SUMMARY REPORT

of the

Fourth Meeting of the IOC Working Group on

International Oceanographic Data Exchange


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UNITED NATIONS EDUCATIONAL
SCIENTIFIC AND CULTURAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

Working Group on International Oceanographic
Data Exchange


SUMMARY REPORT

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Preliminary remarks

The IOC Working Group on International Oceanographic Data Exchange held its 4th Meeting at the UNESCO Building in Paris from 23 - 26 September 1968. Dr. T.S. Austin (USA), Chairman, opened the proceedings by welcoming the delegates and was followed by Dr. K.W. Fedorov, Secretary of IOC, who welcomed the participants on behalf of Unesco and the IOC Secretariat. Mr. H.W. Hill (U.K.) was appointed Rapporteur, after which the Chairman outlined the main tasks before the Working Group and reviewed a suggestion from SCOR for the development of international indices of bottom photographs and bottom cores.

The delegate of Canada then reviewed the aims of IOC and some of its history to set the meeting in perspective. He reminded the delegates that the Commission was unique in its concept and recalled that the IOC was conceived in the minds of those in the international scientific community who realized that the study of the sea would be forwarded by international cooperation, and from these ideas had stemmed the concept of exchange of national oceanographic data. He then briefly commented on the practice of appointing a rapporteur from among the national delegations, which practice he, personally, did not consider appropriate. The Secretary of the IOC replied that such practice was frequently followed within the United Nations system.

After further preliminary discussion the following agenda was adopted:

1. Adoption of agenda.

2. Consideration of the new terms of reference as expanded by the Fifth Session of IOC.

3. Reappraisal of the present international data exchange system for oceanography:
   
   (a) World Data Centres (A and B for Oceanography)
   (b) Regional Data Services (ICES, KDC, etc.)
   (c) National Data Centres.

4. Functions of the Working Group as related to IGOS, and adjustment in the oceanographic data exchange system as may be needed for IGOS tasks.

5. Further development of the exchange of:
   
   (a) geological/geophysical data and particularly bottom photography and bottom core data;
   (b) biological data;
(c) ocean-atmosphere interaction data;
(d) continuously recorded data;
(e) other data.

6. Other matters.

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2. Consideration of the new terms of reference
   as expanded by the Fifth Session of IOC

The Chairman called attention to Resolution V-20A of the Fifth Session
of IOC and the amended terms of reference of the Working Group, viz.:

(a) to review and reappraise the whole international
    oceanographic data exchange system as recommended
    in Section 8 of the report "International Ocean Affairs"
    (IOC/V-INF.111), and as reaffirmed in Recommendation (ix)
    of the recommendations of the Working Group meeting in
    The Hague in September 1967 (IOC/V-4);

(b) to continue and encourage the present work leading towards
    format standardization for use with automated techniques
    for data input, storage, retrieval, dissemination, and
    exchange, but recognizing the considerable financial
    implications inherent in such automation;

(c) to continue the development of means whereby geological,
    geophysical, biological, special air-sea interaction data,
    and data from "continuously recording" sensors are
    incorporated into the international oceanographic data
    exchange system.

The Chairman then reminded the delegates that the agenda as adopted provided
opportunity for discussion of these items in detail, but drew attention
particularly to (b), and its reference to financial implications. He
recalled that WDC-A had received, in the first six months of 1968, more data
than in the whole of 1967, that requests for data and information had
appreciably increased, and that there were now eleven WDCs and three nations
presently developing WDCs. He felt therefore that the Working Group had an
increasingly important role to play in the coordination and standardization
of this growing data exchange problem. There followed some discussion of
the precise details of the functions of the Group and of the implications of
the expanded terms of reference before the Chairman proceeded to Item 3.
3. Reappraisal of the present international data exchange system

The delegate of Canada asked that the discussion should centre on the fundamental concepts of data exchange, e.g., was the present system of WDCs still logical? The original intention was to sponsor studies global in concept, and he felt that few oceanographers now looked at the oceans in a global manner. He questioned whether the synoptic approach was still productive and suggested that effort should now be concentrated on the complexities of local processes rather than to collect data from vast oceanic areas and subject masses of data to smoothing procedures which may degrade the value of the data. He asked who requested this type of data and how were they used?

The Chairman of the Group took exception, in part, with this view. He pointed out that many problems required large area study, e.g., the understanding of the Gulf Stream and Kuroshio systems, and many problems of fish migration. Secular changes of decadal order also need the input of large masses of time series data and IGOSs recognized the need for global data collection. The delegate of the United Kingdom argued that, nevertheless, studies of small-scale processes were important, particularly when they could be made generally applicable to avoid duplication of effort, and when they led to study of oceanic processes on a world-wide scale. The representative of ICES supported the global concept of data collection, pointing out that the ICES region now covered the whole Atlantic, and that there existed a need for data collected from large areas for synoptic charts and atlases. In response to the question of the delegate from Canada, the U.S. delegate pointed out that the past demand for data, especially for large areas, directed specifically to the WDCs does not adequately portray the total demand for such data. The statistics should be augmented by the sizable number of requests which are directed to the NODCs but which qualify as exchange of data under the definition in the IOC manual, i.e., the demand that otherwise would have been met through the WDCs had there been no NODC.

The Chairman then proposed consideration of the suitability of the present system of data exchange for the next decade, and in particular the problems of handling continuously recorded data. The delegate of Italy felt that the present system would be able to cope for the next ten years and further detailed planning at this time was premature in view of the rapid advance of technology. The delegate of the Ivory Coast agreed that the present system was currently satisfactory but argued strongly in favour of the development of more regional centres, since the WDCs were unlikely to be able to cope with the data explosion (Resolution V-20A). The delegates of the USSR and Japan stated that their countries' views were that the present world data exchange arrangements were adequate for the next 5 - 10 years and that the present system was both useful and effective.

A number of delegates commented on the desirability of excluding real time data from the scope of responsibilities of the group. Several did, however, express the view that the efficient archiving of non-real time data would be dependent on the format used for collection of real time data for projects such as IGOSs, and it was concluded that the Working Group should be represented on the appropriate IGOSs Workings Groups and Panels to facilitate coordination.
There followed a lengthy discussion on the financial aspects of supplying data through the world data exchange system in which a number of delegates maintained that there should be no incurred cost, and while agreeing with this in principle the Chairman of the Group stated that in practice requests for smaller jobs were completed without cost, and all requests for data provided to countries submitting data to WDC-A were met free of cost. He informed delegates that some requests had an estimate of over $1,000 and that it would not always continue to be practicable to bear the costs at WDC-A. The representative of ICES agreed with the Chairman and outlined the ICES policy on recovery of costs for data supplied, mentioning that WDC-A had been extremely responsive in producing data for ICES on magnetic tape at no cost. The IOC Secretary instanced a personal case where a request for data from WDC-A had been too expensive and suggested that UNESCO should be asked to consider providing funds to supplement the cost of data requests from small marine laboratories and individual researchers from developing countries. This point of view was supported by the delegate of the USSR who informed the Group that WDC-B often supplied data for Ph.D. theses for individual scientists, but he argued that as a general principle the WDCs should meet the cost of data exchange, as is done by WDC-B.

The delegate of the Federal Republic of Germany agreed with the USSR delegate that the funding of data exchange could not be kept separate from the financing of the WDCs themselves and the representative of ICES asked how such a scheme would affect existing regional centres. The delegate of the United Kingdom suggested that although discussion of the financial implications was desirable, the Group could only suggest that IOC/UNESCO should explore the possibilities of funding requests for data. This suggestion was supported by several delegates in the view that any positive commitment of intent, or financial help, was beyond the brief of the delegates.

The representative of ICES then reported to the Working Group the recommendations and conclusions of the ICES meeting in March 1968 on the Development of Marine Data Systems and some discussion followed on the merits of regional centres, and the extent to which national data centres could fulfill the role previously covered by regional centres. The Rapporteur, speaking on behalf of the U.K. delegation, put forward the view that with the rapidly increasing number of NODCs which were well supported by modern computer facilities, the role of the hierarchical-type regional centre had been superseded, and that exchange among national data centres, and directly between NODCs and WDCs, was the most logical method for the future. The delegates of the USSR and France supported this simplification of the system but the delegate of the Ivory Coast maintained that there was still a case for regional centres in the geographical rather than hierarchical sense and cited the case of the West African countries. The delegate of the Federal Republic of Germany supported this view, suggesting there was a case for Baltic and North Sea regional centres and the delegate of Sweden reminded delegates that certain of the ICES member countries, which were not planning to establish their own NODCs, were considering a joint national data centre. The delegate of Japan considered there was still a place in the future for data centres for special projects, and stated that the Kuroshio Data Centre was in reality synonymous with the Japanese Oceanographic Data Centre. The delegate of the Netherlands also supported the concept of regional data centres. The U.S. delegate concurred but stressed that, as exemplified by the CSK Centre, NODCs with
advanced computing capabilities could handle regional data exchange effectively and economically and that such NODCs be encouraged to assume the additional function of a regional data centre where such a service is desired. He also drew the Working Group's attention to the U.S. "Proposal to Establish International Data Banks in Support of WDCs (Oceanography)", which was tabled by the U.S. delegation in support of the expanded terms of reference of the Working Group, particularly items (b) and (c) (cf. Annex I). He further cited the experience of WDC-A that the cost of data exchange is reduced through the use of automated data banks with their inherently greater flexibility and the belief that data formatting problems introduced by the proliferation of NODCs with their own computer practices could in part be overcome by the "translating power of the NODC with access to more advanced computers."

4. **Functions of the Group as related to IGOSS and associated adjustments as may be needed in the oceanographic exchange system**

The Chairman drew attention to the IGOSS report listed as AVS/9/89R dated July 1968, and particularly to para. 3(c) which suggested that "the IOC Working Group on Data Exchange should work out a uniform code, standard formats and methods for processing, exchange and dissemination of non-real time data". The U.S. delegation thought that the present international exchange system was not adequate to handle the air-sea interaction data which would be accumulated by IGOSS. The delegate of the United Kingdom felt that the problem of coordinating data exchange between WHO and the oceanographic centres could best be solved by following the WHO lead and adopting WHO formats, since it was essential to agree on a joint format. This view was endorsed by the representative of WHO who informed the meeting that there were now nine data centres for the collection and storage of marine meteorological observations including data pertaining to sea surface conditions. He announced that an informal WWW planning meeting was scheduled for November 1968 to study the problems of storage of synoptic data.

The delegate of the United Kingdom expressed the opinion that it was incumbent upon IGOSS to specify their requirements and offer guidelines as to the extent to which the data could be compressed for storage. This view was echoed by the Rapporteur who thought that there was insufficient consideration of aims, types of data required and subsequent methods of analysis. He felt there was a need for a correct balance between the effort put into new large-scale data collection, specific small-scale projects and data analysis methodology to make the most profitable use of the resources available. The delegate of the USSR supported this trend of argument, together with the delegate of Canada who suggested that a realistic cost effectiveness study was indicated. The Chairman of the Group concurred that no impulsive changes should be made in the present system of data exchange until it became clear that a viable and carefully considered IGOSS system had become established. He reaffirmed that the Working Group should be represented on the IGOSS Panel of Experts on Coordination of Requirements.
5. Further development of data exchange

The Chairman tabled the report of the Ad Hoc Working Group on Format Standardization, UNESCO/IOC/V-13, dated July 1967, and particularly to the recommendations. There was considerable discussion of Recommendations 1-4 and of the advantages of the open-ended flexible format, of which an example (STANS) was given in the report. The Group could also examine a further example of a General Data System (GDS) prepared for the NODC and tabled by WDC-A for the Group's information on 23 September 1969 (cf. reference in Annex I). In a series of exchanges between the delegates of USA, USSR and Canada it was agreed that this GDS was intended primarily for internal use within the NODC (USA) but that, in the interest of promoting the flow of data, WDCs should be prepared to accept data in the format most convenient to the originator. In the spirit of these discussions the recommendations were amended as shown in the Working Group's Recommendation 1 (cf. Annex III). The report of the Ad Hoc Group was otherwise accepted, together with a recommendation that the IOC Manual on Oceanographic Data Exchange be updated more frequently, focusing attention on recent developments in data processing, technical details of exchange formats (particularly in respect of descriptions for non-standard, e.g. biological data), and notes of standardization achieved in specific data disciplines. The Working Group also noted the recommendations of the IOC Coordination Group for the Tsunami Warning System, IOC/13-3, dated May 1968, and requested the Secretary to include in the next issue of the IOC Manual on Data Exchange the report's Recommendation 3 on the relocation of the Tsunami Branch of the WDC (Seismology) to the ITIC in Honolulu.

The Chairman then led the discussion to Item 5(a) on geological/geophysical data, saying that although there were no fundamental difficulties in storage and retrieval of classical physical oceanographical data, biological and geological data could not yet be sufficiently reliably quantified or calibrated to store without extensive use of descriptors. The delegate of the Federal Republic of Germany then outlined the system proposed for the Federal Republic of Germany, which is attached at Annex II, and Dr. Uchitske, Chairman of the IAPSO Commission on Marine Geophysics, was invited to give a resume of methods of indexing of geological data used in the USSR, Canada and the USA. He stressed that there was a urgent need for bottom sediment data, bottom photographs, and also for bedrock data to be catalogued and made available internationally, and predicted that there would be an even greater demand for such data when their existence
was widely known and the data were freely available. The delegate of the USA agreed that an inventory was desirable but doubted that a cost-effectiveness study would justify the cost of an inventory as detailed as the one proposed by the delegate of the Federal Republic of Germany and that this cost may approach the cost of a system for the storage and retrieval of the actual data. The delegate of Canada stated that the Bedford Institute were not satisfied with their current system of indexing bottom photographs and aperture card storage. The system had a low priority for improvement because of the difficulty of establishing the demand of users for such data. The CORDO does not presently archive geological/geophysical data. The delegate of the United Kingdom reported on a U.K. scheme for storing radiac records on aperture cards, but indicated that the response from potential users was small. He offered to cooperate in developing a system of storing photographs and similar data. The delegate of South Africa reported great interest in the University of Cape Town in bottom photograph indexing and storage, and suggested that a periodic report of such data should be issued, at cost, via IOC, to interested users. The consensus of the following discussion was that the concepts of core indexing and photograph indexing present somewhat similar problems although the expertise involved differed. It was agreed to set up two Ad Hoc Working Groups, to work by correspondence, to consider the development of indexing systems, and to sift the opinions and expertise of the various interested member countries as well as IAPSO and SCOR, in order to present proposals for an indexing system at the next meeting of the Working Group. Membership of the Ad Hoc Working Groups were agreed as follows:

**Bottom cores**
- Mr. Kohnke (FRG, Chairman)
- Mr. T. Winterfeld (USA)
- Mr. V.E. Gubanov (USSR)
- Dr. D. Enoji (Japan)
- Mr. J. Vicariot (France)

**Bottom photographs**
- Mr. V.E. Gubanov (USSR, Chairman)
- Mr. C.M. Cross (Canada)
- Mr. D.J. Dixey (U.K.)
- Commander R.T. Tripp (South Africa)

Returning to the problems associated with biological data storage, the delegate of Canada reported that Canada was trying to produce a biological storage system structured quite differently from the physical oceanographic system, and he could not envisage being able to accept data in any format. The delegate of USA stated that format standardization was not practical and that, in the interest of data exchange, flexibility in the acceptance of formats was unavoidable; but emphasized that all efforts towards standardization of methods and formats should continue to be strongly supported.

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The Rapporteur noted that feeling among U.K. biologists tended towards the view that biological data did not as yet have sufficient precision and statistical confidence to warrant its inclusion in a data bank because of the large variety of methods, gear and calibration techniques in use, which presented considerable difficulties in interpretation and reliable quantitative comparison. The Chairman of the Group, on the other hand, felt that recent advances in handling biological parameters, including the digitizing of biomass data on magnetic tapes, and experience in complex programming of biological problems at La Jolla, had now reached a stage where the Group should press for the inclusion of biological data. The delegate of the United Kingdom replied that although international expeditions, where considerable efforts were made towards standardization, might produce comparable biological data, he doubted whether the discrepancies inherent in nationally collected data could be sensibly overcome at this stage.

The representative of FAO then spoke of recent developments in FAO, including the setting-up of the FAO Fishery Data Centre, explaining that it had not yet been decided to what extent biological statistics on fish catches (length, age, etc.) could be held as primary data. In the first stages it was intended to concentrate on indexing and the compilation of a fishery data inventory. He reminded the Group of the interim report of the Joint ACMR-SCOR Working Group on Biological Data (WG 18) dated October 1965 and argued that many of its recommendations had never been implemented. He felt that commercial fishery exploration data would not be adequately compiled unless centres within the World Data Centre System could accept and process them and wondered to what extent WDCs should be in touch—certainly, he felt, they should be closely involved with the marine biological sorting centres which were increasing in number and variety. The majority of delegates in the ensuing discussion supported the setting up of a revised ACMR/SCOR Working Group to update the recommendations of WG 18, and to arrange for the implementation of its proposals.

The Chairman then introduced Dr. Odishaw of the ICSU Panel for the Management of WDCs who, at the Working Group’s request, had previously invited by letter to attend the discussions of the Group. Dr. Odishaw briefly reviewed the history of the CIG, described the work of the ICSU Management Panel, and speculated on the possible outcome of its next meeting, at which it would consider the present organization of WDCs and the membership of the Panel and Steering Committee.

There followed some discussion of the problems of exchanging ocean-atmosphere interaction data*. The delegate of the Federal Republic of Germany suggested that it was premature for the Working Group to advise on the coordination of these data, but he, as well as other delegates, stressed the principle that files of oceanographic and meteorological data which are common in space and time should be compatible. The delegate of the USSR pointed out the formatting precedent that would be set by the common use of communication channels for the initial real-time transmission of such data and its possible use as exchange format. The U.S. delegate added that not only the format but the larger question of the structure of files maintained by diverse activities had a bearing on the exchange of air-sea interaction data. The Working Group agreed that the Joint WHO/IOC Panel of Experts on Coordination of Requirements be invited to consider the principle of the creation of common formats for this data.

The Chairman then proposed setting up three Ad Hoc Working Groups to consolidate the views of the meeting in the major areas discussed and to prepare draft recommendations for a further plenary session of the Group. The Ad Hoc Working Groups were appointed as follows:

Reappraisal Group

Dr. G. Tomczak (FRG, Chairman), Mr. J. Smed (ICES),
Mr. L. Lemasson (Ivory Coast).

Format Group

Mr. Kohnke (FRG, Chairman), Mr. T. Winterfeld (USA),
Mr. C.M. Cross (Canada), Mr. R.R. Steeven (Canada).

IGOSS Group

Mr. Wm. H. Haggard (USA, Chairman), Mr. J. Crease (U.K.),
Mr. V.E. Gunanov (USSR), Mr. G. Verploegh (WMO).

When the plenary session reassembled the recommendations proposed by the three Ad Hoc Working Groups were discussed in considerable detail and a number of counter proposals were made which eventually culminated in the agreed set of recommendations 1-3 appended to this report (cf. Annex III).

There was some further discussion of the problems associated with the storage and exchange of data from continuously recording sensors, in which it was generally agreed that some form of reduction of data would be necessary before it could be stored in data centres. The delegates of France, USA and the Federal Republic of Germany suggested various definitions of the reduction of data necessary, the latter supporting the inflexion point and standard depth alternatives for BT and STD data, while the U.S. delegation thought that the real problem lay in the reduction and storage of time series data, for which he thought it difficult for WDCs to present a guideline at this stage of the development. The delegate of the USSR reflected a majority view that the reduction should be specified by the scientist, since he was ultimately responsible for the reliability and methodology, and that WDCs should not attempt to hold full records of this type of data. This view was opposed principally by the U.S. delegation, which argued that the option of transmitting full records of continuous data to WDCs should be left open to the voluntary cooperation of individual scientists and national agencies. After further discussion from other delegates the Chairman summarized the consensus of opinion as follows:

/...
1. that WDCs and NDCs should not in general fix any restrictions on the form of the data received from the various sources, and should accept data in any reduced form.

2. that the data (reduced or otherwise) should be accompanied by a full description of the methods of collection, reduction and processing, and

3. that the degree of availability, and location of the original data should be specified.

6. **Other matters**

   No matters were raised.

   The Chairman moved a vote of thanks to the Secretariat and interpreters before closing the 4th Meeting of the Working Group.
UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

Working Group on International Oceanographic Data Exchange


A PROPOSAL TO ESTABLISH INTERNATIONAL DATA BANKS IN SUPPORT OF THE WDC'S (OCEANOGRAPHY)

(Prepared by WDC-A, Oceanography, Washington, D. C., U. S. A.)

1. Concept of International Data Banks

It is proposed that the U. S. and U. S. S. R. national oceanographic data centers (NODC's) automate all digital data received by World Data Centers A and B, Oceanography, and that each store these data as international data banks (IDB's). It is further proposed that the U. S. and U. S. S. R. NODC's be recognized as supporting computer facilities (SCF's) to the WDC's. The SCF's would perform all necessary computer processing for IDB's.

Requests for data stored in the IDB's as part of the WDC holdings would be serviced directly from the IDB's without cost on an "equivalent" exchange basis or at cost of reproduction.

Hard copy and data which cannot be readily automated will continue to be accessioned, stored, and disseminated by the WDC's.

2. Benefits to Data Exchange

The computer-linked IDB's and the availability to the WDC's of the SCF's would offer significant advantages to data exchange among nations.
- Rapid retrieval (or selection) of specified data sets
- Flexibility of medium for release (e.g., punch cards, magnetic tape, and computer-produced data reports)
- Capability to sort and/or summarize on request
- Capability to accept and release diverse formats (see Section 5)
- Automation and flexibility of inventoring
- Data display graphics (e.g., vertical profiles) computer produced at low cost

3. Prototype of an International Data Bank and Supporting Computer Facility

The U.S. NODC automates essentially all oceanographic station data received by WDC-A. The data are retrieved from magnetic tape, either in the original cruise context or from a geographically sorted file. The U.S. NODC has found that service from this computer-oriented, uniformly formatted data bank is often more flexible, rapid, and economical than hard-copy reproduction of data reports.

Requests to WDC-A are filled from this prototype international data bank whenever possible. Normally, these data can be provided without cost under an exchange agreement on magnetic tape, punch cards, or listings either in ICES or NOCD format. Standard computed parameters (e.g., dynamic terms and interpolations to standard depths) are also available without additional cost.

With the installation (1969) of a more powerful, "third-generation" computer and mass storage devices, it will be possible for NODC to more efficiently accept, store, and retrieve all computer-compatible oceanographic data under the IEB concept (see Section 5).
4. Effect of the International Data Banks on the International Data Exchange System

The principal components of the envisioned flow of data, information items, and inventories to and from the WDC's are shown in Figure 1. In most respects, the system conforms with the guidelines and definitions of the IOC "Manual on International Oceanographic Data Exchange," Second Edition (Revised), UNESCO, 1967. However, under the IDB concept, the following items must be emphasized.

a. Whenever practicable, digital data should be processed to computer-compatible form (i.e., punch card or magnetic tape) at the NODC or regional center level. This would greatly facilitate assimilation into the IDB's and subsequent service.

b. Evaluation of the plausibility of data, extent of reduction to render it meaningful, and quality control should be a national or regional center's responsibility. However, the IDB's would utilize certain automated quality control procedures and, as recommended in Part III of the IOC "Manual" (page 19), would seek clarification when errors are noted.

c. Requests for processed, digital data from the WDC's would be fulfilled whenever practicable from the IDB's, rather than from the hard-copy files of WDC's.

d. The SCF's should not be obligated to process hard-copy materials (e.g., data reports and bathythermograms) into computer-compatible form. However, when such processing is performed on a voluntary basis by the SCF, the data would be added to and retrieved from the IDB's.
e. The IDB's would furnish to the WDC's inventories of data available for international exchange.

f. The WDC's would continue to receive, store, reproduce, and inventory all hard-copy material and data not suitable for automation.

g. The WDC's should consider miniaturization and optic retrieval systems for handling their hard-copy holdings.

h. It is assumed that reduced data and inventories will be received on a non-real-time basis from ICOS or similar networks.

5. International Data Bank Exchange Formats

a. Flexible Formats

   (1) STARS--A New Approach to Standardization

   The report of the ad hoc Group on Format Standardization (UNESCO/IOC/V-13A) recommends in part: "An open-ended, completely flexible format which is easily convertible into known national and regional formats and, vice-versa, which also lends itself to...punch card storage and direct tape recording, will best satisfy the specified requirements for a Standard IOC Exchange Format. An example of such a format was presented...(UNESCO/IOC/V-13A, Attachment B)."

   Attachment B, "The Canadian STAR System," is a significant advance in utilizing the computer to store data in a flexible, open ended system. It is especially applicable to a multi-disciplinary science, such as oceanography, in that it avoids the proliferation of fixed formats.

   (2) General Data System

   The U.S. NODC has adopted the STARS concept to process
and store chemical, geological, biological, and "heterogeneous" oceanographic data in a General Data System (GDS). In anticipation of the "third-generation" computers and associated mass storage or "random-access" devices, it has been possible to further generalize (or broaden) the desirable features of the STARS System. In brief, the GDS, like STARS, uses parameter codes for identification of data, but also uses additional codes for methods of analysis, observational techniques, etc. A flexible, variable-length tape format is used for storage with positive "address" linkage of data to indicative and supplemental information. A generalized reformatting and unit conversion program has been added to the GDS in order to meet the stated requirements for a standard IOC exchange format.

(3) Use of the General Data System in International Exchange

By design, the GDS is suited to data exchange, especially for "nonstandard" chemical, biological, geological, and geophysical data. Its use by the IIB's, with the associated reformatting and converting capability, would in effect provide a "standard IOC exchange format." If adopted, the GDS would:

- Accept any rational, defined local, national, or regional format for digital data
- Release data in these or other specified formats on punch cards, tapes, or listings
- Accept and release supplementary and descriptive information, methods of analysis, precision indicators, etc., in plain language or in locally understood codes
Obviates need for reformatting or for rearrangements of data on the part of contributors provided the data are explicitly linked to date, time, location, and depth.

b. Fixed Formats

(1) "Standard" data--those data generated in large volume by standardized instrumentation and processed by commonly accepted methods are for the present most efficiently stored in standard or fixed formats (e.g., oceanographic station, expendable bathythermograph, and certain current meter data).

(2) IGOS--formats for non-real-time exchange of data from IGOS are to be established by the IOC Working Group on Oceanographic Data Exchange. Assuming that the data will be "standard" and considering the probable need for compatibility of formats and file structures with meteorological data banks, standard fixed formats may prove convenient for the storage and exchange of most types of data generated by IGOS.

6. Continued Need for Standardization

The IDB's will eventually store most of the world's available oceanographic data. The automation of the IDB's makes it possible to use high-speed computers for statistical application, environmental modeling, and low-cost atlas products.

Even though modern storage systems, such as STARS and GDS, can accommodate data observed and reduced by diverse methods, statistical applications require uniform definition (intercalibration) of the source data.
Interchangeability of data in the international exchange system will continue to depend on standardization of instruments and data reduction procedures.

7. Manual on Data Exchange Through the International Data Banks

The continuing advances in computer technology will inevitably result in continual changes in data systems, both at the IDB's and at the local level. For proper interaction between the IDB's and the exchange system, frequent communication with scientists, as well as computer specialists, will be imperative.

It is therefore proposed that supplements to the present IOC "Manual on International Oceanographic Data Exchange" be issued periodically. These supplements would focus on:

- Developments in data processing systems contributing to the WDC's, ICOSS, the proposed IDOE, etc.

- Expansion of capabilities for accessioning, service, and changing technical requirements of the IDB's and supporting computer facilities

- Technical recommendations to speed and facilitate exchange of automated data through the IDB's or among member nations
1. Laboratories (individual scientists)
   Collect
   Reduce
   Code (digitize)
   Prepare reports, maps, analyses, etc.

2. NODC's, designated national agencies (DNA)
   Process (computerize)
   Quality control
   Develop formats, inventories
   Transmit to WDC's and specialized centers

3. Regional centers, NODC's with computing capability acting as
   regional data centers, designated centers for international
   expeditions
   Process data for cooperative expeditions
   Produce analyses and evaluations
   Provide computer services for small NODC's, DNA's, or participating
   countries without NODC's
   Transmit to WDC's and specialized centers

4. WDC's A and B, Oceanography
   Formally accept data, reports, etc., into WDC system
   Prepare catalogues and disseminate IIB data inventories
   Miniaturize hard-copy material
   Handle service requests to IIB's
   Interchange data between WDC's A and B

5. International Data Banks at Supporting Computer Facility
   Accept defined digital data from WDC's
   Prepare automated inventories
   Reformat data into generalized data bank format
   Fulfill all requests for digital data to WDC's by:
   - reformatting into appropriate format, or
   - releasing in original format and context, and/or
   - on request, sorting geographically or chronologically,
   compressing, summarizing, etc.
6. Regional analysis centers, forecast centers, network terminals
   (e.g., IOSSS, WWW)

   Accept buoy and fixed station data, satellite data on real-time
   basis (primary data)
   Issue analyses or forecasts
   Periodically submit inventories and (as arranged):

   - total reduced data, or
   - compressed or selected data, or
   - summaries