THE INTERNATIONAL ADMINISTRATION OF OCEAN RESOURCES

by

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ADMINISTRATION OF SCIENTIFIC AND TECHNOLOGICAL PROGRAMS

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United States Policy Towards the Management of Data Originating In, On or Near the Deep Sea Bed

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Goal

The goal of the United States data management system is to acquire, on a continuous basis, increasingly accurate data about the earth's total environment, to reduce such data to usable proportions, and to disseminate it to the users and custodians of such information. Such a goal is extremely broad in scope and very general in purpose. Quite probably it can stand, as stated, for quite a long time. However, the immediate objective and associated priorities along the path to that goal do need some amplification and clarification.

Objectives

Environmental objectives -- Modern man is coming to realize that the oceans, the atmosphere and certain aspects of the solid earth are interacting parts of the total geophysical environment. These parts can be fully understood, monitored or predicted only as component elements of a single system, which is planetwide. The interacting elements of a single system elements determine weather and climate everywhere, and as a result affect land, sea, undersea and air operations. The technology for this total environment monitoring and predicting has major common elements. New technological developments such as satellites, buoys (fixed and free floating), horizontal sounding balloons, high speed communications, deep

diving submersibles, shipboard computers, and new data processing capabilities offer much promise for a worldwide integrated system. Consequently, the following objectives seem to require our national attention:

1. Cooperation by the United States with other nations and with international organizations in order to fully achieve the goal of an integrated global network of data exchange about the total environment.

2. Effective mobilization of the scientific and engineering capabilities of the Nation, with closer coordination among all the interested agencies, both public and private.

3. Stimulated expansion of total human knowledge of the world's environment with first emphasis on exploration.

4. Accelerated development and exploitation of known or potential resources on or under the sea bed.

5. Preservation of the leadership role of the United States in acquiring and sharing knowledge about the earth.

6. Development and improvement of the vehicles, equipment and the instruments used in exploration, research, surveys and recovery of resources.

Data management objectives -- The exploration of the world's environment has been a somewhat random and most often uncoordinated process. There has never yet been widespread

agreement as to data handling procedures and standardization. As the problems to be attacked become more complex, global in scope, and multi-disciplinary in content, the data consumers will be increasingly less able to produce their own raw data and will become increasingly interdependent on each other. Any system to improve the management of this data should deal in a thoroughly consistent way with the data from its source through authentication, indexing, filing, retrieval, and on to purging and up-dating. Such a system does not necessarily anticipate a completely centralized operation, but does include a number of specialized data centers appropriately linked together. The requests for data would be directed to one central point. However, by utilizing the proper telecommunication links, the data stored in any center can then be readily disseminated to any valid user upon request or according to an approved schedule of transmissions. Users would not have to search several centers' data banks in order to find the data that they were seeking.

Data management implementation -- The Intergovernmental Oceanographic Commission of UNESCO has issued a Manual on International Oceanographic Data Exchange (2nd Edition) which contains a provisional guide for the exchange of data. This guide lists two types of observations and descriptions of data: Standard Observations, and Non-Standard or Experimental Observations.

A. Standard Observations are typically:

1. Values of air temperature, ocean surface temperatures, atmospheric pressure, humidity, speed and direction of wind, precipitation, visibility, sea-ice, and similar phenomena.

2. Visual observations of sea and swells.

3. Color and transparency of sea water.

4. Values of temperatures, salinity and chemical properties sea water at the surface and at stated depths.

5. Mean monthly and annual sea levels.

6. Soundings of depth either on plotting sheets or tabulated.

7. Information on bottom samples, such as cores.

8. Values of plant pigments, primary production, zooplankton biomass, add micro-nekton biomass.

B. Non-Standard and/or Experimental Observations are:

1. Instrumental measurements of various physical properties of sea water (includes optical, acoustic, electrical, etc.)

2. Chemical analysis for trace elements, in sea water or in bottom sediments.

3. Instrumental measurements of waves and swells.

4. Detailed measurements of currents and studies of turbulence at various levels or depths.

5. Bottom photographs, topographic profiles,

biochemical analysis.

6. Gravity and geomagnetic field measurements.

7. Specialized meteorological measurements (solar radiation, detailed gradients of wind velocity, etc.).

8. Biological data, taxonomic and ecological studies, marine life observations, underwater sounds, and bioluminescence.

9. Chemical analysis of sediment and sea bed. Minearls and non-living resources available at stated depths.

The world-wide system should employ standard observations to the fullest possible extent. The future should see more of the non-standard and experimental observations re-evaluated and converted into standardized measurements for easy entry into the system of data acquiaition. The actual implementation will involve review and evaluation of the following elements of the system:

A. Sensors -- means of observation and source input to the data acquisition network.

B. Platforms -- means of supporting the sensors in the environment (ships, buoys, aircraft, balloons, satellites, etc).

C. Transmission links -- means of getting the information from the sensors to data reception, processing, storage, and the retrieval locations.

D. Up date -- means of periodically purging and up

dating the data in order to maintain the validity and usefulness of the data elements currently in storage, or retrieval sections.

E. Dissemination -- means of getting the pertinent data to users in a timely manner, and evaluation of that data by the users.

Priority -- The National Academy of Science's Committee on Oceanography has observed that "Maps are basic tools for all the sciences that deal with the earth. To understand and use the oceans, we must first map them." Yet, if the existing charting and mapping programs of the Federal Government are continued at present funding and staffing levels, the national marine objectives will not be met for another 30 to 50 years. This is much too slow. The following priorities are suggested:

A. As a first priority, the environmental data required for charting and mapping must be obtained initially in order to facilitate the acquisition of all other environmental data on a sound, accurate, scientific base.

B. The second priority should be given to the establishment of the scientific capability, facilities and monitoring networks needed to make possible an assessment of the global consequences of man's activities, including but not limited to the results of burning fossil fuels, use of pesticides and insecticides, and

any other particulate or gaseous pollutants.

C. The third priority should be given to the extension of the world-wide weather monitoring and prediction capabilities. The Barbados Oceanographic and Meteorological Experiment (BOMEX) is a cooperative effort of 7 federal agencies, 19 universities, and 7 industrial laboratories. Data is being gathered by 10 ships, 12 ocean buoys, 24 airplanes, and 7 satellites. Experience will indicate which information is likely to be most useful in a total earth environmental analysis system, and for weather prediction on a truly global scale for some time into the future.

D. The fourth priority would be assigned to gaining knowledge about living and non-living resources on, in, or under the oceans that might contribute to the health, wealth and welfare of mankind. In other words, after exploration should come exploitation, with all due regard to pollution, over-production, ecological damage, etc.

NATIONAL MARINE COUNCIL (JANUARY 1969)

The Federal Government provides leadership and support for ocean research and exploration, but must activity participation by others is absolutely essential and historically has been very effective. Our private industry provides the management and capital to exploit the marine resources. The

many universities and institutes increase the store of scientific knowledge while training much needed skilled personnel. Intergovernmental organizations are adding to the knowledge about the sea and performing valuable coordination activities. Other nations are actively pursuing their own national goals in the sea and its environment. All of these factors are considered in the Third Report of the President to the Congress on Marine Resources and Engineering Dvvelopment entitled Marine Science Affairs -- A Year of Broadened Participation. This report sets out 17 policy issues that were considered by the National Marine Council during 1968. At least 9 of these policy issues involve some aspects of data management in the interests of the United States.

1. Strengthening the base for launching the International Decade of Ocean Exploration...to understand ocean phenomena and to discover new ocean resources...and for improvements in the quantity, usefulness and timeliness of data exchanged between scientists at home and abroad.

2. Improving the international organizational structure for planning, coordinating and carrying out marine science programs of interest to the international community... The central role of the Intergovernmental Oceanographic Commission is being clarified...to enable it to serve as a focal point for coordinating the international ocean research activities.

3. Developing a legal regime for the deep ocean floor which will encourage private investment in development of sea bed resources, reduce the possibilities of international conflicts and disputes, and promote U.S. Security, economic, political and scientific interests.

4, 5, 6, 7, 8, and 9 (not relevant to data management)

10. Encouraging private industrial development of fuels and minerals...which have been identified on the Continental Shelf and slope...protection of the environment from possible harmful side effects of extraction activities, and reccon-naissance surveys of the Continental Shelf.

11. Instituting new measures to insure safety of life and property...(b) development of a world-wide navigation plan incorporating land and satellite based technology to serve non-military needs.

12, 13 (not relevant to data management)

14. Emphasizing Sea Grant investments for training specializes manpower, particularly ocean engineers and technicians...research results will be disseminated to industry and the public.

15. Fostering marine applications of new technology... development of buoy technology to collect oceanographic and meteorological data as a basis for later decisions on a world-wide ocean data station network is being accelerated...

16. Improving capabilities for management of marine science information which is critical for successful research

and development activities through broader use of automated equipment at the National Oceanographic Data Center, a comprehensive study of data needs to provide a framework for an expanded environmental data program, and preparation of catalogs of current research projects.

17. Strengthening the Nation's base of marine research and technology which undergirds any aspect of the total national effort...improvement of national facilities for testing, standardization, and calibration of oceanographic instruments.

JUSTIFICATIONS

The many possible justifications for the global data system can probably best be summed up by reference to various official Acts of Congress, to statements and Reports by the President, and to the published plans as formulated by various international non-governmental scientific organizations Following are five examples:

A. The system is needed in order to adequately pursue, and attain, the national goals as formally set for the United States by the Congress in approving the Marine Resources and Engineering Development Act of June 1966. The Act partially reads as follows:

> Sec. 2(a) It is hereby declared to be the policy of the United States to develop, encourage and maintain a coordinated, comprehensive and long-range national program in marine science for the benefit of all mankind, to assist in the 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.
>
> Sec. 2(b) The marine sciences activities of the United States should be conducted so as to contribute to the following objectives...the expansion of human knowledge of the marine environment...the development and improvement of the capabilities, performance, use and efficiency of vehicles, equipment, and instruments for use in exploration, research, surveys, the recovery of resources, and the transmission of energy in the marine environment.

B. The system is needed for the implementation of the International Decade of Ocean Exploration, proposed by President Johnson for the 1970's. The stated objectives are "to probe the mysteries of the sea...to assist in meeting world threats of malnutrition and disease... and to bring closer the day when the people of the world can exploit new sources of minearls and fossil fuels." The United Nations General Assembly has approved such a resolution. Our own, and other nations as well, are in various stages of approving the establishing the implementation of the Decade.

C. The system is needed to implement the Global Atmospheric Research Program (GARP), now in full preparation by the international meteorological fraternity for basic atmospheric research. The existing World Weather Watch includes the traditional meteorological parameters such as cloud cover, temperature, pressure, and humidity. GARP will use all of these and, in addition, investigate solar heat inputs, energy

transformation over land and sea, transport of water, and characteristics of atmospheric electricity, in order to find out the basic answers, or partial answers, to why and how the environment really does work.

D. The system is needed to implement the United States' plans to participate in the Integrated Global Ocean Station System (IGOSS) which is being planned and coordinated by the Intergovernmental Oceanographic Commission of the United Nations. This participation should certainly harmonize with the planned national efforts in data management.

E. The First Report of the President to the Congress on Marine Resources, and Engineering Development, February 1967, Chapter VII, makes the following points relevant to the need for data management. (They are as valid in 1969 as they were in 1967.):

1. Studies have shown evidence of previous deficiencies in the Nation's marine data handling: delays in filing, archaic handling methods, lack of critical evaluation, and inadequate identification of purpose.

2. The exploration of the oceans has been a somewhat random process. There has never been widespread agreement among the marine science field as to data handling procedures and standards, with the result that materials are not as coherent and

systematic as we now desire. In the meantime, technology makes it possible to accumulate the data at a vastly faster rate than ever before.

3. As the problems to be solved become more complex, global in scope, and multi-disciplinary in content, the data consumers will be separated from the data collectors. Coordination then becomes vital to the success of the data management system. To prevent unnecessary and costly duplication in data collection -- by far the most costly part of marine and environmental sciences -- the collected data should be readily available to all users consistent with the need for national security.

CURRENT PRACTICES, PROCEDURES AND REQUIREMENTS

Because of the vastness of the world and the inaccessability of some parts, large gaps exist in our present store of environmental data. In order to fill some of these data gaps in world-wide coverage, various programs have been proposed and are in various stages of implementation. These include such programs as the National Data Buoy Program, Spacecraft Oceanography Project, World Weather Watch, Smithsonian Oceanographic Sorting Center, Essa's SEAMAP Program, etc. A very significant aspect of modern data collection by buoys, ships, balloons, aircraft and satellite is the much greater volume of data that can be collected per unit of time as compared

with any of the older methods. This potential increase in volume is due to greater geographic coverage in a shorter time span and the continuous data handling capability usually provided by these platforms. The increased emphasis on the greater geographic coverage and synoptic data reporting does not, however, mean that ships are immediately outdated as data collection platforms. It may well indicate that ships will always be best for intensive study of limited areas. Furthermore, ships are still the only practical platform for drilling down into the deep sea bed in order to obtain cores, bottom samples, deep temperatures, etc.

Current practices -- Current practices concerning the collection of and dissemination of oceanographic environmental data divide it into two very large classes. These two classes, time dependent and time independent, can be further subdivided as follows:

A. Time independent -- the information about these features of the earth, oceans and environment is relatively stable for any given length of time.

1. core samples of the bottom of the sea bed
2. gravity
3. profiles of the bottom
4. magnetic measurements
5. water depth
6. sediment depth and composition
7. extinct volcanoes
8. geological faults and features
9. shoreline configuration
10. sunken objects and disposal sites (particularly explosives)

B. Time dependent -- the information about these features of the earth, oceans and environment is nearly always varying in even relatively short periods of time.

1. temperature of air, water and earth
2. salinity of water
3. acoustic properties of water
4. subsurface currents and velocities
5. living organisms
6. wave propogation
7. earthquake and volcanic activities
8. chemical anslysis of water and upper sediment
9. sea-ice conditions
10. bioluminencence
11. marine life migration routes
12. wind direction and velocity
13. barometric readings

Present and past procedures -- These procedures have left no combined inventory of historical data concerning marine science, oceanography, and the earth's environment. The data gathered in the past by the Federal Government, or with its funds, is still scattered among many agencies. These include the Office of Naval Oceanographer, Office of Naval Research, Environmental Science Service Administration, Bureau of Commercial Fisheries, Coast Guard, Coast & Geodetic Survey, National Aeronautics and Space Administrations, Corps of Engineers, contractors, and universities. The heads of the major Federal data gatherers met in 1968 and agreed to initiate action to create a national inventory of existing unclassified marine science and environmental data. In early 1968 the National Oceanographic Data Center initiated the National Marine Data Center. Each of the major oceanographic research and survey activities were asked to submit a detailed description

of each cruise that had occurred in 1967. The name of the vessel, time, area of operations, types of data and samples collected, and the names of responsible individuals were included. Similar information was collected for 1968 and will be collected in all future years. But prior to 1967 it is not feasible to reconstruct such a record.

Implementation -- The successful implementation of the system will require an improvement over past and current coordination activities. In the past very little coordination was effected between the function of collection of data and that of storage, retrieval, and dissemination. Men, materials and equipment were much more likely to be available for collecting and analyzing data but less likely to be available for the storage, retrieval and timely dissemination. In 1969 the various Federal agencies are considering means whereby contracts with data generating activities, within either government, or industry, or universities, will include funds for forwarding copies of data to the National Oceanographic Data Center in the prescribed format. This is an absolute minimum and more should be done. Nearly all of the information classed as time dependent requires a very closely coordinated effort to obtain the desired samples or instrument readings at the prescribed intervals and at the proper time. Much of this activity must be done simultaneously at widely located ships, stations, or platforms. For the time independent data the coordination is not so vital on an instantaneous basis but nevertheless the degree of coordination

must be reasonably high in order to decrease and/or eliminate duplication of effort, expenditures, etc.

Scientific reluctance -- A limiting factor to full implementation of a real-time system may always be what can be termed "scientific reluctance." In general, research scientists are very reluctant to release their data to centers while the research is under way or before the results have been published. This has been found to be true, even though these data, more often than not, have been obtained through some form of Federal financial support. This practice has existed, does now exist, and will most probably exist as long as research scientists continue to do research and be dependent upon published reports for evaluation by their peers.

Proprietary information -- The information about the sea and seabed being gathered by petroleum, mining and fishing industries is not now being submitted to government data centers. It is readily seen that the companies do not wish to aid their competitors or rivals. This data, core samples, bottom samples, photographs, profiles, etc. are of vital influence on the economic health of the company. However, it seems that some arrangements could be made for the sharing of this data bank without damage to private interests. In most instances, if not every time, the companies have benefited greatly from a variety of Federal or State supporting services, such as navigation aids, charts, search and rescue,

etc. One possible avenue is to have each agency come to some agreement with the industry, or industries, with whom they deal most often.

PROBLEM AREAS

Although many problems exist relative to the management of historical and current environmental data, the most critical data problem confronting the marine science and environmental community is how to manage the anticipated increases in data requirements due to new data generating programs when existing data management facilities are already overloaded. Increasingly, there is a shift from research projects performed in isolation, to many projects requiring continuous large-scale geographic coverage. Not all, but a major part of this newly collected data will be for environmental prediction and worldwide weather coverage. Currently, physical and chemical data are being handled reasonably well because this data can be converted to digital form for quick handling by computers. Geological, biological and ocean engineering outputs are woefully understandardized and do not now lend themselves to conversion into digital format. Other problems exist when one tries to store and retrieve descriptive and narrative analytical reports.

National problems -- A number of specific national problems which seem to require attention are:

1. Incomplete identification of the multiple purposes and technical requirements of the data collected.

2. Inadequate quality control, consistent from start to finish, and critical evaluation of collected data. Is it needed?

3. Excessive delays in the total "data transmission" system. Extensive delays between the collection of data and its availability to users and custodians.

4. Inefficient data acquisition, collection and handling methods. Is it done this way?

5. Lack of firm, and binding, agreements on data handling procedures and standards among the many agencies.

6. Inadequate correlation of data in space and time. This leads to a lack of selective data retrieval capability -- by geographical area, by depth, etc.

7. Expanded airborne, spaceborne, surface, and subsurface collection systems that will give a greater selective growth in data.

8. The "gap" between the actual, every day state of data management and the potential management made possible by today's developments.

9. Lack of a coordinated system of data traffic management from the point of acquisition to the ultimate user, and a return route for the user's evaluation of received data, or for new data requirements.

10. Lack of adequate system cost/benefit/effectiveness information about existing small systems, much less a worldwide system.

International problems -- A number of significant international problems which seem to require attention are:

1. The allocation and usage of the radio frequency spectrum for the many types of platforms.

2. Permission to place fixed sensors, and related data transmission equipment, on islands, or lands, under the national jurisdiction of someone other than the data gatherer. This involves guarantees that the information is for non-military purposes.

3. Placement, and maintenance, of fixed buoys in accordance with all requirements of international agreements, convensions, etc. with respect to navigation particularly.

4. Utilization, and recovery, of free floating buoys and subsurface submersibles, in a way to minimize hazards to freedom of the seas, navigation, and fishing activities.

5. Creation of bilateral or multilateral agreements to apportion the world's environment in such a way as to minimize political friction and duplication of data acquisitions, to optimize the costs to all concerned, and to maximize the dissemination of all information for mutual satisfaction.

6. Establishment of data dissemination networks that are as low in cost as feasible, and maintain standards, and will meet the aspirations of most of the less developed countries of the world. Perhaps, access should be based on ability to pay. The computers of the system will be massive, expensive, and difficult to maintain; but the input-output devices now being marketed are increasing in usefulness, versatility,and

decreasing in cost per unit of data.

NATIONAL JURISDICTION & INTERNATIONAL REGIME

National jurisdiction -- The management of data originating in, on, or near the deep seabed is relatively independent of the limits of national jurisdiction. First and possibly foremost, the heart of the system will alwsys be the massive computational capability which will be landbased for the foreseeable future. Secondly, the proposed data management system would encompass the entire world's environment. Therefore, the apportionment of the world's environment among the data gatherers could be adjusted to fit any limits of national jurisdiction since these jurisdictions on the seabed represent no logical or physical barriers to the collection of data by diverse types of sensors and platforms.

International regime -- The management of data originating in, on, or near the deep seabed is also relatively independent of the type of international regime to be established. The computational capability required by the international regime in the performance of its duties could be linked to the worldwide data management system very easily with modern telecommunications, but it would cost money, materials and skilled manpower. Again, the proposed data management system would encompass the world's total environment. The apportionment of the world could be readily accomplished between the international regime and the coastal nations of the world, in regards to data. The management of data could follow any guidelines

or limitations placed upon it by whatever political decisions are made internationally.

RECOMMENDATIONS

The present management of environmental data on the oceans and the world's environment has evolved on a purely cooperative basis among the many agencies of the Federal Government. Each agency met a specific set of needs at the time. As a result, the existing organization of the National Oceanographic Data Center involves a very cumbersome arrangement for control by a multi-purpose, multi-agency board. It is almost impossible to sharply focus such control or to set priorities that are truly in the Nation's best interest. It is recommended that the National Oceanographic Data Center, in its present form, be abolished.

It is further recommended that Federal funding for a centralized, comprehensive environmental data management system be focused on a single agency. This management and budgeting agency would have sufficient funding to receive, store, process, retrieve, and disseminate the data supplied to it by gathering and originating agencies. In every instance data management COSTS have far exceeded any estimates because without a total systems review some expensive portions of the system were left out of cost estimates. The proposed data management agency would have authority to ensure comprehensive participation in submission of data as an input. On the other hand, the agency would be obligated to disseminate the data on

a timely basis to users and clients of the system. (For an extreme example: certain samples and specimens and data gathered by HMS CHALLENGER in the 1870's has not yet been evaluated.)

The total effort needed to acquire the necessary global data is certainly beyond the capability of any nation by itself. The need for aggressive coordination to standardize data format, reporting codes, etc. on an international basis is evident. This implies some measure of world-wide integration of existing data collection, processing, management, storage, retrieval, and dissemination. The Intergovernmental Oceanographic Commission has produced a Provisional Guide for the Exchange of Oceanographic Data. Such efforts should be encouraged and extended as rapidly as possible. This coordination of data should extend from private industry, universities, local, state and national governmental agencies, on up to world-wide data exchange networks that meet the needs of today and may possibly meet the needs of the immediate future.

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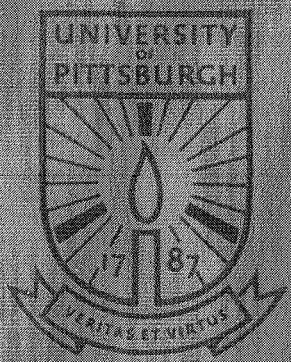
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