individual States implement and enforce this new regulatory program. EPA has proposed a guideline which describes the elements a State hazardous waste program must have in order for a State to be authorized to carry out the national program. Among other things, States must have legislation and regulations for hazardous waste management which are no less stringent than the Federal analogs, and must demonstrate that they have adequate resources to administer and enforce the program. States may be given interim authorization to carry out the program for a period of two years, even if they do not fully qualify. During this two-year period, States would be expected to develop a program which meets all authorization requirements. Federal financial grants are available to assist States to develop and implement fully acceptable hazardous waste management programs. EPA is required to operate the hazardous waste program in States which do not qualify for authorization.

IMPLEMENTATION ISSUES

Several major issues of implementation have arisen for this new program. One involves the interstate movement of hazardous waste. Some States believe it is within their powers derived from the U.S. Constitution to ban the disposal of wastes originating in other States. This approach runs counter to the concept of large regional hazardous waste facilities which, owing to the economics of scale, could operate at lower cost than smaller facilities. The issue is politically and emotionally charged, and not yet fully resolved. However, the U.S. Supreme Court ruled in June 1978 that certain types of State waste importation bans are a restraint on interstate commerce and therefore unconstitutional.

A related issue is the potential lack of acceptable hazardous waste facility capacity to accommodate all the hazardous waste which will be regulated under this new program. State waste importation bans discourage private sector investment in new facilities, since many facilities would have to draw wastes from an area encompassing several States in order to be economically viable. Another factor is citizen opposition to the siting of new facilities near them. In fact, an existing hazardous waste facility in Illinois with valid State permits was closed down by court order in September 1978 as a result of local citizen opposition. New approaches to hazardous waste facility siting are being considered to overcome this problem.

Another issue is the new requirement for financial responsibility for owners and operators of hazardous waste facilities. In the past, several facility owners have taken in large quantities of hazardous waste for treatment or disposal, but then declared bankruptcy before these wastes were adequately disposed. Local or State governments were then faced with the job of cleaning up the problem at taxpayers' expense. To preclude these events in the future, the proposed hazardous waste regulations require that facility owners deposit sufficient funds for ultimate facility closure in a trust account before an operating permit is issued. Further, facility owners must show proof of financial responsibility to handle liability claims and to conduct remedial actions, if necessary, during facility operations. Lastly, land disposal facilities, such as landfills, land farms, or surface impoundments, must build up a fund during the facility lifetime to pay for monitoring, security, and maintenance at the facility for a 20-year period after closure. These proposed requirements are likely to force small operators out of the hazardous waste management business, and thus may add to the facility availability problem. However, RCRA provides that existing facilities can obtain interim status prior to permit issuance. This interim status period can be viewed as a safety valve for capacity creation in the program start-up period.

Information Systems for Optimum Use of Ocean Resources[†]

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The world's oceans offer tremendous potential for providing food, energy, metals, minerals, and recreational experiences. If we are to achieve optimum use of the oceans' resources, then we need to have readily available a variety of information on them: their location; their chemical, biological, and physical makeup; the extent to which they can be extracted and used; and how such extraction may affect us and our environment. This paper (1) indicates the large amount and variety of information now available on the oceans; (2) describes U.S. and international systems for making ocean information available to users; and (3) discusses factors that need to be considered in the further development of ocean information systems.

The oceans, which cover two-thirds of the earth's surface, offer tremendous potential for providing food, energy, metals, minerals, and recreational experiences. If this potential is to be realized, the oceans' resources must be managed to achieve optimum use. Optimum use of ocean resources means optimizing a complex mix of biological, chemical, physical, economic, legal, political, and aesthetic factors. The quantity and quality of information available on each of these factors can have an important bearing on optimization decisions and on the resulting effects of those decisions on the future health and wealth of the world's oceans.

I. OCEAN INFORMATION

A surprising amount of information is being produced on the oceans, on the location and makeup of ocean resources, on the possible uses of those resources, on the processes for extraction, and on the effects of extraction processes on us and our environment. The National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce is a major producer of ocean information. NOAA has as one of its charters the exploration, researching, and mapping of the global oceans and their living and mineral resources. NOAA uses new biological, chemical, and physical knowledge to assess the sea's potential yield, and to develop techniques that can be used to manage, use, and conserve the animal and

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mineral resources of the sea. Following are some examples of NOAA oceanic programs, activities, and studies:

- NOAA is studying and mapping the currents, tides, sea-surface temperatures, sediment transport, and the physical features of the ocean floor for use by navigators and explorers.
- NOAA's ocean climate program produces information to help define the relationship between the ocean and the atmosphere and the effect of this interaction on climate.
- A study of how the development of petroleum and other resources affects marine life and the environment is producing information that can be used to establish baselines for measuring environmental changes. The information can be used to predict future environmental impacts in order to avoid irreversible damage to marine life.
- By collecting biological information on marine plants and animals, NOAA produces fundamental knowledge on the physiological processes, life histories, and dynamics of fish populations.
- NOAA is studying the abundance and distribution of living marine resources to provide a data base for domestic and international fisheries management.
- NOAA-funded researchers have discovered 12 chemical compounds in such creatures as sea cucumbers, sea hares, and sponges which are potentially valuable in treating cancer, cardiovascular problems, and central nervous system disorders. The newly discovered compounds may serve as models for the development of new drugs.
- NOAA cooperates with the U.S. Navy and other organizations on studies to extend our ability to work more efficiently under water.
- NOAA is cooperating with national and international organizations to determine the technical and economic feasibility of obtaining energy from the oceans.

NOAA collects data and information using aircraft, fixed and free-floating buoys, divers, satellites, ships, submersibles, and bottom and sub-bottom stations. NOAA has a Cooperative Ship Program that assists with the collection of information. The program comprises 1780 merchant vessels, 350 U.S. Navy commissioned ships, 67 Navy ships under the control of the Military Sealift Command, 53 Coast Guard cutters, 30 NOAA ships, and 26 miscellaneous ships including university-controlled research ships. These vessels transmit information on true wind speed and direction, visibility, precipitation, sea-level barometric pressure, air temperature, sea-surface temperature, cloud cover, ocean waves, and ice conditions. Also part of NOAA's data collection system are a number of experimental buoys deployed in the Atlantic Ocean, Pacific Ocean, and Gulf of Mexico. Data from these buoys are sent through geostationary satellites to ground receiving stations for processing and dissemination. The buoys provide information on wind speed and direction, air temperature, sea-level pressure, surface-water temperature, wave height and period, spectral data on waves, and water temperatures at various depths. A network of 135 tidal stations along the coasts of the United States, the Great Lakes, Puerto Rico, and other U.S. trust territories and possessions provides tidal information on a continuous basis.

The kinds of ocean data and information being generated by NOAA also are being generated by public and private research organizations throughout the world. National governments, universities, and private research companies are collecting thousands of bits and pieces of ocean data. These data are stored in a variety of ways: on $8^1/_2 \times 11''$ paper, on $3 \times 5''$ cards, on computer punch cards, computer tapes, and floppy discs, and in desk drawers and file cabinets. The data may or may not be available for public consumption. There may or may not be organized ways of processing the data and making the data available to researchers and other interested parties. Following is a description of how NOAA processes and makes available the data and information it collects, and the procedures that have been developed to coordinate the handling of ocean data worldwide.

II. OCEAN INFORMATION SYSTEMS

U.S. Systems. As might be expected, data holdings in NOAA are extensive. The world's largest collection of oceanographic data is held by NOAA's National Oceanographic Data Center (NODC) (a facility of NOAA's Environmental Data and Information Service). Ocean data held by NODC include:

- mechanical and expendable bathythermograph data in analog and digital form
- oceanographic station data for surface and serial depths, giving values of temperature, salinity, oxygen, inorganic phosphate, total phosphorus, nitrite–nitrogen, nitrate–nitrogen, silicate–silicon, and pH
- continuously recorded salinity–temperature–depth data in digital form
- surface current information obtained by using drift bottles or calculated from ship set and drift
- biological data, giving values of plankton standing crop, chlorophyll concentrations, and rates of primary productivity
- other marine environmental data obtained by diverse techniques; e.g., instrumented buoy data and current meter data

The data bases in which these data reside are growing continually. For example, the oceanographic station data file, a major source of information about the chemical and physical properties of the oceans, now contains data from more than 620 000 stations.

All of these data are available to users on a request basis. They can be obtained on a variety of media—magnetic tape, punched cards, microfilm, and computer printouts. Data analysis is available on request.

NOAA also has developed two computerized information retrieval systems that can refer users to marine data collections outside of NOAA and to the published marine science literature. These systems are ENDEX (Environmental Data Index) and OASIS (Oceanic and Atmospheric Scientific Information System). OASIS is a computerized information retrieval service that provides access to several million scientific and technical references in more than 100 data bases. Examples of data bases accessible through OASIS are:

Aquatic Sciences and Fisheries Abstracts (ASFA)
Bibliography and Index of Geology (GEOREF)
Biological Abstracts (BA)
Chemical Abstracts Condensates (CAC)
Geophysical Abstracts (GPA)
Oceanic Abstracts (OA)
Petroleum Abstracts (TULSA)
Smithsonian Science Information Exchange (SSIE)

Aquatic Sciences and Fisheries Abstracts (ASFA) is a new data base developed cooperatively by three U.N. agencies (Food and Agriculture Organization of the U.N., Intergovernmental Oceanographic Commission, and the Ocean Economics and Technology Office). ASFA provides the most comprehensive coverage of ocean-related topics of any data base in the world, running about 23 000 abstracts per year.

Chemical Abstracts Condensates (CAC), one of several computer-readable files available from the American Chemical Society's Chemical Abstracts Service (CAS), provides a means of accessing bibliographic information on documents abstracted by CAS. About 460 000 documents will be included in *CA Condensates* in 1979. Other computer-readable files available from CAS give users access to a variety of chemistry-related information. Files of interest to ocean researchers include: "Ecology and Environment", "Energy", and "Food and Agricultural Chemistry". Each of these files contains several thousand abstracts on a variety of subject matter.

A complementary system to OASIS is the Environmental Data Index (ENDEX), a computerized referral system to data files (as opposed to published information in OASIS) held within and outside NOAA. It contains descriptions of data collection efforts, descriptions of data files, and actual inventories of large, commonly used files. Examples of ENDEX data files are:

"Environmental Data Base Directory" (11 000 descriptions)

"Ocean Bottom Photograph Camera Station File" (9000 stations)

"Reports of Observations/Samples Collected by Oceanographic Programs" (3300 reports)

International Systems. NOAA's automated information systems contain mostly data and information generated by scientists in the United States. Optimum use of the world's oceans, however, requires international cooperation to study ocean phenomena. A vital element of such international research is the ability to pool data and information available in all countries that have an interest in the oceans. There needs to be a way of exchanging the data and information collected and stored by countries that study and use the ocean's resources. Such a way has been developed by the Intergovernmental Oceanographic Commission (IOC), an arm of the United Nation's Educational, Scientific, and Cultural Organization (UNESCO). IOC, through its Working Committee on International Oceanographic Data Exchange (WC-IODE), provides a focal point for the exchange of data among its nearly 100-member nations.

IOC has encouraged each member country to establish its own data center to serve as a national focal point for accessing and disseminating oceanographic data and information. According to IOC guidelines, each data center should have an adequate base of historical data or information and be equipped to provide data products tailored to specific requirements and to present data and information in a variety of forms and media; e.g., charts, maps, visual displays, computer listings, punched cards, magnetic tapes. NOAA's National Oceanographic Data Center (NODC) is the U.S. focal point for accessing and disseminating ocean data. Over 30 countries have established national oceanographic data centers or have designated agencies for data exchange.

Also part of the international data exchange network is the World Data Center (WDC) System established under the auspices of the International Council of Scientific Unions (ICSU). The WDC System consists of three World Data Centers; each center is comprised of subcenters organized according to discipline, one of which is oceanography. There are two WDC's for Oceanography, one in the U.S. and one in the U.S.S.R. The WDC for Oceanography in the U.S. is located with and operated by NOAA's NODC in Washington, D.C. The WDC's for Oceanography contain data files and literature references. A significant amount of chemical data is reported to the WDC's.

The types of data available at the WDC's for Oceanography, as well as the procedures for exchanging these data, are outlined in IOC's "Manual for International Oceanographic Data Exchange". Available data include soundings of ocean depth (bathymetric), temperature values (taken by bath-thermographs (BT)), atmospheric pressure and other meteorological observations, salinity and temperature (taken by STD's and Nansen casts) at surface and at depth, and velocities of currents. Also included is information on bottom samples, cores, and various biological observations. Nonstandard data normally are exchanged only on special request. Examples are bottom photographs; measurements of heat flow, gravity, and magnetic field; chemical analysis of trace elements.

Much of the data is in machine-readable form, processed when necessary by the adjacent national center (the NODC in the U.S.) and placed into the national center's automated system. Thus, the national center may bundle for the WDC for Oceanography data requested for specified geographic areas or requests with other specialized requirements.

An Ocean Directory. As described above, we have a worldwide ocean data network consisting of national and international data centers that process, store, and make available ocean data and information. What is needed to complete the picture is a way for potential users to know exactly what data and information are in this global network. Such a way exists, and its name is MEDI (Marine Environmental Data Information Referral System), a comprehensive data cataloging system being developed and operated by the Intergovernmental Oceanographic Commission (IOC), the same group that has encouraged the formation of the national ocean data centers and the exchange of data between them. The Data Referral System (MEDI) contains detailed descriptions of data files held by the national and international centers as well as other participating international organizations such as:

Food and Agriculture Organization of the U.N. (FAO)

International Council for Exploration of the Seas (ICES)

International Atomic Energy Agency (IAEA)

International Hydrographic Organization (IHO)

United Nations Environmental Program (UNEP)

World Meteorological Organization (WMO)

Each file description contains the name of the file, a narrative description of the file, the types and volumes of data in the file, geographic coverage, storage media, availability, and how to access the data. These descriptions are contained in a computer in retrieval form as well as in a catalog published by the MEDI Coordinating Center. In addition to the catalog, products currently planned to be available from MEDI are specialized indexes for broad subject areas of interest (e.g., pollution and wave data); geographic plots of worldwide data distribution for various data types; and customized searches to meet specialized needs.

MEDI is still in the developing stage. As now envisioned, a user would request information from one of the data centers in the worldwide network (either a national data center such as NODC in the U.S., or a World Data Center). If the center cannot fully meet the need of the user, it will request referral information from MEDI, either directly or through a point of contact in one of several international organizations. This information will be passed to the user. As a potential user of the MEDI system, I would like to see the system developed to the point where a user—you or I—could ask MEDI via a computer terminal for a certain type of data or information, and MEDI would tell me which center in the worldwide network has the information and how I can obtain it. With today's advanced data communications technology, we could easily take this one step further and give the user the ability to directly call via a computer terminal the center containing the data, and access what is needed. Any accounting procedures, such as recording who requested what data from what center, the charges for computer use and communications, and any other information desired by the operators of the systems involved could be readily designed into such a system.

As it currently stands, MEDI is being built up by having national and international centers provide file descriptions on "input registration forms" which the MEDI Coordination Center screens, edits, and processes. The originator verifies the output and enters it into a file, and the file is stored on disk in the computer and on a backup magnetic tape. It would be possible to speed up this process by inputting directly the file descriptions onto a tape or disc from computer terminals anywhere in the world. I am sure this is something IOC and its member nations will be looking at in the future.

III. CLOSING REMARKS

The oceans provide an excellent forum for broad-scale, multinational, interdisciplinary research. As the world seems to become smaller and the demand for food and energy accelerates, the need for cooperative interdisciplinary research will increase. The trend will be toward larger studies that examine the interaction of biological, chemical, and physical processes and how a variety of economic, social, and political factors influence these processes. One area where these interactions will come increasingly under study is ocean pollution, where the industrial activities of one nation can influence the environment of other nations and can affect the biological, chemical, and physical characteristics of ocean areas belonging to different nations and to the world as a whole. Economic, social, and political factors also come into play. The worldwide network of ocean data centers and the supporting referral system, MEDI, provide planners, researchers, and others with an excellent tool for surveying and accessing a wide range of data and information available for studying ocean processes and products.

Historical Development of Abstracting†

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The abstract, under a multitude of names, such as hypothesis, marginalia, abridgement, extract, digest, prêcis, resumê, and summary, has a long history, one which is concomitant with advancing scholarship. The progression of this history from the Sumerian civilization ca. 3600 B.C., through the Egyptian and Greek civilizations, the Hellenistic period, the Dark Ages, Middle Ages, Renaissance, and into the modern period is reviewed.

THE BEGINNING

Abstracting is a literary form that dates back far in history with no recorded beginning. The oldest recorded inscriptions, which were on clay, are those from the Sumerian civilization, about 3600 B.C. It is reasonable to assume that even then scribes and students resorted to note-taking as an aid to memory, using the point of a stylus on wet clay, then baking the clay into a durable record or document. Egyptian libraries were established as early as 2000 B.C., in which papyri rolled and packed in labeled jars were arranged on shelves. As these documents consisted mostly of legal proceedings and historical accounts, they were probably arranged chronologically and by the reigning king.

At the height of the Greek civilization, thousands of books were written on papyrus and on parchment, and the accumulation of personal libraries became common. Those who attended Greek plays were given a written summary of the play with a list of characters—which was called a hypothesis by the Greeks.

HELLENISTIC PERIOD

During the Hellenistic period, when the Greek civilization was dispersed throughout the Mediterranean area, Ptolemy I (367–285 B.C.) founded the famous Alexandrian Library, which was enlarged by Ptolemy II (309–247 B.C.). The Alexandrian Library contained over 500 000 scrolls, which are equivalent to about 100 000 books of today. Every scroll brought to Alexandria by its owner had to be deposited in the Library and exchanged for a copy. Another great library of the period was the one in Pergamum, which had a collection of about 200 000 scrolls. The Alexandrian collection was classified on 120 scrolls. Scholars and scribes busily engaged themselves in these libraries, copying, abstracting, extracting, and annotating these scrolls to aid their memories or to repackage the information into histories, biographies, philosophies, etc. Through the decline of Greece and the ascendancy of the Roman empire, the Alexandrian Library was the means by which the heritage of the Greek civilization was transmitted throughout the Roman world and into the stream of history.

DARK AGES AND MIDDLE AGES

After the collapse of the Roman empire in 476 and through the long years of the Dark Ages, the Church maintained a degree of literacy through the monks in its many monasteries throughout Europe. Latin was the international language in the literate population of Italy, Spain, France, England, Scandinavia, Germany, etc., through this period until the 18th century. Parchment made from sheepskin was the usual medium for writing until paper became common in Europe from the 12th century on. There were numerous, although small, libraries in monasteries and in the homes of the wealthy. It was during this period that the word abstract was introduced as the word "abstractus" in Medieval Latin, the liturgical and literary language in use between the 7th and 15th centuries; the word's original meaning was "to draw away". A common practice among the monks in the Middle Ages as they transcribed each page was to write marginalia, summarizing the contents. Kings throughout this period required their generals and ambassadors to write summaries of their reports and the Vatican on receiving numerous reports from its envoys had them abstracted for the papal court. Since the year 1000, countless abstracts of these reports have been accumulating in the Vatican.

Although eclecticism was employed by the Greeks, i.e., writing manuscripts by drawing or selecting elements from past

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