

Marine science: its present and future

OUR NATION AND THE SEA. Report of Commission on Marine Science, Engineering and Resources. 305 pp. US Government Printing Office, January 1969. \$2.75

by HUGH BRADNER

Approximately 15 years ago a small group of farsighted oceanographers began to develop public awareness of the future vital role of oceans in world affairs. They pointed out that understanding, exploiting and controlling the oceans will have great economic and military importance in the near future when nations will need increased supplies of food, fuel and minerals. At present we are ignorant of ocean basins and their currents, biology, chemistry and physics and need seashore conservation and recreation. They pointed out our serious underdevelopment in all the above aspects as well as in maritime law, needed to govern our sea activities.

Their arguments were effective. The National Academy of Sciences

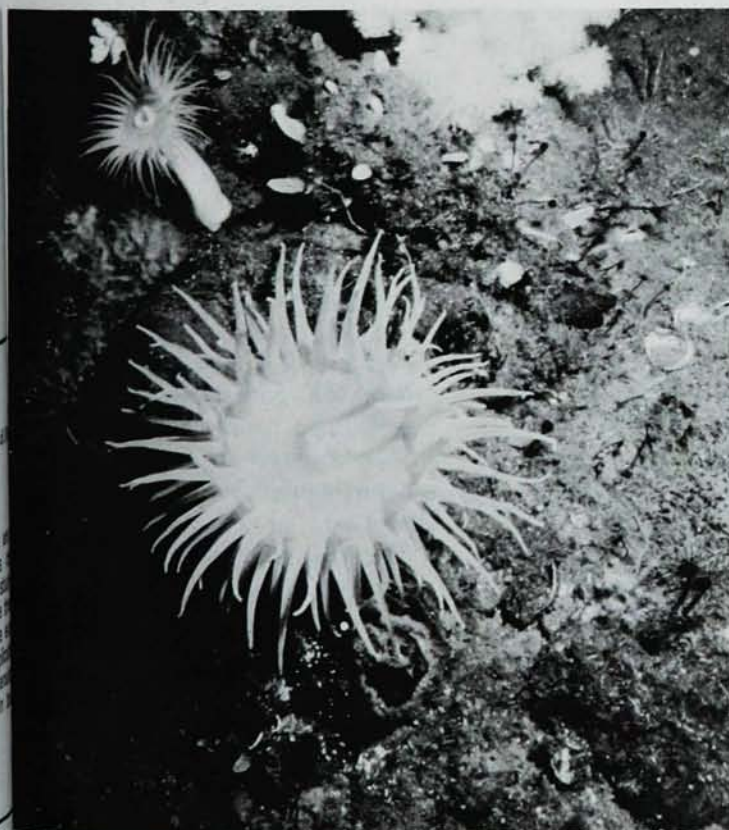
and the US Navy published reports that underscored the vital nature of the challenge.¹ Congress showed an ever increasing concern, and public interest rose rapidly. The nation became aware of the potential of the oceans and the urgency of devoting a large effort to using them effectively.

Between 1950 and 1963, the yearly output of papers on oceanography increased more than 20-fold. Between 1959-60 and 1964-65, the number of graduate degrees in oceanography rose from 15 to 60. Congress prepared a series of acts to advance marine science, culminating in June 1966 with the Marine Resources and Engineering Development Act "to develop, encourage, and maintain a coordinated, comprehensive, and long-range national program in marine sciences for the benefit of mankind to assist in: protection of health and property; enhancement of commerce, transportation and national security; rehabilitation of our commercial fisheries; and

increased utilization of these and other resources."

Since mid-1966:²

- The President has issued more than 20 policy statements including goals, priorities, and plans to mobilize our resources for intensified marine activities.
- The Congress has held more than 100 hearings and enacted more than two dozen new laws to promote broader, safer and more rational use of the oceans.
- The US has cosponsored five resolutions adopted by the UN General Assembly, calling for broader international cooperation to explore and to develop the oceans and their resources for the benefit of mankind.
- The National Council on Marine Resources and Engineering Development has acted on more than 65 major ocean policy issues at 15 plenary sessions.
- The Commission on Marine Sci-



UNDERWATER LIFE AND LABORATORY. The US Navy Sealab 3 investigates marine resources and plant life to understand, exploit and control the full potential of the oceans.

ence, Engineering and Resources has issued a major report on a national marine-science program to meet present and future needs, including a recommendation for the establishment of a new independent federal agency to serve as the focal point for civilian ocean affairs.

- California, Washington, Florida and other states, industrial associations such as the National Security Industrial Association, professional societies and other non-governmental bodies have taken steps to strengthen and broaden the marine-science activities within their purview.

The act established two complementary bodies: the National Council on Marine Resources and Engineering Development and the Commission on Marine Science, Engineering and Resources. The Council was directed to plan and coordinate current marine programs and to advise the President. The Commission was asked to:

- Review the known and contemplated needs for natural resources from the marine environment necessary to maintain our expanding economy.
- Review the surveys, applied research programs and ocean engineering projects required to obtain these resources.
- Review the existing national research programs to insure realistic and adequate support for basic oceanographic research that will

enhance human welfare and scientific knowledge.

- Review the existing oceanographic and ocean-engineering programs, including education and technical training, to determine which programs are required to advance our oceanographic competence and stature and which are not adequately supported.
- Analyze the findings of the above reviews, including the economic factors involved, and recommend an adequate marine-science program that will meet the present and future national needs without unnecessary duplication of effort.
- Recommend a government organization plan with estimated cost.

The 15 man Commission, under the chairmanship of Julius Stratton, has summarized its conclusions on a broad spectrum of the most important marine-science activities in the final report, *Our Nation and the Sea*. More detailed discussions are contained in three volumes of panel reports that have just been issued³ and in a number of Commission sponsored studies. (Because of the nature of the final report, I have quoted some parts directly from it.)

Our Nation and the Sea takes into account many relationships between civil and military activities, but it does not attempt to treat questions of military national security as such. It also avoids the admittedly important subject of the Merchant Marine on the grounds that many studies already

exist. Its loosely organized main chapters bear the titles "National Capability in the Sea," "Management of the Coastal Zone," "Marine Resources," "The Global Environment," "Technical and Operating Services" and "Organizing a National Ocean Effort." The perspectives vary in each chapter, as would be anticipated in an effort of many contributors. Although the emphasis is on recommendations for implementing a great national marine program, the document embodies a well written survey of current knowledge and accomplishments. It will be informative and entertaining to readers outside the fields of oceanography.

Summaries of the Commission's recommendations, occupying ten pages at the end of the report, deal with legislative, administrative and reorganizational actions. The designated responsible bodies range from local or state government to international bodies. Some of the detailed discussion in the individual chapters does take cognizance of the private sector of the economy, for example, under "Support for Marine Industry" in chapter 1, the report states, "Private investment capital is available for ocean ventures, and industry neither desires nor requires direct government subsidy."

Predominately, however, the Commission's recommendations are in terms of what can be done for us, rather than by us. Even technical recommendations are couched in terms of support. For example, in chapter 6 on "Technical and Operating Services," "The Commission recommends that the National Oceanic and Atmospheric Agency (CG) give priority attention to providing a system yielding navigation accuracies on the order of 50 feet in the zone within approximately 200 miles of the US coast. Development work should be focused on low-cost systems to permit undersea navigation of civilian submersibles."

The most important organizational recommendations concern a major new civilian agency, the National Oceanic and Atmospheric Agency, to direct the national effort. The oceanographic community, including existing government laboratories, generally agrees on the importance of establishing such a powerful new agency, although they have divergent views about which laboratory should be the nucleus.

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An interesting aspect of the Commission's recommendations for organization is the coupling of oceanography and meteorology. In this respect they are more conservative than the President's Science Advisory Committee panel, who recommended a three way coupling of oceanography, meteorology and solid-earth activities under one master agency.

Vice-President Agnew has recently indicated that we can expect five of the six recommendations to be soon implemented in some measure. The sixth recommendation, to establish a single large controlling agency, should not be anticipated for several years. US industries were warned that they could expect austerity in government support of marine activities.

The Commission advises that a small group of institutions should be designated "university-National laboratories," somewhat in the manner of the Atomic Energy Commission laboratories, with sustained support for broad gauge, basic science activities and commitment to serve scientific groups from other institutions. In addition, and somewhat different from AEC practice, the Commission recommends a network of smaller laboratories that would serve local areas for

mainly ecological "county agent" type of support.

The writers of the Commission's report have treated the important subject matter seriously but not pretentiously. From time to time they display a laudable irreverence that is most evident in the epilogue that begins, "It is worth remembering that America began, or rather almost did not begin, with a commission on marine science. In 1484, King John II of Portugal, intrigued by a project to sail west to the Indies and Japan proposed by a Genoese navigator named Christopher Columbus, appointed a commission of distinguished scientists to hear him and report on the worthiness of his proposal. One year later, this commission turned thumbs down on the whole idea; it considered a western route to the Indies to be too long and too hazardous to merit support."

Our Nation and the Sea is worthwhile reading for those who wish a perspective on the technical status of marine science or a perspective on the management directions that the US program is likely to follow. Complementary reading is contained in the three yearly reports titled *Marine Science Affairs*, produced by the Marine Council.² Detailed critiques of

the Commission's recommendations, and of the rapidly growing national position on a "wet NASA," can be found in nearly all recent ocean-oriented publications.^{4,5}

References

1. "Oceanography 1960-1970," National Academy of Sciences Committee on Oceanography (1959); "TENOC—Ten Year Program in Oceanography," Department of the Navy (13 March 1961).
2. "Marine Science Affairs—A Year of Broadened Participation," The Third Report of the President of the Congress on Marine Resources and Engineering Development. US Government Printing Office (January 1969).
3. Panel Reports of the Commission on Marine Science, Engineering and Resources. Vol. 1, "Science and Environment"; Vol. 2, "Industry and Technology"; Vol. 3, "Marine Resources and Legal-Political Arrangements for Their Development."
4. National Oceanography Association News, 3, 1 (Jan. 1969).
5. Gulf Universities Research Corporation Review, 3, 6 (Feb. 1969).

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Philosophy and quantum mechanics

PRINCIPES ESSENTIELS DE LA MÉCANIQUE QUANTIQUE. By D. I. Blokhintsev. Trans. from Russian. 192 pp. Dunod, Paris, 1968. 22 F

by R. BRUCE LINDSAY

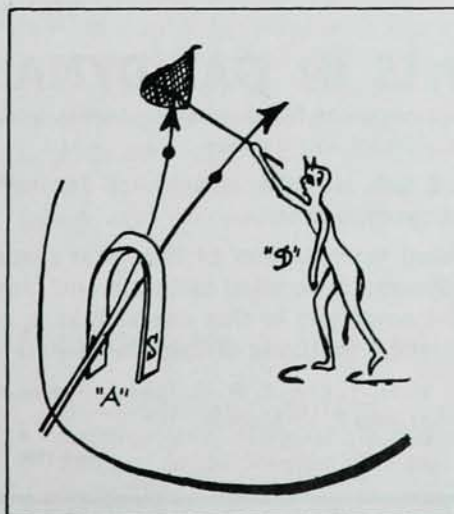
Books on quantum mechanics are now almost legion in number, testifying to the importance physicists attach to the instruction of this discipline to the rising generation. Most of these books put chief emphasis on the clear exposition of the techniques.

Blokhintsev's book is an exception to this mode of presentation. It is essentially a philosophical examination of the fundamental principles of quantum mechanics. The author in his preface insists that the work is a small treatise on theoretical physics, and this is correct, but the emphasis is decidedly philosophical and not utilitarian.

The book is a French translation of a small monograph by the well known Russian physicist who is director of the laboratory of theoretical physics in the Institute for Nuclear Physics in

Dubna. The monograph is based on a larger Russian work on quantum mechanics by the author.

Blokhintsev's approach is that quantum mechanics is a statistical discipline and fundamentally indeterministic in character. Indeed he seems to dismiss



LITTLE DEMON "... at work in the name of quantum mechanics."

determinism entirely from physics, even considering that its role in classical physics is illusory. He develops the theory of quantum mechanics from the standpoint of statistical ensembles, beginning with the Gibbsian ensemble and then modifying it to meet quantum requirements. Among the topics discussed are causality and measurement in quantum mechanics, the role of the observer and the question of the "completeness" of the theory and the problem of hidden variables.

Blokhintsev is convinced that quantum mechanics is causal in character. He believes that the role of the observer in the usual presentations of the subject is much overrated (presumably here disagreeing with Neils Bohr). On the other hand, he disagrees with Albert Einstein in feeling that quantum mechanics is indeed a complete theory. With regard to hidden variables, his attitude is that there is nothing bad about this idea as long as the variables are unobservable.

The book is entertaining reading