Soviet Books in Oceanography

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Soviet monographs in the ocean and earth sciences are much less well known outside the Soviet Union than the Soviet periodical literature. One reason for this is that monographs are generally not included in literature exchanges between institutions and must be ordered individually from Moscow (*1*) through specialized booksellers. Moreover, monograph titles are often missed by Western abstracting services, and our lag in learning Russian hinders us not only from absorbing the contents of Soviet books, but also from utilizing Soviet bibliographic works such as *Knizhnaya Letopis* and the abstract journal *Referativnyi Zhurnal*.

In the past five years, several hundred scientific books and monographs on oceanographic subjects have been published in the Soviet Union, probably more than have appeared in the English language in these subjects. Yet few Americans know more than a handful of Soviet works, even by title. The question is not whether we are missing something, but how much.

In any attempt to evaluate this knowledge gap, a "pound for pound" comparison of Western and Soviet books may be misleading because of differences in the scopes and roles of the respective publications. First, some Soviet works have a local or specialized character and may be roughly compared with some of our limited-circulation publications or with company reports of larger private firms. More important in bulk are volumes of collected articles, frequently by members of a single institution or a few institutions. That such collections partly fill the role of periodicals in this country and elsewhere is suggested by H. E. Hawkes in summarizing a recent survey of world literature in geology (*2*). Hawkes reports that 67 percent of Soviet titles in 1961 fell into the nonperiodical category, compared with 45 percent for North American and 30 percent for European literature. Thus, whereas our own bread-and-butter publications are most often submitted to journals, our Soviet colleagues' meal tickets frequently find their way into book form.

The centralized organization of publishing in the Soviet Union also influences the character of the output. Soviet officials point out that the need to make a profit is not a factor in the publication of their scientific books and that as a result an acceptable book can be issued regardless of the size of its immediate readership or of the possibility of financial loss. Russian books are indeed cheap, ordinary scientific publications averaging about 0.62 kopek per octavo page (official exchange rate \$1.11 = R 1.00 = 100 kopeks). On the other hand, because Soviet publishers do not have to compete for readers' favor and pocketbooks and because they and authors have less to fear from tough-minded critics in the Soviet equivalents to journals such as *Science*, there is less incentive to avoid duplication and trivia, to strive for conciseness and authoritativeness in writing, or to make attractive and durable books. For instance, conveniences such as indexes are rare. Finally, press runs are limited, and once an edition is exhausted, it is rarely reprinted.

In summary, the search for Soviet books of international importance is difficult for American scientists not because able Soviet authors and editors do not produce such works, but because the monograph field is diluted with routine material, because Soviet monographs are poorly covered in Western literature reviews or abstract journals and tend to go out of print, and, most important of all, because so few Americans have a working knowledge of Russian.

The five works reviewed here include two collections of papers, two volumes by single authors, and an atlas. All have in common that they summarize Soviet work in their fields. One of them, the Atlas of Antarctica, is an extraordinary achievement and should be purchased—before it goes out of print—by every institution that has a serious interest in oceanography or the polar regions.

Series on the Pacific

As is fitting for a large, powerful contry, one of the favorite strategies of the Soviet Union in dealing with scientific problems is a massive attack on a broad front. This strategy is responsible for a new series of volumes on the Pacific Ocean, *Tikhii Okean*, published by the Nauka Publishing House in Moscow, and edited by a board headed by V. G. Kort, director of the Institute of Oceanology, U.S.S.R. Academy of Sciences. The first four volumes of the series, *Meteorologicheskie Usloviya nad Tikhim Okeanom* (Meteorological Conditions above the Pacific Ocean), *Gidrologiya Tikhogo Okeana* (Hydrology of the Pacific Ocean), *Khimiya Tikhogo Okeana* (Chemistry of the Pacific Ocean), and *Berega Tikhogo Okeana* (Shores of the Pacific Ocean), are scheduled for 1966. Volumes 5 through 7, *Geomorfologiya i Tektonika dna Tikhogo Okeana* (Geomorphology and Tectonics of the Floor of the Pacific Ocean), *Osadkoobrazovanie v Tikhom Okeana* (Sedimentology of the Pacific Ocean; in two parts), and *Biologii Tikhogo Okeana* (Biology of the Pacific Ocean; in two parts), are to appear in 1967.

Volume 3, **Khimiya Tikhogo Okeana** (358 pp. 2.16 rubles), edited by S. W. Brujewicz (his own preferred transliteration of his name), became available in time to be displayed at the Second International Oceanographic Congress in Moscow in June 1966. It is the first modern attempt at a synthesis of the hydrochemistry of the Pacific Ocean. The first part of the book, hydrochemistry of Pacific waters, encompasses general questions about salinity, the subjects of nutrient elements, *p*H and carbonate equilibria (solubility of calcium carbonate is not treated), microelements, oxygen, and, in brief chapters, dissolved organic matter and radioactive contaminants. The subject of the second part, chemistry of interstitial waters of sediments, is one which has not previously been included in texts on chemical oceanography, and reflects Brujewicz's long-standing interest in and study of interstitial waters. Interestingly, Soviet workers have made many more elemental analyses of pore waters of sediments than of free overlying waters.

Although some critical synthesis is

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included, the main effort of the book is an attempt to present an overview of the shelffuls of scattered data on the hydrochemistry of the Pacific Ocean. The authors have leaned heavily on profiles and contour maps of given constituents at various depths in the Pacific. A large degree of generalization is enforced by the limited ability of page-size illustrations to depict hydrochemical conditions in an area covering half the globe. Methods are discussed briefly, and where the limitations of or controversy over analytical procedures influence the interpretation of data, as is especially true for *p*H and organic phosphorus, no attempt is made to shove unsolved problems under the rug. The compartmentalization of the volumes in the *Tikhii Okean* series is evidently a partial barrier to discussion of the interrelation of hydrochemistry and other factors—even hydrology. Whatever one thinks of the resulting restrictions on the scope of the treatment, these appear to be inherent in the basic concept of the series.

The authors have made an obvious effort to search out usable data from many sources, including limited-distribution reports of world oceanographic institutions, and have tabulated and plotted areal coverage of the data in a useful manner. I have taken advantage of the convenient listing of scientific cruises and expeditions to the Pacific Ocean to group (consolidated) cruises to the Pacific since the 1920's in Table 1. Because of differences in the scope of the investigations, the numbers do not necessarily give quantitative estimates of the scientific data collected, but they do provide an interesting historical picture of relative ship activity by participating countries.

Table 1. Oceanographic expeditions to the Pacific Ocean, 1927–1961.

Nation	Number of expeditions		
	1927–41	1946–53	1954–61
United Kingdom	10	1	
United States	9	17	60
Japan	4	46	52
Soviet Union		2	18
Canada			18
Australia			5
France			5
Denmark	2		
Sweden		1	
Total	25	67	158

Radionuclides

Radioekologiya Morskikh Organizmov (Radioecology of Marine Organisms. Atomizdat, Moscow 1964. 295 pp., 97 kopeks), by G. G. Polikarpov, is an ambitious attempt to cover in a small space a broad and nebulous field. Most attention is focused on the distribution, behavior, and effect of radionuclides in the marine biosphere and hydrosphere, but freshwater organisms are also treated. The book includes many tabulations of data from published sources, many of which are Western (475 references are cited, of which 200 are in Russian). Polikarpov does better with Western literature than any Western worker appears to have done with Soviet literature in this area. However, his uncritical choice of data and failure to isolate variables and define experimental conditions limit the value of large parts of the treatment. For example, what can one do with an "accumulation factor of 157" for phosphorus-32 in *Mytilus galloprovincialis* when the experimental conditions are not given? And what does an "accumulation factor" for stable phosphorus in marine organisms mean in view of the fact that this element's concentration may vary by orders of magnitude in sea water, not to mention its presence in many different forms?

Sedimentology

Alexander Petrovich Lisitsin, author of **Protsessy Sovremennogo Osadkoobrazovaniya v Beringovom More** (Recent Sedimentation in the Bering Sea. Nauka Publishing House, Moscow, 1966. 547 pp., 2 maps. 3.47 rubles), has had a brilliant career since his appearance on the Soviet scientific scene in the early 1950's. Best known in the West for his extensive studies of suspended matter in the world oceans, Lisitsin has also been active in many other studies, including sedimentological surveys in the Antarctic, the Indian Ocean, and the Bering Sea, as well as in the development of oceanographic equipment and techniques for shipboard analysis of suspended matter and bottom sediments. He also participated actively in the preparation of the Atlas of Antarctica.

Beginning with a dedication to the late Soviet oceanographer N. N. Sysoev (personal dedications are not common in Soviet scientific monographs), Lisitsin's book shows evidence that its author is a scientist of more than ordinary breadth. The first four chapters summarize, in remarkable detail, the relevant environmental factors and processes in the Bering Sea, including regional geomorphology and geologic setting, soils, climate (including ice cover), seismicity, vulcanism, gravity distribution, stream drainage and denudation, ice transport, marine hydrology and hydrochemistry, distribution of organisms and biomass, and distribution and composition of suspended matter. This section of the book provides a concise and useful body of information in its own right and demonstrates that Lisitsin is equally at home in Western and Soviet literature. The book's manuscript was evidently submitted in May 1965, and even so one American paper as late as 1965 is cited.

The remaining five chapters are devoted to the composition and distribution of the sediment, based chiefly on about 1000 sediment cores and grab samples from ten Soviet expeditions. Granulometric composition, petrology, and major chemical components of the sediments are emphasized, and a concise discussion of hydrodynamic influences on sediment transport is included. Lisitsin's material-balance data indicate that 90 percent of the total sediment deposited yearly in the Bering Sea (about 2250 tons per square kilometer) is biogenic. In view of this, the extensive analytical data on "authigenic" (amorphous) silica, as well as on carbonate and organic content, are helpful in characterizing the origin of the deposits. On the other hand, although many optical data on the petrology of the sediments are presented, data from x-ray studies are few. Information on clay minerals and other fine-grained minerals is sketchy, and carbonate is referred to only as "calcite," no differentiation being made between high- and low-magnesium forms or between calcite and aragonite.

The chemical treatment suffers from rigid adherence to the six-component frame of reference (Si, Fe, P, Mn, carbonate, and organic matter) introduced by N. M. Strakhov and extensively employed by Soviet geologists in the past decade. These components are certainly important, but excessive reliance on a conventionalized pattern of study evidently has held back development of new approaches and insights into the chemistry of the sediments and slowed application of modern techniques to the fertile field offered by the sample material of the Soviet expeditions. With the development of sensitive analytical tools, as well as isotopic techniques, for analysis of organic compounds, description of organic matter chiefly in terms of organic carbon, "humic acids," "bitumens," and carbon-nitrogen ratios has outworn much of its useful-

ness. These criticisms are justified, not by the existence of better information on Bering Sea sediments elsewhere, but by contrast with the scope and obvious expense of the Soviet expeditions and with Lisitsin's own initiative in studies of suspended matter.

As its title indicates, the book is restricted to surface processes; a considerable amount of available deep-core information, some of which was reported by Lisitsin himself in earlier publications, is not included. In spite of this limitation, the book covers an enormous amount of ground (pun intended) and will be indispensable to any worker concerned with the geology and sedimentology of the Bering Sea.

Sovremennye Osadki Morei i Okeanov (Recent Sediments of the Seas and Oceans. N. M. Strakhov, P. L. Bezrukov, and V. S. Yablokov, Eds. Izdatel'stvo Akademii Nauk S.S.S.R., Moscow, ed. 2, 1962. 644 pp., 3 colored maps. 4.17 rubles) is a sequel to *Osadkoobrazovanie v sovremennykh i drevnyich vodoemakh* (Formation of Sediments in Recent and Ancient Basins, 1954) and summarizes the great expansion of Soviet studies in marine geology and sedimentology in recent years. Most active Soviet marine sedimentologists are represented in the 29 articles in this book, and its reception by Soviet scientists is indicated by the reprinting of the 1961 edition, a rare occurrence for a non-textbook in the Soviet Union. The book should have been translated into English when it first came out, but there may still be good reason for a translation, since the volume provides a concise guide to a broad range of Soviet work and many of the articles offer treatments of topics which are still unavailable except in Russian publications. Perhaps Russian marine geologists are exhausted enough after the 1966 International Congress in Moscow to wait a few more years before convening a conference similar to the one which gave rise to this book.

The book has four parts: 1, Supply of Sedimentary Material to Marine Basins; 2, Sediment Formation in the Oceans; 3, Sediment Formation in the Seas, and 4, Diagenesis of Marine Deposits. Among the papers in the first part, one by O. A. Alekin and L. V. Brazhnikova and one by N. M. Strakhov summarize the transport of soluble and insoluble matter from the continents. A. P. Lisitsin dominates the second part with three papers, "Sedimentation in the south and central parts of the Indian Ocean," "Ice rafting as a transport mechanism for coarse sediments," and "Distribution and composition of suspended matter in the seas and oceans." Lisitsin also collaborates with P. L. Bezrukov, V. P. Petelin, and N. S. Skornyakova in presenting a generalized map of bottom sediments for the northern Pacific Ocean. Other articles include a summary on organic matter in marine waters by B. A. Skopintsev and a review by S. M. Zverev, V. M. Kovykin, and G. B. Udintsev on the thickness of oceanic sediment deposits. Although some Soviet seismic work appeared in the late 1950's, the latter article leans heavily on the results of American investigators.

Part 3 contains articles on the Bering, Barents, Kara, Azov, Okhotsk, and Black seas and the Kurile Island region. Articles by M. A. Glagoleva and by V. P. Petelin and E. A. Ostroumov summarize recent chemical data, including information on trace elements, on sediments of the Black and Okhotsk seas, respectively. A map of the distribution of tungsten in the sediments of the Okhotsk Sea (between the Kurile Islands and Siberia) provides a new contribution to our scanty knowledge of the behavior of this element in the marine environment. The final section includes brief summary articles on interstitial waters of sediments and three articles on forms of sulfur in Black Sea sediments.

Antarctic Atlas

The *pièce de résistance* of this group of publications is an atlas which was released just in time to become available at the recent second International Oceanographic Congress. **Atlas Antarktiki** (Atlas of Antarctica. Vol. 1, 1966, published by the Chief Directorate for Geodesy and Cartography, Ministry of Geology of the U.S.S.R., Moscow-Leningrad. 248 pp. 30 rubles) aroused the admiration of nearly all participants in the Congress, although its 3½-kilogram weight and folio (60 by 38 cm) size probably did not encourage many foreign scientists to carry copies home with them. It contains 225 full-page, double-page, or composite plates, in color, explanations on facing pages, and a geographical index. (A second volume, of text, is in preparation.)

A culmination of nearly eight years' work by Soviet expeditions to the Antarctic, the Atlas also incorporates international data on the Antarctic regions from the voyages of Cook and Furneaux (1772–1775) up to 1963. Many of the data on the Antarctic continent itself have come from the work of several countries participating in the Antarctic program associated with the International Geophysical Year. The immense labor involved in researching, compiling, drafting, and editing is illustrated by the fact that nearly 300 scientists are cited as having collaborated in the work. Credits for drafting, engraving, and actual production of the atlas are given to some 80 other persons. Art work, line engraving, printing, color separation, and reproduction are all superb, and from the introduction one learns that the fine paper on which the maps are printed is a special stock obtained from the currency and document-printing division of the Ministry of Finance of the U.S.S.R. Unlike the *Morskoi Atlas* of 1950–51, *Atlas Antarktiki* provides complete citations for all domestic and foreign sources of data. Aside from citations and non-Russian names in the Geographic Register, all printing is in Cyrillic type. Possibly in order to ensure that the Atlas will lie flat when opened, the pages are glued rather than sewn; one hopes that the volume will hold up in hard library wear.

The contents are arranged under the following headings:

Part I: Introduction—orientation and location maps, morphometry, star positions, miscellaneous information. History of Investigation. Cartography. General Geography. Aeronomy and Physics of the Earth—the ionosphere, cosmic rays, geomagnetism, earth tides, gravimetry, seismology. Geology and Geomorphology. Climate. Ice Cover. Hydrology of the Southern Ocean—currents and general hydrochemistry. Biology. Physical-Geographic Regions.

Part II (Regional Geography): Continent and Islands. The Southern Ocean —bathymetric maps, a physiographic map (similar to those of Heezen and Tharp), charts of some detailed hydrologic features, distribution and composition of suspended matter, and various aspects of bottom sediments.

All maps are drawn in a polar azimuthal equal-area projection. Maps showing the entire Antarctic continent and region are given in scales from 1 : 10,000,000 to 1 : 120,000,000. More detailed maps of particular regions range in scale from 1 : 10,000,000 to 1 : 100,000, larger-scale maps often being augmented by inset drawings and photographs, both land and aerial. Where data are scarce, the bathymetric and other contour maps have been

drawn with discretion, and contour intervals appropriate to avoid "monograph" effects have been used.

At its best, not only is an atlas useful for general orientation and a pleasure to the eye, but it puts masses of scattered information into a compact and accessible reference work the utility of which is limited only by the accuracy and scope of the available data. It can relieve researchers of much unnecessary archive work and let them get on with their main studies. The care and thoroughness with which this atlas was prepared suggest that it will fill this function to a high degree; its compilers deserve the thanks of scientists everywhere.

References and Notes

1. From the International Book. Service (V/O Mezhdunarodnaya Kniga). A few firms in the United States also maintain limited stocks of current books.
2. H. E. Hawkes, *Geotimes* **10**, 23–43 (1965).
3. Publication approved by the Director, U.S. Geological Survey.

Numbers

Francis D. Parker's **The Structure of Number Systems** (Prentice-Hall, Englewood Cliffs, N.J., 1966. 151 pp., illus. $3.95) is an excellent book. It is written with clarity, directness, and simplicity, and these are attributes we cannot take for granted. The entire contents form a single coherent story, told from start to finish. What this story is all about can best be indicated by comparing different approaches to the study of numbers.

In the first place, there is the confused approach which most of us experienced in elementary school, high school, and probably even college. We have all become accustomed to the easier ideas about numbers—we believe there is a number 4, and perhaps even a complex number like $3 + 2i$. When a number like $\sqrt{2}$ or π is concerned, we may feel a bit more doubtful.

There is a second approach, commonly used nowadays by professional mathematicians (and prominently featured in the "new math" programs for schools): one summarizes a sizable amount of information about numbers in a very succinct form, namely in the axioms dealing with commutativity, associativity, the distributive law, the existence of identity elements and inverses, axioms on order, and (ultimately) something like the Cauchy axiom on topological completeness. (I admit to a prejudice in favor of this approach as the one closest to the main concerns of contemporary mathematics.)

Now any axiom system bears some resemblance to an iceberg: there is the small amount of information which the axioms tell us clearly and explicitly, but the vast amount of information given by the axioms is not of this sort—rather, it lies beneath the surface. If our axioms are adequate, the information *implied* by them includes every single fact about our entire number system. Of course, extracting this information requires the devices of the formal logic of implications, and usually also requires considerable ingenuity and patience as well. The less our axioms say explicitly, the more they must say implicitly, and the harder it will be (in general) to carry out the necessary implications.

This brings us to our third approach to number systems. Using the axioms developed by Peano, we work with an almost unbelievably tightly knit approach: there are only five axioms. From them, using set theory and logic, we can build up all that we know about numbers, whether we think of the integers, the rational numbers, the real numbers, or the complex numbers.

Why is so much discussion of numbers worth the effort? One could claim that the answer is related to settling matters of genuine doubt about such things as infinite decimals or questions of limits, integrals, and so forth. But I think the value does not lie in this direction—indeed, set theory itself poses enough new problems and uncertainties to more than match the old problems that it may appear to settle. The real value of the Peano approach, as presented in *The Structure of Number Systems,* seems to me to lie in the tone that it takes, the point of view from which it approaches mathematical questions. Any reader whose mathematical education consisted primarily of calculus as taught two decades ago will probably see in this book a whole new way of looking at mathematics. It is an interesting viewpoint, and an important one—but perhaps it should not become the only one.

For maximum effectiveness, a book like this should probably be read before the student undertakes the study of calculus. It would make calculus take on an entirely new appearance.

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Studies of the Moon: The End of an Era

The detailed physical nature of the lunar surface has occupied the attention of astronomers for years and is now of pressing importance because manned lunar exploration is near at hand. The state of knowledge as it existed before the Surveyor landing is admirably summarized in **The Nature of the Lunar Surface**, the proceedings of the 1965 IAU–NASA Symposium (Johns Hopkins Press, Baltimore, 1966. 328 pp., illus. $13.50), edited by Wilmot N. Hess, Donald H. Menzel, and John A. O'Keefe.

The volume is organized into four parts, Interpretation of Ranger Photographs and Related Topics, Crater Formation and Surface Structure, Physics and Chemistry of the Lunar Surface, and Conclusions. Part 1 presents the various theories of the lunar surface, with strong emphasis on the Ranger photographs. The results of these papers are the most likely to be revised in the near future. Parts 2 and 3 describe the results of observational and experimental programs in which lunar luminescence, projectile cratering, optical and radar properties, physics of sputtering, lunar temperature, and the possible relationships of lunar formations to geology were investigated.

The quality of the papers is not uniform, but generally they make interesting reading. For example, there is the classical problem of the low visual albedo of the moon. Laboratory studies show that many kinds of rock powders obtain low albedos after exposure to energetic proton and alpha particles. In fact, the albedo would be less than the lunar value after prolonged exposure, and the result should be an equilibrium situation in which darkening by irradiation would be balanced by brightening due to continual exposure of undarkened material by meteoritic bombardment.

Part 4 contains a summary of the conference by E. Öpik and a substantial panel discussion. Ranger photographs are presented throughout the