively technical papers on flow processes through snow, firn, and glaciers: "Master plumber" Collins contrasts fast reservoir runoff through moulin-conduits with slower runoff through the firn-aquifer system; an excellent contribution by Oerter and Moser details the firn-aquifer system; Higuchi and Tanaka explain the parallel flow patterns in seasonal snow; Rau and Herrmann show that the snow-pack structure changes from a "stratified" media to a "homogeneous" media before the initiation of melt; Gurnell has observed "rapid flushes" of sediment in glacial streams, and concludes that even hourly discharge observations may be misleading; and Kazanskiy, citing Kazanskiy, expands earlier theoretical analysis by Kazanskiy on glacier channels.

That "mountain hydrology" is really a broad subject is underscored by some interesting papers on miscellaneous topics: Abe on alternate bars, Lakhera on erosion hydrology in the Himalaya, Nakawo and Takahashi on ablation under debris, Keller and Strobel on nutrient discharge, and Avdyushin *et al.* on cosmic ray measurement of water equivalent.

Last mentioned, but not least, is the single paper that emphasizes high mountain hazards — Hewitt's "Natural dam and outburst floods of the Karakoram Himalaya" — which provides a summary of 400 years of major disasters, and is based on 20 years of research.

Indeed, it was an international venture, but why was North and South American hydrology not represented in proportion to European and Asiatic studies? Surely, not because of a lack of problems. In the late spring and summer of 1983, just as these proceedings were distributed, rapid and unpredicted snowmelt filled dams on the Colorado River to beyond capacity; floodwaters poured from the Sierras onto some of the most precious agricultural land in California, and mud slides descended from mountain slopes onto developed areas in Utah and British Columbia. The streets of Salt Lake City turned into rivers; Hoover Dam overflowed; and transportation came to a grinding halt on the Trans-Canada highway for nearly two weeks.

Thanks to its indefatigable editor, John Glen, and others acknowledged in its preface, these proceedings were quickly distributed within a year of the Exeter, U.K., meeting. The best recommendation that can be given to any publication in these days of "fast track" science is that it is up-to-date.

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WORLD OCEAN ATLAS. VOLUME 3. ARCTIC OCEAN. Edited by S.G. GORSHKOV, Admiral of the Fleet of the USSR Navy. Original Russian-language edition published in Leningrad by USSR Ministry of Defence, Department of Navigation and Oceanography, 1980. Various unnumbered introductory and explanatory pages of text; 184 p. of maps, charts, and graphs; index; fold-out relief map of world ocean floor. Soviet price 25 rubles. Hardbound.

Edition reviewed here contains supplementary booklet in English (Introduction, Index) plus English-language title page and publishing data added by Pergamon Press, Oxford, 1983. Pergamon edition: original edition plus English-language supplement (xx + 41 p.). ISBN 0-08-028735-2. CAN$582.00.

This is the third atlas in a series on the world's oceans published by the USSR. The first dealt with the Pacific Ocean, the second with the Atlantic and Indian Oceans. *Arctic Ocean* is basically intended to enhance navigation and teaching, but it also will serve as a comprehensive source of data for a wide range of people interested in the physical components of the Arctic Ocean. Not only will a variety of technical and scientific students benefit from the atlas, but all those concerned with applied studies in the Arctic Ocean and adjacent land masses will probably make frequent use of its extensive materials. Pergamon Press has translated the atlas's table of contents, the descriptions which preface each of the major sections, and most of the index. To make effective use of the atlas, however, the user of each map needs to transliterate the Russian text and to translate the legends and related data. The Pergamon supplementary booklet contains neither a transliteration guide, a Russian-English gazetteer of terms appearing in the map legends, nor reference to appropriate Russian-English dictionaries and technical manuals. The Russian-language prose, however, is beautiful and precise throughout the atlas and should cause little difficulty for translation by readers who have a knowledge of related English technical terms in their own areas of expertise. For the generalist, *Arctic Ocean* provides an appropriate opportunity to become familiar with the Russian language and to acquire a broad understanding of many features of the Arctic.

The Soviet compilers, including an impressive array of naval and scientific personnel, suggest that investigation of the world's oceans together with space and nuclear research constitute the most important scientific endeavours of our age; the oceans' mineral and biological resources will eventually sustain much of the world's population. This atlas obviously demonstrates the importance of the Arctic Ocean to the USSR and allegedly draws upon extensive materials obtained by a variety of research programs. Although most of the maps are drawn at a very small scale (1:15 million, 1:30 million, or 1:45 million), their total effect is to demonstrate that the physical properties of the Arctic, particularly that portion investigated by the USSR, are well known in aggregate; the maps testify to the rapid increase in knowledge about the Arctic which has occurred since World War II.

Arctic Ocean is divided into seven sections. The first uses eight map sheets and 17 maps to identify "the most important" voyages and oceanographic expeditions made to the Arctic Ocean; it is a particularly useful summary of Russian and Soviet voyages to the Arctic. Section two is approximately the same size and portrays the ocean floor, particularly elements of relief and geomorphology. The third section is the largest of all; containing 63 map sheets, 209 maps and two diagrams, this section focuses on climate and emphasizes thermal, wind, circulation, and regional climatic patterns. The fourth section comprises 30 map sheets, 67 maps, and 27 diagrams pertaining to hydrology, particularly to physical properties of water and dynamics of ice. These maps are followed in section five by 11 map sheets, 33 maps, and nine diagrams devoted to hydrochemistry. Section six contains five map sheets and 20 maps pertaining to biogeography and the fauna and flora of the ocean. The final section with 11 sheets, 13 maps, and 12 diagrams provides reference materials on terrestrial magnetism, aurorae and astronomy. The atlas is accompanied by a loose two-sheet fold-out relief map of the world ocean floor at a scale of 1:25 million.

Arctic Ocean, primarily devoted to climate and hydrology, thus fulfills its basic purpose of serving mariners and students, presumably students of navigation and science, by describing the physical properties of ocean water and atmosphere. In keeping with the general sensitivity in the USSR to the release of detailed information on resources, the atlas avoids identification of those metallic and non-metallic minerals which have direct utilization for industrial processing. The atlas is also devoid of settlement data and related demographic and cultural information. It excludes descriptions of the volume of water entering the Arctic Ocean, a subject of great concern throughout the Northern Hemisphere in view of extensive proposals for diversion of northward-flowing streams into mid-latitude arid regions.

As a research tool, unfortunately, *Arctic Ocean* is inadequate. The editorial board's recognition of the oceans' importance to scientific inquiry is not matched in this atlas by the inclusion of appropriate references and bibliographical sources. Although the individuals responsible for each map sheet, and the major educational and research institutions supporting Soviet investigation of the Arctic, are identified, the user of this atlas cannot estimate either the reliability or the length of record of the data used to derive patterns. The reader cannot directly proceed to consult related supplementary sources such as larger-scale maps, scientific reports, or compendia of statistical information, in either Russian or English, because the sources used to compile the maps and diagrams are not identified. For the non-Soviet user lacking access to appropriate Russian institutions, *Arctic Ocean* lacks both authority and that essential property of scientific investigation, the possibility for independent verification of data and alternative interpretation. This criterion is especially acute if the atlas is to be used creatively and if the accuracy and limitations of its sources are intended to be evaluated. Thus, while the formal credits include truly impressive personnel whose work is both known and outstanding, the atlas misses the opportunity to support its impressive appearance with documentation which would enhance its utility to the reader.

The difference in price between the Soviet and Pergamon editions is not matched by a corresponding increase in the amount or utility of material provided. Furthermore, given the large amount of data available in the original, the Pergamon supplementary volume is niggardly in the material it offers for a price that is over fourteen times the Soviet original. This reader cannot understand why Pergamon did not justify its otherwise excessively high price by providing an operational guide to the Russian original, and why all the items contained in the original index were not reproduced in the Pergamon translation.

While the quality of Pergamon's limited translation by D. A. Brown generally is fluent and idiomatic, the English introduction occasionally is capricious. For example, some items beginning with the Cyrillic letter "E" have been transliterated as "Ye" (Yenisey) while others appear in English beginning with "E" (Ermak). Translation, however, while never easy, is also not without humour: the Russian original of "seashore bird colony" (p. 169) is translated in the Pergamon introduction as "poultry." Another small but serious flaw occurs in the Pergamon booklet where the table of contents under "atmospheric circulation" states that map pages 84-101 show wind data for March; they actually show it on a series of two-page sets monthly commencing with March and ending with November.

Apart from the limitations in scientific documentation and utility of the English-language guidebook, *Arctic Ocean* is a beautiful and comfortable atlas. In keeping with most major Soviet atlases used by those of us who study that country's geography, *Arctic Ocean* has been carefully produced and the quality of colour reproduction is excellent. The great strength of *Arctic Ocean* is that, unlike any other atlas on the area, it contains a large number of important physical topics in one volume. This atlas thus represents a comprehensive source of aggregate information for an area of great ecological, climatological, hydrological, and political significance.

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LES BALEINIERS FRANÇAIS DU XIX^{e} SIÈCLE (1814-1868). By J. THIERRY DU PASQUIER. Grenoble: Terre et Mer (3 rue Charrel, 3800 Grenoble, France), 1982. 256 p. Price 380 francs.

Every schoolboy knows about the growth of the New England whale fishery, starting in coastal waters and spreading over the whaling grounds of the whole world. In the late Dr. Brian Roberts's *Chronological List of Antarctic Voyages* (1956, now being revised) there are some pages where only American ships appear, proof of the way in which they dominated the trade. It is true that the list was only as good as Roberts could then make it (though a marked improvement on its predecessor) and that more recent research has yielded a number of whaling voyages to the sub-Antarctic from British ports and the Cape of Good Hope; but it still remains that American whaling men showed the way and led for a century or more.

Not so well known is the part they played in establishing the South Seas trade in London and, to a limited extent, in Haverfordwest. Those Quaker masters Coffin, Rotch, Gardner, Macy, Hussey, and others, in anticipation of the war of independence, came to England and were to be found in British shipping lists for over half a century. So numerous were they that it is impossible to disentangle them, brothers and fathers and sons.

Even less was known about the French South Seas trade. In his introduction, J. Thierry Du Pasquier gives a brief account of the first French whaling trade, founded by New England masters who bore the same names as those who went to Britain. He shows how the first ships were sent out in 1784 and how the trade was cut short by the supremacy of the Royal Navy when the war between Britain and France began. A fuller account of this trade will be welcome.

The second French whaling trade, of 1816-1868, was founded at Le Havre in 1816 by Jeremiah Winslow, another Quaker New England master, who settled in France and became naturalized. Mr. Du Pasquier shows how by business ability, hard work, and strength of character he achieved a fortune of between two and four million francs, the reward of hard-headedness with the French government and his crews.

The emphasis in this book is on Jeremiah Winslow and his successor, Edouard Winslow, but Mr. Du Pasquier also deals with other French ports. In half a century nearly 600 ships took 12-13 000 whales. Towards the end of the period, when whales were becoming scarcer, they went as far as the Sea of Okhotsk, Bering Strait, and the Arctic Ocean. Regrettably the author does not know how far they went into the Arctic Ocean and what they caught there.

The relevance of this book is twofold. Whaling men sailed in the hope of making a profit. That depended not only on the size of the catch and the quality of the oil, but also on the market price at the time. Since all oils were to some extent in competition, the prices turned on the Greenland and Davis Straits catches, which have not yet been fully examined. Nor has the relation between the Arctic and South Seas trades been looked at closely, but the trade as a whole cannot be understood without a knowledge of all three trades.

The second point is that this book is a lesson on how to deal with such a subject where the facts are hard to find and fragmentary. The bibliography shows the length to which the author has gone in gathering printed and manuscript material in France and the United States — sadly there is very little on the British whaling trade — as well as using his own collection. The appendices, with biographies of masters and a table of all the voyages, shows the years that the author must have spent in extracting and sorting a multitude of facts.