AD-A036 878 NAVAL INTELLIGENCE SUPPORT CENTER WASHINGTON D C TRA--ETC F/G 8/10
TEN YEARS OF SCIENTIFIC ACTIVITY OF THE MARINE HYDROPHYSICAL IN--ETC(U)
JAN 77 A G KOLESNIKOV

UNCLASSIFIED NISC-TRANS-3881 NL

| OF |
AD
A036878

END

DATE
FILMED
4-77

DEPARTMENT OF THE NAVY
NAVAL INTELLIGENCE SUPPORT CENTER
TRANSLATION DIVISION
4301 SUITLAND ROAD
WASHINGTON, D.C. 20390

(3)

CLASSIFICATION: UNCLASSIFIED

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

TITLE: (6) Ten Years of Scientific Activity of the Marine Hydrophysical Institute (Ukr SSR Academy of Sciences) in Sevastopol'

(Desyat' let nauchnoy deyatel'nosti MGI AN USSR v Sevastopole);

AUTHOR(S): (10) A.G./Kolesnikov, A.G.

PAGES: 6

SOURCE: Trudy Morskogo Gidrofizicheskogo Instituta, No. 1(60), 1973
Pages 17-25

ORIGINAL LANGUAGE: Russian

TRANSLATOR: C

(14) NISC-TRANSLATION-3881

APPROVED P.T.K.

(11) DATE 31 January 1977

(12) 7p.

40768

TEN YEARS OF SCIENTIFIC ACTIVITY OF THE MARINE HYDROPHYSICAL INSTITUTE (Ukr SSR ACADEMY OF SCIENCES) IN SEVASTOPOL'

[Kolesnikov, A. G., Desyat' let nauchnoy deyatel'nosti MGI AN USSR v Sevastopole, Trudy Morskogo Gidrofizicheskogo Instituta, No. 1(60), 1973, pp. 17-25; Russian]

In 1961, the Marine Hydrophysical Institute was transferred to the Ukrainian /17* SSR Academy of Sciences, and in 1963, moved to Sevastopol', where A. G. Kolesnikov arrived with twelve former associates. They were faced with the task of effectively reconstructing the institute: determining the subject fields of the main scientific directions to be followed, creating the most effective organizational structure, recruiting scientific personnel, and solving many urgent problems of production and economic development. It is now apparent that this objective has been successfully achieved.

Extensive prospects for the development of the institute as a leader in the study of the World Ocean within the system of the Ukrainian Academy of Sciences were opened up in Sevastopol'. This was understood by all the newly arrived staff members, who began the work with great energy and initiative.

The scientific subject areas of the MHI AS Ukr SSR were determined by its physicomathematical profile, unique among the country's institutes concerned with marine research. The institute was called upon to study the key physical processes in the ocean and ocean-atmosphere interaction processes. This study could be based on the application and development of the latest mathematical methods, modern physical theories, advanced technical facilities, and experimental laboratory and field work. The structure of the institute was formed in accordance with the main subject areas.

By the end of 1963, the following scientific sections had been formed and had /18 begun to operate: turbulence, hydrology and topography of the sea floor, currents, chemistry of the seas and oceans, mathematical methods of investigation, hydrooptics, nuclear hydrophysics, and marine instruments. Thanks to the support of the union and republican academies, State Committee on Science and Technology, USSR Council of Ministers, as well as minicipal organizations, it was possible within a short time to set up the institute, recruit qualified personnel, and carry out theoretical and field work. Without discussing the sequence of the development of the institute's activity, we will mention the main present research trends and their results. These trends include theoretical and field work, development of new methods and technical means of investigation, automation of scientific research, and utilization of mineral resources of the sea.

In the area of ocean physics, the institute is conducting theoretical studies of the interaction of the ocean and atmosphere, dynamics of tidal, internal and perturbed waves, circulation of waters of the World Ocean, and laws governing the formation of space-time physical fields with different scales, turbulence, etc. The results of theoretical research include, in particular:

Development of the theory and methods of calculation of physical fields of the ocean (temperature, salinity, current velocities; optical, acoustic, magnetic, radioactive concentrations, etc.).

---

*Numbers in the right margin indicate pagination in the original text.

Development of a theoretical pattern of surface and deep circulation of Atlantic Ocean waters allowing for the configuration of the shores and bottom.

Development of the theory of unsteady surface and internal waves caused by various kinds of perturbations, in particular, tsunami-type waves.

Development of the theory and numerical methods of calculating quasi-steady currents for various regions of the World Ocean (North and Tropical Atlantic, Caribbean and Azov Seas).

Development of a method of effective calculation of the radiation balance over the entire water area of the World Ocean on the basis of data from weather satellites.

Development of theoretical principles of planning and optimization of marine experiments.

The theoretical results obtained make a substantial contribution to the solution of the problem of prediction of weather and climatic changes and classification of /1
tsunami-endangered shores, and are used for purposes of navigation and identification and exploitation of ocean resources. The study of the World Ocean is impossible without extensive field work, which is being done by the Marine Hydrophysical Institute by means of two large scientific research ships: the MIKHAIL LOMONOSOV (in service since 1959) and the AKADAMIK VERNADSKIY (in service since 1969). Much has been done by the institute to supply these ships with modern scientific equipment. In addition to the ships, the institute has a storm basin, an ionospheric station, a marine experimental range, and a computing center.

In the last ten years, the institute has done considerable research on many regions of the World Ocean, including the Mediterranean and Black Seas and the Atlantic, Indian and Pacific Oceans. Twenty-seven cruises were made by the MIKHAIL LOMONOSOV, and six cruises by the AKADEMIK VERNADSKIY. Hundreds of thousands of miles were traveled, numerous observations and measurements were performed on the surface and in the ocean depths, and invaluable scientific data were obtained.

Many years of purposeful field work in the powerful subsurface countercurrent in the Tropical Atlantic, discovered in 1959 and named the Lomonosov Current, have resulted in the determination of its nature, erection of a theory, and development of computational methods. These results, published in a monograph by a group of staff members of the MHI, along with articles dealing with currents bordering on the Lomonosov Current, written by a group of staff members of the Oceanology Institute of the USSR Academy of Sciences, were honored with a USSR State Prize for 1970.

On the basis of data of Joint International Studies of the Tropical Atlantic (JISTA), 286 maps of physical elements were plotted and included in an International Atlas, and comprised 86% of its contents. The Atlas is published by the Intergovernmental Oceanographic Commission of UNESCO, and the editor of the Atlas is A. G. Kolesnikov, member of the Ukrainian Academy of Sciences.

Joint Soviet-French studies on the subject "Interaction of the Ocean and Atmosphere," made simultaneously on the MIKHAIL LOMONOSOV and a French buoy laboratory, were very successful. The result of this major work was the publication in Russian and French of papers delivered at a joint symposium in Bordeaux in 1971.

On the basis of observational data obtained from cruises of the MIKHAIL LOMONOSOV, an "Atlas of the Thermal Balance of the Oceans" was compiled and published. A /2

considerable number of interesting studies were made under international programs of joint research in the Caribbean and adjacent regions (JSCAR), Mediterranean Sea (JSM), and by a Soviet-Icelandic expedition.

Quantitative characteristics of turbulent processes were obtained from the relationship to average hydrological conditions in a frequency range not previously studied. This makes it possible to approach the explanation of the mechanism governing the excitation and energy balance of turbulence in the ocean and to determine the spectral regions of energy inflow into fluctuational motion in a frequency range not studied thus far. Quantitative characteristics of the three-dimensional macrostructure of the velocity fields of water masses in the ocean, studied synchronously with temperature fluctuations, were obtained. Statistical characteristics of the distribution of wave elements and wave energy spectra were also obtained. A map of the radioactivity of World Ocean waters was compiled.

The data obtained from the marine expeditions have considerably enriched our knowledge of the ocean and provided an approach to a practical utilization of its enormous resources. Scientists at the institute in collaboration with experts of the Executive Committee of "Azcherryba" developed an effective method of forecasting regions of fish accumulation, resulting in a considerably increased efficiency of industrial fishing in the ocean.

Objective and reliable scientific information on vast regions of the ocean can be obtained only through an extensive incorporation in marine research of automation devices developed from the latest advances in electronics and computer technology. This trend was extensively substantiated by the institute's director, A. G. Kolesnikov, and is being persistently and purposefully promoted in practical applications under his supervision.

Various types of automated instruments have been designed at the institute since 1964. Initially, they were mechanical, electromechanical and electronic instruments for standard measurements in the sea. As the volume of scientific information obtained from expeditions grew, and it became necessary to process it directly on board the ship by means of computers, and also by taking into consideration the space and time variability of the physical fields in the ocean, various automated systems were created for direct and long-term measurements over large water areas. Such systems include:

On-board automated systems "Istok-1" and "Istok-2," operating while the ship is /21
on station, measure the temperature and conductance (salinity) of seawater, and the depth of immersion of the sensors. The measured parameters, converted to a 12-digit binary code, are transmitted by cable to the ship;

The hydrological system "Nyrok," operating while the ship is moving at speeds up to 12 knots. It measures the temperature and conductance (salinity) of the water down to 300 m;

The deep-sea self-contained GAT-3 turbulence meter, which determines the statistical characteristics of turbulence in deep layers of the ocean. The instrument measures and records the horizontal and vertical components of current velocities and the water temperature;

A series of optical instruments (undersea bathyphotometer, pulsed photometer-transparency meter, logarithmic photometer-transparency meter, etc.). The instruments make it possible to measure all the fundamental characteristics of optical fields in the ocean.

A meteorological system, consisting of several on-board gauges of atmospheric parameters and a floating gradient station, which simultaneously measures up to 30 parameters in the bottom layer of the atmosphere and top layer of the ocean. The system makes it possible to study the energetic interaction of the atmosphere and ocean;

A buoy telemetry station for measuring many hydrological parameters: water temperature and conductance, speed and direction of the currents, etc. The station operates under different conditions of inquiry, with instructions transmitted by radio link from an on-board or shore center controlling the operating conditions. Information from the gauges is fed to magnetic storage or to the ship;

An electronic telemetric bathythermooximeter for automatic measurement and recording of the distribution of temperature and molecular oxygen concentration with depth;

A telemetry system for measuring the natural electric field on the ocean floor, using an acoustic communication channel for data transmission;

A towed proton magnetometer for geomagnetic surveying in the ocean;

An automated system for studying the ocean bottom relief, etc.

A distinctive characteristic of the instruments and systems designed is the fact that they not only perform the measurements automatically, but also convert the /2
data to a form convenient for direct input into computers. It has now become possible to process the data directly on board the ship. The use of automated systems in a series of cruises of the research ship MIKHAIL LOMONOSOV has permitted a sharp increase in the volume of scientific information obtained per cruise and has uncovered many previously unknown phenomena and characteristics in the ocean.

Work aimed at creating increasingly advanced means of measurement, transmission and processing of oceanographic information is being conducted with increasing vigor at the institute. In 1970, a Special Design Office was created at the institute. The design of new instrumentation is being carried out in close creative collaboration between the designers and scientists. A steadily increasing number of project studies are being made at the invention level. In the last three years alone, over 60 inventions have been made, most of which pertain to means of measurement and processing of oceanographic information.

A further logical development of means of automating marine research was the creation of automatic systems of collection, transmission and processing of information obtained during scientific investigations in the ocean. Two such systems have now been created at the institute: one is in use on the ship MIKHAIL LOMONOSOV, and the other, more complex, on the ship AKADEMIK VERNADSKIY. The automated system includes: on-board measuring instruments, both sounding and towed by the ship; self-contained self-surfacing units mounted in the ocean on anchored, partially submerged buoys; automate buoy stations consisting of telemetric anchored buoys with a series of instruments placed at different levels in the ocean; an on-board computing center with a computer, information input and output devices, and a communication circuit between the computer and the ship's laboratories; an on-board computing center with a radio communication center, processing the information and controlling the experiment in the sea.

The automated systems have made it possible to organize and carry out scientific research in the sea in a new way, using the method of controlled experiments in

accordance with the stated goals. In order to draw the interest of the country's scientific and technical community in problems of automation of marine research, the Marine Hydrophysical Institute has initiated the convening of special symposia. The first All-Union symposium, entitled "Automation of Scientific Research in the Seas and Oceans," was held in Sevastopol' in 1967. The next three symposia took place in 1968, 1969, and 1971. The symposia attracted the attention of many organizations. They were attended by representatives of the USSR Academy of Sciences, academies of union republics, institutions of the Hydrometeorological Service, institutions of higher learning, area scientific research institutes, and many industrial establishments. /23

The symposia discussed numerous problems pertaining to precision of measurements, reliability of marine instruments, construction of new types of sensors, creation of measuring equipment based on new physical principles, as well as problems of information compression and conversion, methods of processing of experimental data, principles of construction of large automated systems, software for oceanographic research, etc. Extensive exchange of views during the symposia made it possible to determine the prospects for the development of means of automation, ways of creating automated systems of the future, and further development and adoption of mathematical methods of planning of optimal experiments in the ocean. The symposia fostered a scientific consensus with regard to the problems of automation of marine research and aided in the determination of practical steps aimed at increasing its effectiveness.

The institute is conducting studies on the recovery of useful substances dissolved in seawater. An original and inexpensive method was devised for recovering organic substances, boron, and a range of trace elements from Black Sea water and the Sivach saline water. The final product of the recovery was found to be useful as a trace element fertilizer for agricultural crops. The tests demonstrated a very effective action of marine trace element fertilizers, resulting in a 10-15% increase in the yield of various crops.

The successful activity of the institute is promoted by the establishment of extensive scientific communications with many of the country's scientific research organizations and institutions of higher learning. Included among them are the following institutes of the USSR Academy of Sciences: Oceanology, Hydrodynamics, and the Computing Center of the Siberian Branch; institutes of the Ukrainian Academy of Sciences: Cybernetics, Geological Sciences, Geophysics; institutes of the Main Administration of the Hydrometeorological Service of the USSR: State Oceanographic, Arctic and Antarctic Institutes, etc.

At the present time, the Marine Hydrophysical Institute has scientific links with a number of foreign countries, initiated in the course of joint studies of the ocean, and also at international meetings and symposia. The scientific library of the institute receives periodical publications of oceanographic organizations in the USA, France, Japan, England, etc. This makes it possible to follow the level of development of scientific research in the world and to utilize the experience of other countries. /24

The scientific activity of the Marine Hydrophysical Institute during the last 25 years has been widely and extensively represented in numerous and varied Soviet publications. It is most fully reflected in 48 volumes of the institute's proceedings, which have been regularly published since 1948. From 1965 to 1969, the institute published 16 volumes of abstracts dealing with the results of expeditions of the scientific research ship MIKHAIL LOMONOSOV.

The scientific collection entitled "Marine Hydrophysical Studies" began publication in 1969. To date, 17 issues of the collection have appeared. They discuss the results of scientific research on such subjects as the theory of waves and currents, theory of formation of physical fields in the ocean, and methods of calculation of physical fields. Each issue of the collection devotes considerable space to problems of automation of marine investigations, experience with instruments developed at the institute and operated during expeditions, and also information on completed successive cruises of the scientific research ships of the institute, etc. Data of four all-union symposia on automation of studies of the seas and oceans conducted at the MHI AS Ukr SSR have been published in separate collections. Works by scientists of the Marine Hydrophysical Institute are continually being published in journals: Doklady AN SSSR, Izvestiya AN SSSR, Geofizika, Okeanologiya, Meteorologiya i gidrologiya, Problemy Arktiki, Akusticheskiy zhurnal, etc. In the last ten years alone, 820 scientific papers have been published.

The most penetrating theoretical generalizations of data obtained in expeditions and in the course of laboratory experiments from 1963 to 1973 are represented in monographs and dissertations. During this period, eight monographs were published, and six doctoral and over thirty master's dissertations were defended.

The Marine Hydrophysical Institute nears its 25th anniversary with considerable accomplishments. Its successes in the area of study of the World Ocean and in the development of modern means and methods of investigation of the ocean since 1967 are being demonstrated by Expositions of the Achievements of the National Economy of the USSR (Moscow) and Ukrainian SSR (Kiev). Many of the institute's scientists have been awarded gold, silver and bronze exposition medals.

In ten years of its activity in Sevastopol', thanks to the considerable assistance and steady interest of the Presidium of the Ukrainian Academy of Sciences, daily efforts of the entire staff, and a high level of creativity of its scientists, designers and engineers, the MHI AS Ukr SSR has grown into a major scientific research institution widely known not only in this country, but also abroad.

At the present time, a large team of scientists is working at the institute, including two academicians (USSR Academy of Sciences and Ukrainian Academy of Sciences), eight PhD's, and fifty masters of science. They are all successively working on problems of study and development of resources of the seas and oceans, proposed by the 24th Congress of the CPSU.