INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS
COMMITTEE ON DATA FOR SCIENCE AND TECHNOLOGY

CODATA 5 NEWSLETTER

DECEMBER 1970

CODATA CONSTITUTION

At the 5th Annual Meeting of CODATA held at St. Andrews University, St. Andrews, Scotland, U.K., on 11 September, 1970, the Members of CODATA approved the recommendation of the CODATA Bureau that the wording of Item V. 17 of the CODATA Constitution be changed from the original:

"The Bureau of CODATA shall consist of the four officers together with three additional Members of the Bureau elected by CODATA from among its Members. The Executive Director of the Central Office (See Article VI, Section 22) shall be a non-voting Member of the Bureau. Any one country and any one Union may not have more than one Member (excluding the Executive Director) on the Bureau at any one time", to a new wording as follows:

"The Bureau of CODATA shall consist of the four officers together with three additional Members of the Bureau elected by CODATA from among its Members. The immediate Past President shall be a non-voting Member of the Bureau for two years following his term of office as President. The Executive Director of the Central Office (See Article VI, Section 22) shall be a non-voting Member of the Bureau. Any one country and any one Union may not have more than one Member (excluding the Executive Director and the immediate Past President) on the Bureau at any one time".

CODATA BUREAU

According to the above change in the CODATA Constitution, Prof. Frederick D. Rossini (U.S.A.) becomes the first Past President of CODATA after serving as President since the establishment of CODATA in 1966.

The proposals of a Nominating Committee set up by the CODATA Bureau at their 9th Meeting in Frankfurt/Main, Federal Republic of Germany, on 16/17 March, 1970, were approved at the 5th Annual Meeting of CODATA, and the following changes in the composition of the CODATA Bureau have taken place: Prof. Boris Vodar (France) moves from Vice-President to President, Academician Michail A. Styrikovich (U.S.S.R.) becomes a Vice-President, and Dr. Lewis M. Branscomb (U.S.A.) a Member. In addition, Dr. R. Norman Jones (Canada) was elected to membership on the Bureau. The Officers and Members of the CODATA Bureau, with terms of office, are therefore now as follows:

President: (1970-1974)	Prof. Boris VODAR, Laboratoire des Hautes Pressions, 1, place Aristide Briand, 92 – Bellevue, FRANCE
Past President: (1970-1972)	Prof. Frederick D. ROSSINI, Vice-President for Research, University of Notre Dame, Notre Dame, Ind. 46556, U.S.A.
Vice-Presidents: (1970-1974)	Academician Michail A. STYRIKOVICH, Academy of Sciences of the U.S.S.R., Leninskiy Prospekt 14, Moscow B-71, U.S.S.R.
(1968-1972)	Sir Gordon SUTHERLAND, The Master's Lodge, Emmanuel College, Cambridge, U. K.
Secretary-Treasurer: (1968-1972)	Prof. Wilhelm KLEMM, Anorg.-chem. Institut der Universität, Gievenbeckerweg 9, 44 Münster, GERMANY, FED. REP.
Members: (1970-1974)	Dr. Lewis M. BRANSCOMB, National Bureau of Standards, Washington, D. C. 20234, U.S.A.
(1970-1974)	Dr. R. Norman JONES, National Research Council of Canada, Sussex Drive, Ottawa 7, Ontario, CANADA
(1968-1972)	Prof. Masao KOTANI, Science University of Tokyo, Kagurazaka 1-3, Shinjuku-Ku, Tokyo, JAPAN
Executive Director: (Ex Officio)	Dr. Christoph SCHÄFER, CODATA Central Office, Frankfurt/Main, GERMANY, FED. REP.

The 12th Meeting of the CODATA Bureau will be held in Paris, France, on 18, 19 and 20 March, 1971.
On the invitation of the U.S. National Academy of Sciences – National Academy of Engineering and the U.S. National Committee for CODATA, the 6th Annual Meeting of CODATA, together with the 13th Bureau Meeting, will be held in Washington, D.C., U.S.A., from 19-21 July, 1971.

SECOND INTERNATIONAL CODATA CONFERENCE

on

Generation, Collection, Evaluation, and Dissemination of Numerical Data for Science and Technology

St. Andrews, Scotland, 7-10 September, 1970

In selecting the University of St. Andrews, Scotland, as the location of the Second International CODATA Conference, the Local Organizing Committee of the Royal Society provided the required ingredients of invigorating sea air, sufficient isolation, and excellent facilities necessary for the success of the "Gordon type" Conference. Following the successful pattern established at the First International CODATA Conference in 1968, the Conference was run on informal lines with presentation of invited papers in the mornings and evenings, leaving the afternoons free for organized discussion groups, computer demonstrations, informal exchanges of information, and recreation. Conference sessions were held in the large and excellently equipped main lecture theatre of the new Physics Building, while conferees were accommodated in the ultra-modern Andrew Melville Hall of Residence, a building of spectacular architecture, providing equally impressive views across the famous St. Andrews golf courses, where in the afternoons many small expert groups could be seen apparently engaged in animated discussion of the morning sessions.

The Conference Programme (see pages 5, 6 and 7) was selected by a Programme Committee under the Chairmanship of Dr. Christoph Schäfer, Executive Director of the CODATA Central Office, to reflect as far as possible the common problems and interests of the 130 participants, who represented the involvement of 15 countries and 8 international organizations in the compilation and evaluation of numerical data. In bringing together data experts in such diversified fields as nuclear and reactor physics, thermodynamic and transport properties, spectroscopy, crystallography, engineering, and the earth and biosciences, with managers of data centres and programmes, computer experts, and users of numerical data, it was hoped, and indeed successfully demonstrated, that such a confrontation can help to define and clarify common problem areas, e.g., the presentation of data in the primary literature, to illustrate the role of modern techniques in the work of data centres, e.g., computerized storage, processing and retrieval of numerical and spectroscopic data, and to stimulate and initiate world-wide co-ordination of data activities, both by personal contacts and through the work of CODATA and its Task Groups.

The activities of CODATA, past, present and future, were the topic of the opening session of the meeting, introduced by Conference Chairman Sir Gordon Sutherland, a Vice-President of CODATA and Chairman of the British National Data Committee. The substantial progress and achievements of CODATA in the four years since its formation were summarized by Prof. Frederick D. Rossini, President of CODATA during this period of establishment, consolidation and growth. Since 1966, the number of National Members on CODATA has increased from six to twelve, a Central Office with five staff members has been established in Frankfurt/Main, and one of the principal tasks assigned to CODATA in its Constitution, the production of a directory-survey of data centres and their publications, the "International Compendium of Numerical Data Projects", has been achieved. Staff members of CODATA described the content of the Compendium in more detail, and outlined plans for its updating, which include more complete coverage of Soviet data activities, and more detailed treatment of the comprehensive data collections, e.g., Landolt-Börnstein, and of data handbooks.

The role of CODATA in the UNISIST Project – the Joint ICSU – UNESCO Study on the Feasibility of a World Science Information System – is an area of great current interest for CODATA, and potentially decisive for its future structure and activities. In illustrating the UNISIST concept as it could be applied to the area of science information of con cern to CODATA, Mr. Scott Adams, ICSU Special Assistan for UNISIST, suggested to the Conference that a much close functional relationship between existing numerical data centre and the abstracting and indexing services is both timely an urgent. Although 89 % of the data centres and projects de scribed in the "International Compendium of Numerica Data Projects" depend wholly or in part upon searches of th primary published literature to derive their numerical data there is at present little or no evidence of co-operation with th secondary literature retrieval systems.

The present state of development of the abstracting and index ing services in science and technology is, however, complex their number is estimated by the FID to be of the order o 1300, and their organization, size, function, coverage, an source of support vary widely. Among these services, ther exists a limited number of large computerized abstracting an indexing organizations, representing both the missions of go vernmental and intergovernmental agencies and broad scien tific disciplines. Such systems are generally flexible with regar to international development, either through co-operation (e.g. atomic energy, agriculture) or division of labour (e.g., chem istry, medicine, space sciences); since a computer-based systen seldom remains static, they are interested in expanding th market for their services and products. From this point o view, therefore, the prospects for closer functional relation ships between the data centres and the literature processin services are favourable.

The data centres on their side should review the extent an costs of their current literature search operations, against whic could be estimated the costs and effectiveness of any futur co-operation with the appropriate abstracting and indexin service or services. Factors to be considered in any negotiation are the extent to which current literature coverage can b supplied, or extended, and the possibility of modification o the indexing-abstracting service to alert users to the existenc of significant numerical data within the literature it covers. I order to catalyze such co-operative activities, it would be desir able to arrange an international working conference, involvin for example the member services of the ICSU Abstracting Board, and of CODATA, with the specific objectives of identi fying possibilities of closer co-operation and those problem which inhibit closer co-operation, and of establishing commo task groups to find solutions to these problems. This in effec would be an example of the UNISIST principle at work.

During the course of the Conference, many problems of genera interest to compilers and evaluators from a broad spectrum of scientific disciplines were discussed. Dr. E. Richard Cohen Chairman of the CODATA Task Group on Fundamental Con stants, described the current status of the evaluation of the fundamental constants, and revealed recent advances in preci sion measurement which allow the definition of many funda mental constants with a remarkable precision (see page 20).

The CODATA Task Group on Key Values for Thermo dynamics, under its Chairman Prof. Stig Sunner, met on tw occasions in order to discuss the first tentative set of ke values finalized at an earlier three-day working meeting at th U. K. National Physical Laboratory, and the means for its dis semination to the scientific and technical community (see pag 19). The Task Group also considered its future activities, bot immediate, with respect to a second set of key values fo further key compounds, and long-term, with respect to th entire field of chemical thermodynamics, which would enta an extension of its terms of reference. The ultimate aim of th

Task Group is to create the necessary basis for a true internationalization of future data compilation work in chemical thermodynamics.

The presentation of data in the primary literature, together with sufficient information for its meaningful evaluation, is of growing concern to the compiler, evaluator, and user of the data, and therefore to CODATA. The difficulties inherent in the situation are compounded both by the exponential growth of the scientific literature, and by the increasing use of computers for the generation, derivation, analysis, and reduction of property data. In addition, modern information transfer technology permits, and therefore indirectly encourages, the storage and retrieval of documents of all descriptions from every source. A scientific document may not be "published", with the degree of quality control that this may imply, but may still be available to the potential user through a central depository such as the U.S. Clearinghouse for Federal Scientific and Technical Information (now the National Technical Information Service – NTIS).

This topical problem was subjected to a thorough examination in an open discussion, moderated by Dr. Lewis M. Branscomb, Director of the U.S. National Bureau of Standards, with the assistance of three expert panelists, Dr. R. Norman Jones, National Research Council of Canada, Dr. Olga Kennard, University Chemical Laboratory, Cambridge, U.K., and Prof. Stig Sunner, Thermochemistry Laboratory, Lund University, Sweden.

The consensus of the discussion was that authors, i.e., producers of the data, and editors, referees, and reviewers of the primary literature should adhere to certain criteria in the presentation of data. Experimental results – the absolute values, the quantitative description of both precision and accuracy, and the characterization of the object or circumstances to which the numerical data refer – should be unambiguously defined, so that a qualified observer is able to objectively and independently evaluate the validity of each of the above three elements. The author should describe his results in such a way that more recent information on, for example, input quantities, measurement standards, or numerical coefficients in the theory of the experiment, can be used to revise his original data in a valid manner. If such criteria, stringent by present standards, are to be universally observed, their application in some degree to the increasing quantity of archival data, stored for selective retrieval rather than primary publication, should also be considered.

Another problem emphasised by the participants in the discussion is the required degree of uniformity in data presentation with respect to, e.g., units, constants, terminology, and error treatment. Although some scientific societies and international organizations have made considerable progress regarding standardization, there has to date been little co-ordination of their recommendations and few efforts to establish such standards as part of editorial policy throughout the scientific literature. A need was expressed for a primary "metrological" literature, possibly developed from existing review journals, which could report and compare advances and reliability of measurement techniques. Looking further to the future, the publication of all data produced may become an unacceptable burden on the scientific literature. Whereas at present the data evaluator and data user work in parallel from the same literature sources, the situation can be foreseen where of necessity the evaluator (or the information analysis centre) is placed in series between the original author and the user of his data.

The second day of the Conference, Tuesday 8 September, was entirely devoted to computers, and the computer-based techniques which are now available to assist the data centre in the generation, evaluation, storage, and retrieval of numerical and graphical data. Dr. C. J. Duncan of the Computer Typesetting Research Project, University of Newcastle, U.K., reviewed the current status of computer typesetting equipment and techniques, which are of particular benefit to those data centres already committed to computerized data processing. In spite of their comparatively high cost, such computer-controlled typesetting systems offer considerable advantages where speed, accuracy, and overall control are important, particularly when fully printed output of computer-processed data is required.

The computer storage of large volumes of crystallographic and spectroscopic data and the need for their retrieval in meaningful and useful form have stimulated the development of visual man-machine communication techniques. Dr. R. Norman Jones described the production of graphs as an output medium, as exemplified by the regeneration of various classes of spectroscopic data (e.g., electron spin resonance, neutron magnetic resonance, ultraviolet, infrared). A vivid impression of "computer graphics" was given in a film shown by Dr. Olga Kennard: an interactive computer-controlled cathode-ray display system allows the generation of a two-dimensional representation of complex three-dimensional crystal structures. The system permits specification of the shape and size of the image to be displayed, control of the direction from which it is to be viewed, and formation of composite images from a number of separate picture elements, each capable of individual rotational or translational movement. Although of real benefit to crystallographers, such techniques can be considered only to be in their infancy, since in the foreseeable future the combination of the computer and lasar holography will allow the true three-dimensional representation of complex crystallographic data.

The CODATA Task Group on Computer Use, with the expert assistence of Mr. J. Hilsenrath of the Data Systems Design Group, Office of Standard Reference Data, U.S. National Bureau of Standards, arranged a full programme of computer demonstrations (see page 6) which, in spite of some technical difficulties, gave Conference participants live experience of remote on-line data retrieval and computation.

An example of the computer generation of property data is the "NEL-APPES" system developed at the U. K. National Engineering Laboratory, Scotland, for the estimation of thermodynamic and thermophysical property values of gases and liquids. Using a UNIVAC 1108 (Exec. 8) computer, the optimum combination is selected from a library of over 130 estimation methods to derive the required data, with estimated error, for a wide range of well-defined substances of importance in industrial plant and process design and operation.

The computer identification of infrared spectra was demonstrated by Dr. Duncan S. Erley, Computation Research Laboratory, The Dow Chemical Company, U.S.A. The spectrum of the unknown compound is compared at a rate of 1000 per second with the 92,000 ASTM standards to give the serial numbers of the 20 standards which best fit the input data, and also the data coded for these "hits". The searcher is therefore able to evaluate the "hits", discarding those which are chemically unreasonable. Dr. Gerald G. Johnson, Materials Research Laboratory, Pennsylvania State University, U.S.A., demonstrated a similar comprehensive search and match system for the identification of multi-phase unknown X-ray powder diffraction patterns, against the 18,000 standards in the ASTM Powder Diffraction File.

The increasing use and importance of computerized techniques in the handling of numerical data is evident from the recurrence of this theme throughout the Conference. In the Federal Republic of Germany, the feasibility of a national materials data bank has been studied in detail (see below), while in Sweden, the five million inhabitants of that country are evidently subjected to a remarkable degree of computer control, at least as far as regional and urban planning data are concerned, as reported by Mr. O. Salomonsson of the Central Bureau of Statistics, Stockholm, in his paper on some aspects of geographical data organization. The potential application of computers to the evaluation of numerical data was discussed by Dr. Tangis V. Golashvili of the CODATA Central Office, who emphasised that an essential prerequisite to such techniques is the development of definite criteria for the evaluation of various classes of data.

The more conventional aspects of the critical evaluation of the large volume of neutron nuclear data at present being generated world-wide were covered by Dr. J. J. Schmidt of the International Atomic Energy Agency (IAEA), Vienna, Austria. A paper by I. P. Selinov of the Academy of Sciences of the U.S.S.R., presented to the Conference by Dr. Golashvili, emphasised that compilation and evaluation of nuclear data other than properties of neutrons should be encouraged, for example, properties of isotopes, nuclear spectroscopy, elementary particles, in the development of scientific information centres for nuclear data.

Evidence of the increasingly international nature of data compiling work was given by Dr. Selby Angus, Director of the IUPAC Thermodynamic Tables Project, a programme for the production of internationally agreed values of the thermodynamic properties of fluids of scientific and industrial importance. Tables compiled by expert panels on argon, ethylene, and methane are being prepared for publication. Another successful international co-operative programme in the field of chemical thermodynamics was described by Dr. I. Ansara of the Laboratoire de Thermodynamique et Physico-Chimie Métallurgiques, Grenoble, France. The programme includes the compilation, calculation, and exchange of thermochemical data, using computer techniques, by scientists in France, the Federal Republic of Germany, and the U. K.

On the national level, data compiling projects in Japan, as reported by Dr. Y. Mashiko, Japanese Government Chemical Industrial Research Institute, Tokyo, are now well-established in the fields of infrared data (Infrared Data Committee of Japan), gas chromatography (Gas Chromatographic Data Committee of Japan), nuclear data (Japan Nuclear Data Committee), polarography, and molecular weights of polymers. Many of these projects co-operate actively with other national and international programmes; infrared data, for example, are indexed in the ASTM collection, while nuclear data are submitted to the European Nuclear Energy Agency as part of the international programme sponsored by the IAEA. Prof. I. Eliezer, Tel-Aviv University, revealed that in Israel, one of the new National Members on CODATA, a plan for a national network for scientific and technological information has recently been approved, which will include the many operational data compiling projects in that country. The existing Center of Scientific and Technological Information (COSTI), which is a part of the National Council for Research and Development, will be designated as the National Center for Scientific and Technological Information, and will act as a focus for the development, operation, and co-ordination of the national information network, which will be based as far as possible on information systems already in existence. Where needed, COSTI will encourage and if necessary finance the establishment of additional information services as part of the national network. COSTI will also serve as a national clearinghouse, and as a part of this activity will develop SDI services, and publish data compilations and guides to information sources in Israel and other countries. Other future functions of COSTI include responsibility for standardization, and for active Israeli participation in the appropriate international organizations dealing with scientific and technological information.

An effective means of reviewing the current status, priorities and gaps in particular areas of data compiling work is the organization at the CODATA Conferences of panel and group discussions. On this occasion, a formal panel on transport properties data, comprising two groups covering fluids and solids, was set up under the Chairmanship of Prof. Yeram S. Touloukian, Director of the Thermophysical Properties Research Center, Purdue University, U.S.A. In view of the importance of the deliberations and conclusions of this panel, the Chairman's summary of the discussions, presented to the Conference, is reproduced in full below. During the course of the Conference, more informal group discussions were initiated by Dr. Edward L. Brady, Associate Director for Information Programs of the U.S. National Bureau of Standards, on "CODATA and the UNISIST Project", and by Dr. F. W. Matthews, at present at the Central Information Unit, ICI Ltd., U. K., on "Chemical Notation".

The increasing interest and involvement of CODATA in th types of numerical data, which because of their time- a location-dependence, or dependence upon sample history processing, are not amenable to "critical evaluation", was flected by the presentation of three papers on geographic biological, and geological data, and by the devotion of a co plete morning session to "industrial" data.

Dr. R. W. McIntyre, Rolls Royce Ltd., U. K., discussed t many types of data which must be handled by a large industr organization; these comprise not only data supplied from (ternal sources, but also data generated within the organizatic including the technical specifications of the products to marketed and the many data which are needed for the int mediate stages of designing the products and predicting th performance. Such data may be experimental, for examp property values of raw materials experimentally derived preference to the minimum or "guaranteed" values of t supplier, or calculated to produce new data or data in a fo more convenient for engineers, for example, graphical rat than tabular data, and more recently curve – and surface fits from both tabular and graphical source data. Since the da generated within the organization ultimately appear as technic specifications, which may include proprietary information, g neral external publication of such data is limited, althou "intermediate" data may retain sufficient generality to wa rant publication.

Whereas the scientist engaged in pure research is free to u the most up-to-date or "best" data, his counterpart in indust may be prevented from doing so by the need to follow certa established procedures. Thermochemical data for predicting j engine performance, for example, may be limited by manc tory national standards for aviation kerosene. Such difficulti are compounded in multi-national industrial manufacturi projects, where varying national standards, and usage wi regard to units, nomenclature, etc., are encountered. The rap and wide acceptance of international standards, e. g., the stan ard atmosphere, is of great importance for industry. Areas su as these could with advantage be subjected to the influence CODATA.

The impact of the computer upon data for industry has be great, not least in the areas of data dissemination, where, f example, information on jet engine performance is now oft supplied to the customer in a computer software package, a of data acquisition, where software packages can replace t traditional handbooks as a means of covering, e. g., aerodynam data. Here, the data centres could well assess what proporti of their customers have ready access to computers, and adju their output accordingly, avoiding printed tabular data in bu wherever possible. The best compromise may be a softwa package to generate the data, together with a graphical sur mary of the qualitative behaviour.

Ideally, each large industrial organization should have its ov Committee on Data to monitor the flow of data both into a within the firm. This committee should have close links wi the organization's own technical library, standards, math matical, and computing departments, and also with the l boratories.

The results of a feasibility study on a national materials da bank for the Federal Republic of Germany were reported the Conference by Dr. W. Oberender of the Battelle Institu Frankfurt/Main*. One of the principal results of the stuc based upon interviews with representatives of 74 industr companies in the Federal Republic of Germany, is the defi tion of the functions and scope which such a materials da

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* This report is available on request and free of charge fr the CODATA Central Office.

bank should have. According to the information interest profiles derived from the study, a comprehensive materials data bank is of interest to industry in three main areas: selection of materials; provision of informative data on materials; and as an information base for technological forecasting and research and development planning for structural materials. Information was also gained on the type and number of enquiries to be expected from industry, which made possible an estimate of the required computer storage type and capacity.

Dr. Oberender outlined the general concept of the data bank with respect to screening and documentation of information sources, evaluating and deriving materials data and information, data input, storage and retrieval, and the information service and users.

As a result of the feasibility study, an integrated network of specialized data banks with the comprehensive materials data bank as integrating centre is proposed. The development, i.e., planning, establishment, testing, implementation, and operation, of such a system, together with its operational costs, were further detailed by Dr. Oberender. Its successful realization will require "from the beginning an efficient organizational basis and adequate support of the project by stimulating ideas and financial means, as well as national and international cooperation".

The needs of industry for data on respectively aerodynamic/mechanical/physical, and thermodynamic properties were further detailed by Dr. A. J. Barrett of the U. K. Engineering Sciences Data Unit, and Prof. B. J. Zwolinski, Director, Thermodynamics Research Center, Texas A & M University, U.S.A.

The extent to which geological or biological data can be subjected to "critical evaluation" is dependent upon the type of data considered: Crystallographic data on minerals or organic molecules are reproducible and can be precisely defined, and therefore critically evaluated. Data on mineral occurrence or organic fluid composition, however, are influenced by many variables, including sample history, making effective intercomparison or evaluation difficult. These topics were discussed in detail by Dr. A. Hubaux, representative of the International Union of Geological Sciences (IUGS) on CODATA, and Dr. Raymund L. Zwemer, Office of Biological Handbooks, Federation of American Societies for Experimental Biology (FASEB), U.S.A. Their papers on critically evaluated data in geology and in the biological sciences are reproduced in full below (pages 9 and 11).

The final session of the Conference comprised an open discussion, introduced by Dr. Christoph Schäfer, on the problems of indexing and classification of physical and chemical properties, with particular reference to the indexing of the "International Compendium of Numerical Data Projects". The consensus of opinion was that the principal requirements of any index are simplicity and stability with time.

In closing, it was agreed that all participants should submit to the CODATA Central Office their suggestions and proposals regarding the organization and programme of the 3rd International CODATA Conference to be held in 1972.

CONFERENCE PROGRAMME

MONDAY, 7 September, 1970

Morning Session: Chairman: Sir Gordon SUTHERLAND, Chairman of the British National Data Committee

Chairman's Opening Remarks	
The Progress of CODATA	F. D. ROSSINI, President of CODATA, University of Notre Dame, Notre Dame, Indiana, U.S.A.
CODATA and the UNISIST Project (Joint ICSU – UNESCO Study on the Feasibility of a World Science Information System)	Scott ADAMS, ICSU Special Assistant for UNISIST, National Academy of Sciences, Washington, D.C., U.S.A.
Data Compilation and Evaluation Worldwide – An Analysis of the CODATA "International Compendium of Numerical Data Projects"	M. LEWIS, C. SCHÄFER, CODATA Central Office, Frankfurt/Main, Germany, Fed. Rep.
Problems of Compilation and Evaluation of Property Data of Substances and Materials	T. V. GOLASHVILI, CODATA Central Office, Frankfurt/Main, Germany, Fed. Rep.

Evening Session: Chairman: F. D. ROSSINI, President of CODATA

Evaluation of Fundamental Constants	E. R. COHEN, North American Rockwell Corp., Thousand Oaks, California, U.S.A.
The Improvement of Presentation of Data in the Primary Literature (Open Discussion for all Conferees)	Moderator: L. M. BRANSCOMB, National Bureau of Standards, Washington, D.C., U.S.A.
	Panelists: Olga KENNARD, University Chemical Laboratory, Cambridge, U.K.
	R. N. JONES, National Research Council of Canada, Ottawa, Canada
	S. SUNNER, Thermochemistry Laboratory, University of Lund, Sweden

CONFERENCE PROGRAMME (continued):

TUESDAY, 8 September, 1970

Morning Session: Chairman: Gordon BLACK, Chairman of the CODATA Task Group on Computer Use

Some Aspects of Computerized Typesetting of Importance to Data Centres	C. J. DUNCAN, Computer Typesetting Research Project, T University, Newcastle, U. K.
Visual and Other Non-printed Output Useful to Data Centres	Olga KENNARD, University Chemical Laboratory, Ca bridge, U. K. R. N. JONES, National Research Council of Canada, Ottav Canada
Introductory Remarks on the Evening Computer Demonstrations	G. G. JOHNSON, Materials Research Laboratory, Penns vania State University, Pennsylvania, U.S.A. D. S. ERLEY, Dow Chemical Co., Midland, Michigan, U.S.
Computer Use for Compilation, Storage, and Calculation of Thermochemical Data in an International Co-operative Research Programme	I. ANSARA, Laboratoire de Thermodynamique et Physic Chimie Métallurgiques, Grenoble, France.

Evening Session: Demonstrations of Remote Data Retrieval and Computation

Scientific computation using the MIRFAC language, especially the solution of differential equations with pure mathematical notation. Computer: Cosmos (via scripting typewriter terminal) at the Royal Armament Research and Development Establishment, Fort Halstead, Sevenoaks, Kent, U. K.	H. J. GAWLIK, Computer Branch, R.A.R.D.E., Kent, U.
Computer identification of X-Ray diffraction powder patterns. Computer: Univac 1108 (Exec. 8) at the Univac Computing Corporation, London, U. K.	G. G. JOHNSON, Materials Research Laboratory, Pennsy vania State University, Pennsylvania, U.S.A.
The computer identification of infrared spectra. Computer: IBM 1130 and Burroughs 5500	D. S. ERLEY, Dow Chemical Co., Midland, Michigan, U.S.
A computerized estimation service (NEL-APPES) to provide physical property data for gases and liquids for plant and process design and operation. Computer: Univac 1108 (Exec. 8) at the National Engineering Laboratory, East Kilbride, Scotland, U.K.	A. A. MILNE, Properties of Fluids Division, National E gineering Laboratory, East Kilbride, Scotland, U.K.
A conversational system for retrieving data on intermolecular potentials. Computer: I.C.L. 1907 at the Computation Laboratory, Queen's University, Belfast, Northern Ireland, U.K.	F. J. SMITH, Computer Services, Queen's University, Belfas Northern Ireland, U.K.
Prototype NSRDS data files and associated programmes written in XBASIC and on-line numerical and statistical analysis using Omnitab. Computer: Univac 1108 (Exec. 8) at the University of Rome and at Univac Central European Group in Rome, Italy	J. HILSENRATH, National Bureau of Standards, Washingto D.C., U.S.A.
A demonstration of a computer terminal capable of transmitting to, and receiving from a computer, scientific text and data with full notational complexity required in mathematical, spectroscopic and chemical literature. Applications will be shown to data storage and retrieval and to computer-assisted typesetting of text and tables of data	H. E. WEIR, Teletype Corporation, Skokie, Illinois, U.S.A.

WEDNESDAY, 9 September, 1970

Morning Session: Chairman: B. VODAR, Vice-President of CODATA

Basic Principles to be Observed in Preparing Evaluated Data for Use in Industry	A. J. BARRETT, Engineering Sciences Data Unit, The Royal Aeronautical Society, London, U.K.
Results of a Feasibility Study for a National Materials Data Bank of the Federal Republic of Germany	W. OBERENDER, Battelle Institute, Frankfurt/Main, Germany, Fed. Rep.
Selected Thermodynamic Data on Organic Substances for the Petrochemical and Chemical Industries	B. ZWOLINSKI, Thermodynamics Research Center, Texas A & M University, College Station, Texas, U.S.A.
Some Aspects of Data in a Large Industrial Organization	R. W. McINTYRE, Rolls Royce Ltd., Bristol, U.K.

Evening Session: Chairman: M. A. STYRIKOVICH, Member of the Bureau of CODATA

Development of Scientific Information Centres for Nuclear Data	I. P. SELINOV, Academy of Sciences of the U.S.S.R., Moscow, U.S.S.R. (presented by T. V. Golashvili, CODATA Central Office)
Aspects of Critical Evaluation of Nuclear Data Information	J. J. SCHMIDT, International Atomic Energy Agency, Vienna, Austria
Data Compilation Activities in Japan – Infrared Chromatography, Gas Chromatography, Polarography, Molecular Weights of Polymers, Nuclear Data	Y. MASHIKO, Japanese Government Chemical Industrial Research Institute, Tokyo, Japan

THURSDAY, 10 September, 1970

Morning Session: Chairman: Guy WADDINGTON, Co-opted Member of CODATA

International Network for Generating, Collecting and Evaluating Thermodynamic Data, illustrated by the IUPAC Thermodynamic Tables Project	S. ANGUS, IUPAC Thermodynamic Tables Project Centre, Imperial College, London, U.K.
Summary of Wednesday Afternoon Panel Discussions on Transport Properties Data	Y. S. TOULOUKIAN, Thermophysical Properties Research Center, Purdue University, West Lafayette, Indiana, U.S.A.
Some Problems in Geographical Data Organization	O. SALOMONSSON, Centralnämnden för Fastighetsdata, Sundbyberg, Sweden
Are there Critically Evaluated Data in Geology?	A. HUBAUX, EURATOM, Ispra, Italy

Afternoon Session: Chairman: W. KLEMM, Secretary-Treasurer of CODATA

Critically Evaluated Data in the Biological Sciences	R. ZWEMER, Federation of American Societies for Experimental Biology, Bethesda, Maryland, U.S.A.
How Critically Should Data Be Evaluated? Some Examples from the Experience of a User	I. ELIEZER, Institute of Chemistry, Tel-Aviv University, Tel-Aviv, Israel
Problems of Indexing and Classification of Physical Properties	C. SCHÄFER, CODATA Central Office, Frankfurt/Main, Germany, Fed. Rep.
Discussion of the Programme of the Third International CODATA Conference	ALL CONFEREES
Evening:	Conference Dinner

REPORT OF PANEL DISCUSSION ON THE STATE OF TRANSPORT PROPERTIES DAT

Y. S. TOULOUKIAN, CHAIRMAN

BACKGROUND REMARKS

Transport (or non-equilibrium) properties are considered distinctly separately from thermodynamic (or equilibrium) properties to the extent that they differ in the fundamental treatment of the integral differential equations describing them. Because of both the theoretical and experimental difficulties in the prediction and measurement of these properties, I believe one can state that our knowledge of these important properties is one order of magnitude less than equilibrium thermodynamic properties. I am, therefore, personally grateful to the Programme Committee of the Second International CODATA Conference for the opportunity we have had to get together and discuss mutual problems in the transport properties data and to present the somewhat unique peculiarities of this field which are not present in thermodynamics in general.

Before embarking on the summary of the deliberations of the panels yesterday afternoon, I wish to take this opportunity to define carefully the usage of certain terms which have been used earlier in this Conference either without definition or with inferences which differ from those I shall use hereafter.

1. Critical Analysis

In the sense used in these deliberations, the term "Critical Analysis" implies that a body of data has been critically reviewed and evaluated by individual experts in the field, having a significant degree of sophistication. As a result of such close scrutiny of the data, one normally arrives at a set of recommended values which are considered as the "most probable" value of the property at a given time; reserving the privilege of changing the recommendations at a future date based on newer data and/or improved state of knowledge. While "critical analysis" always does set a level of confidence for the recommended values, there is *no* implication whatsoever of high accuracy or precision of the recommended values.

2. Scope of the Literature

First, I wish to clearly distinguish that the problem facing science and technology is not one of *information explosion*, but *document explosion*. Documents may contain information and at times they may even contain correct information. Some colleagues have contested the assessment that there has even been a document explosion, referring to the substantiated evidence that documents only double in magnitude approximately every eight years. I wish to suggest, however, that this is only the visible part of the iceberg as impressive as it is. What is even more shattering is the fact that aside from sheer physical volume, today's literature is more complex in character; papers in 1970 contain at least one order of magnitude more numerical data than those in 1940, due to laboratory electronic instrumentation operating in the automated mode. Furthermore, the accessibility of the literature is much more diffused, its cost constantly increases, and the language barrier remains to be a formidable one in spite of major efforts at translations. As a result of these factors and several others having to do with the presentation of numerical data, I wish to suggest that the literature numerical data effort in science and technology is effectively increasing at a rate of nearly one order of magnitude every decade and not simply doubling as bibliographic statistics would seem to indicate.

3. Synthesis of Knowledge (the role of the computer)

In the field of transport properties data we have no illusion that we can find the answers to the problems cited above in the almighty computer. While at best the computer gives us a hope for possible solutions to a number of these problems, it cannot eliminate the requirements of the "man-machine" ir facing. Note that the important part in this term is the and not the *machine*. For the future, the answer to knov what it is that we know rests in the further developmen specialized information analysis centres (IAC) of excelle to perform the functions of the synthesis of knowledge. Th fore, the specialized IAC is a technical institute and nc mechanized technical library. I wish to conceive therefore at its best the specialized IAC interposes itself as a filter tween the flood of diffused information of high noise l and the ultimate user of this information, the engineer scientist. The effectiveness of such a centre is measured, th fore, by its ability to increase the signal-to-noise-ratio in published information, as well as the range of the band-w of the spectrum it covers. Data synthesis truly creates new kn ledge feeding itself on the fragments of conflicting knowle thus making contributions of original information of lc level of entropy than what is commonly reported to be *orig research*. The thermodynamic explanation, of course, is fo in the negative entropy provided by the synthesizer or ana

4. The Quality of Information

On numerous occasions I have amply documented that tl exists a great discord among reputedly authoritative inde dent sources of data. The conditions and causes contribu to such conflict of information are many and were discu to some extent during our deliberations of yesterday aftern and I will touch upon them shortly. However, before I b my report I must point a finger to every author reminding that he is not only a contributor to the explosion of the lit ture, but also is a potential polluter of scientific and tech knowledge. The term "pollution" as used in this context i deed uniquely descriptive of the state we find ourselve when we examine the numerical data on transport proper

SUMMARY OF PANEL DISCUSSIONS

A panel discussion was organized for Wednesday aftern September 9, to deliberate on the state of numerical dat transport properties of materials (excluding biological stances). Twenty-four attended the discussions and of t present at least fifteen participated actively. Considering fact that the Second CODATA Conference did not prim represent specialists in the transport properties area suc attendance serves as an indication of the interest in and portance of the topic. While a tentative agenda was prep for the discussion it was not possible to cover all subject a For effectiveness of the discussions, those present condu their deliberations in two separate groups; namely, on fl and solids, under the leadership of D. T. Jamieson and R. man, respectively, with J. R. Sutton and R. E. Taylor ser as recording secretaries. The major points discussed wer follows:

1. State of the theory, its adequacy, and the need for sele new data of high accuracy for further advances.

2. The dire need of well-characterized standard reference terials whose properties are well-established. (In this con tion, I would point out that the International Union of and Applied Chemistry (IUPAC)* recommends only five ganic liquids as standards for thermal conductivity only 45°C temperature range in the extreme case. The one-hal cent accuracy assignment is also contested).

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* IUPAC Information Bulletin Appendix No. 2, Dece 1969, *Catalog of Physicochemical Standard Substances*, Commission on Physicochemical Measurements and dards (Chairman: D. R. Stull), Division of Physical mistry, IUPAC.

In the case of liquids, the problem of thermal radiation exchange was discussed at some length primarily relative to recent results communicated by Dr. Poltz from the Physikalisch-Technische Bundesanstalt (PTB), Braunschweig, Federal Republic of Germany. These results, while still debatable, cast doubt on the suitability of toluene as a reference liquid.

The possibility of selecting fluids for secondary industrial standards was also mentioned. It was recognized that while all these considerations did directly influence the analysis of data, they would be outside the prime charter of CODATA as presently interpreted and, therefore, these discussions were not elaborated.

3. The urgent need for the determination of the causes for the excessive discord in data was stressed. It was felt that a critical examination and assessment of the major techniques in current use is urgently needed, as they are cluttering the literature with new results which further confuse the picture. While it was strongly felt that the analysis of techniques is very much in the domain of the IAC's, the discussion was not pursued to any greater length because the subject once again was considered to be somewhat outside the domain of CODATA as presently conceived. A means must be found within CODATA to accommodate discussion on and full consideration of experimental techniques which are so closely related to the data of science and technology.

4. Special peculiarities to be resolved in both fluids and solids were brought up and stressed. For the case of non-metallic solids the necessity of specimen size and geometry specification with the test results (in addition to other characterization parameters) was pointed out as necessary for low temperatures even as high as 100 to 150 K.

In the case of liquid metals, if recent results on thermal conductivity are confirmed, it will require a modification in the present theory.

The degree of adequacy of the data on the viscosity and thermal conductivity of water substance was briefly discussed.

5. Towards the end of the discussion, those present felt the need for pursuing further, and on a continuing basis, exploration of those aspects of the discussion which clearly fall within the domain of CODATA. A resolution to establish a CODATA Task Group on Transport Properties will therefore be submitted formally to the CODATA Bureau no later than January, 1971.

Panel on Solids

R. Berin
R. Berman
S. Bertoletti
W. Klemm
J. F. Masi
H. Ootuka
R. E. Taylor
Y. S. Touloukian
H. J. White

Panel on Fluids

S. Angus
C. F. Beaton
E. Bretnütz
E. A. Bruges
R. Creuse
D. T. Jamieson
A. A. Milne
G. Ostertag
J. F. T. Pittman
R. W. Powell
P. Rathbone
M. Schönberg
J. R. Sutton
B. Vodar

ARE THERE CRITICALLY EVALUATED DATA IN GEOLOGY?

A. HUBAUX

EURATOM, Ispra, Italy

The main object of the present talk, which is intended for physicists, chemists, and, in general, scientists accustomed to the study of properties of matter, will be to analyze the differences between geological data and data about pure substances. Before attempting to answer the title question, the first question which should be answered is: "What are geological data?".

The major aim of geology is to reconstruct the history of the Earth's crust. While astronomy deals with enormous distances, geology is the science of very long periods of time. Geology, hand-in-hand with paleontology and geochronology, endeavours to reconstruct events of the remote past from the imperfect and limited records contained in rocks accessible at the surface. The only records we possess of the past, apart from the comparatively short historical period (which at best goes back some 6,000 years), are contained in rocks. This research has a profound bearing on such philosophical problems as the origin of Man, the origin of Life, the origin of the Earth and the origin of the Universe. Geology, of course, also has important economic aspects; we depend on it for all our mineral resources, including ground water. Lastly, our hopes to diminish the dangers presented by such hazards as earthquakes, landslides, floods, ruptures of dams, etc., lie to a great extent in a better knowledge of geological phenomena.

Geology then, studies the rocks upon which we live and from which come our mineral resources. The basis of all geological research is observation and measurement of these rocks. If you have looked through the CODATA *International Compendium of Numerical Data Projects**, you will have observed that there is almost no mention of data on rocks, whereas tables and books on mineralogical properties are cited.

Why, then, are there critically evaluated data on minerals and not on rocks? I suppose the majority of specialists present here are more-or-less familiar with the types of studies which are made on minerals. As is well known, the variation with composition of the physical properties of minerals (especially the optical properties) is the object of intensive research, as is also the study of the crystallographic structure. Let us now look at what happens when we change our interest from minerals to rocks, and see why minerals may be regarded as substances, while rocks, paradoxically, are not substances. Substances will be considered here as homogeneous compounds possessing well-defined properties, with the important quality that these properties do not depend on time and place, but remain constant at any point of the Earth.

* *International Compendium of Numerical Data Projects*, produced by CODATA, Springer-Verlag, Berlin, Heidelberg, New York, 1969, xxiii + 295 pp.

Minerals, which are crystalline phases occurring in nature, certainly are substances in this sense. But what are rocks? Just like forests are formed by trees of different species set side-by-side, rocks are formed by crystals of different mineral species, and in most rocks these crystals may be seen under the optical microscope. The list of the different species of tree, together with their relative abundances, is one of the major characteristics of a forest. Likewise, a rock is characterized by the relative abundance of the mineral species of which it is composed. A rock must therefore be seen as an assemblage of several mineral species, arranged in crystals of different lengths, and with a definite structure and texture.

The number of mineral species is finite. Since this is an important point, let us look at this fact in another manner. It may also be stated that species of tree and species of mineral are discrete, e.g., there is no chain of intermediary types to be found between quartz and pyrite. It is therefore meaningful and useful to study the properties of a given mineral species, independently of its location and independently of its possible genesis.

Rocks, on the contrary, are not discrete. Between any two types of rock even if very different or very far apart, for example, granite and limestone, it is always possible to find a complete chain of intermediary types. The chain is complete in the sense that, between any two links of the chain, it is possible to find a set of intermediary rocks. In other words, rock types form a continuum**. Therefore, the notion of species does not strictly apply to rocks. Another consequence is that, contrary to minerals, a complete description of the composition and properties of a rock specimen, without reference to its location, is useless. As an illustration, let us suppose that someone would measure, with the greatest possible accuracy, the specific gravity of a block of granite of unknown origin. His result would be useless to geologists, because they would not know to what entity this result applies. Certainly not to granite in general, because there is a whole range of granites with varying densities.

A specimen of a mineral, therefore, represents a certain mineral species with a specific composition and arrangement of atoms; it represents a homogeneous substance. A rock specimen, however, represents quite another thing; it represents a bit of the Earth's crust.

While mineralogical observations do not depend on time and place, geological observations are directly connected to the place where the observations are made. In other words, geological data are *environmental* data.

This difference between minerals and rocks, the first being substances and the others not, has important and far-reaching consequences. The most immediately visible result concerns their classification and description. The classification of minerals is based on chemical composition: sulphides, oxides, alumino-silicates, etc., and on crystallographic structures. For rocks, on the other hand, the three broad classes, sedimentary, eruptive, and metamorphic, are based on origin instead of composition. Furthermore, all rock names imply a certain mode of formation of the rocks. It would be theoretically possible to describe a rock by completely objective criteria without naming it, but in practice this is never done. It must also be added that the classification of other geological objects such as ore deposits, faults, types of intrusion, are similarly based on genetical concepts. In the description of the geology of a region, a geologist also makes constant use of what he thinks is the most probable geological history of that region.

One may wonder why this reference to origin is so frequent in geology. I see two reasons. First, to reconstruct the succession of events is, as we have seen, one of the major aims of geology, and it is also intellectually satisfying to be able to make partial reconstructions of a bit of the Earth's crust. How this interweaving of facts and hypotheses in what shoul objective descriptions offers several disadvantages. Other logists, working in other parts of the world and using description, have to disentangle facts from hypotheses, an reconstruct what the descriptor geologist actually saw. So vious is this hindrance to the communication of geological servations that there must be another reason for this con use of origin connotation in the descriptions.

This other reason, as I see it, is that in geology, most objec be described have hazy outlines. This lack of sharpness reg both the material object to be described (such as a litholo formation, a fault, an ore body, etc.), and also the categ of objects, i.e., the divisions of the classification, and h the names given to these categories. For instance, in the f one rock very often grades progressively into a rock of anc composition; furthermore, as we have already seen, the di ent categories of rock grade into each other. Consequer to give the description in genetic terms is usually much qui than to give a completely objective description of the fiel be studied.

The emphasis in mineralogy, therefore, has been on the desc tive side, and mineralogists have acquired an analytical m In geology, however, emphasis has from the very begin been put on the possible origin and on the reconstructio the chronology of events which rocks of a given region h undergone; geologists then have acquired a synthetical m It is said that shepherds of goats have a very different s from shepherds of sheep. Their minds are influenced by object of their cares. Likewise, there exists a marked differ between the characters of mineralogists and geologists. first are generally much quieter and more ready to collabo in a common research project, because their science requ it. Geologists, on the other hand, have been described as "i and rugged individualists". This was especially true in the p when pioneers were the first to describe the geology of a re and to see order and reason, where until their arrival c hazard seemed to prevail. The times, however, are chang and the geologists of today are much more ready to collabor as it is increasingly realized that the Earth's crust must be c sidered as a whole, and that the best explanation of obser facts cannot be derived only from the isolated study of region, because each region contains only a few pieces of puzzle. One individual will be able to see only a very small of the Earth's crust during his professional life; but it is Earth's crust as a whole and as a unique object which n eventually be studied.

To give just one example, it has only recently been reali that the Appalachian-Caledonian orogenic belt (now know Eastern United States and Great Britain) was formed a single mountain chain which has been rifted apart with opening of the Atlantic. Segments on opposite sides of the oc were once adjacent. Only a fully integrated approach can mount the confusion created by the present dislocation of belt. It may be safely predicted that this change of viewp from the local to the global, brought about in part by the n theory of sea floor spreading, will eventually transform geological methods of research, and yield, as a prerequisit this new approach, a considerable improvement in the p sentation of geological information and data.

If we now try to sum up our brief review of the main cha teristics of geological data, we may say that, with the excep of data on mineralogical properties, geological data are envir mental data, containing a high proportion of genetical conce

To return to the title question: "Are there critically evalua data in geology?", it should now be abundantly clear why th are not and cannot be at the present time, many critic evaluated geological data, if by "critically evaluated" is me measurements which are repeatedly checked by specialists wo ing with an ever-increasing precision in different parts of world. If, however, the expression is intended as meaning most accurate and significant data which may be obtained

** A. Hubaux, Description of Geological Objects, *Mathematical Geology* 2 [1], 89 (1970).

the present time, then of course there are a lot of critically evaluated data in geology, which for the most part are presented as geological maps. Maps covering large regions or whole continents, and which are produced under the sponsorship of the International Union of Geological Sciences (IUGS) Commission for the Geological Map of the World, must be mentioned here. Many kinds of small scale map, showing the general geology, the Quaternary, the hydrology, the metamorphism, the tectonics, the distribution of ore-bodies, etc., have been published within the past few years or are in preparation. For all these maps, specialists of the interested countries meet regularly and discuss the most pertinent way of representing the actual state of knowledge.

It is perhaps also worth while to recall here that geologists are frequent users of critically evaluated data; chemical and thermodynamic data are widely used in geological computations and models. Some geological specimens have served as standards. For instance, several rocks have been especially prepared and thoroughly homogenized to serve as chemical standards for the analysis of rocks and for comparison between chemical laboratories. Such standards have had and still have a useful role in geological research, but they serve mainly to standardize chemical methods of analysis and are hence more chemical standards than geological standards.

Through the sponsorship of the International Union of Geological Sciences, several projects of standardization are currently underway. One of the most important is the choice of stratotypes, where well-chosen outcrops, representative of well-defined points in the history of the Earth, are to be agreed upon. For instance, in the IUGS Commission on Stratigraphy there exists a Committee on the Silurian-Devonian boundary. This Committee is presently studying two preliminary submissions, one for the Barrandian area of Czechoslovakia, and the other for the Northern Yukon of Canada. The Committee will eventually decide which exact part of a carefully chosen outcrop will be earmarked as the agreed limit between the two periods. It must also be mentioned that IUGS has recently created a Committee on Storage, Automatic Processing and Retrieval of Geological Data (COGEODATA), whose aim is to foster the exchange of data on an international level. As mentioned above, however, these efforts bear only a small relation to the critical evaluation of data in physics or chemistry.

Let us conclude by looking at the practical consequences that these characteristics of geological data bring to the relationship between CODATA and the International Union of Geological Sciences. We have seen that the interests of geologists for critically evaluated data on substances is only marginal. The main stream of geological research is concerned with a better knowledge of our environment.

Geology, of course, is not the sole environmental science; meteorology, biology, oceanography, pedology, geochemistry, and geophysics are also concerned with the study of different aspects of the world around us. The volume of the international exchange of these environmental data will increase at a steady rate. The problems involved in this data exchange are in part specific to each science, but also have many facets in common. There is therefore a need for international and interdisciplinary co-ordination of environmental data activities similar to that which CODATA is at present promoting for data on substances. The aims would be to collect information on environmental data exchange on an international level, to form a clearing-house where information on formats, input sheets, retrieval programmes, etc., could be concentrated, and to organize meetings and working groups through which common problems could be studied and appropriate decisions taken.

Although probably not all geologists would agree, I would say that our geological knowledge of the Earth is not much more advanced than the geographical knowledge of the Earth at the time of Magellan. Geology is still in a phase of growth, and that is why this young science offers such a challenge to imaginative researchers. Geology is now passing through a real scientific revolution, brought about by an impressive series of discoveries made by the study of the ocean's floor, by much closer collaboration with geophysicists, and by the use of computers for building mathematical models, processing large amounts of data, etc. The next step will be the generalization of the passage from the local to the global, which will be enhanced in part by satellite photography. International co-operation, through which the exchange of data could be effected, would materially facilitate this progress.

CRITICALLY EVALUATED DATA IN THE BIOLOGICAL SCIENCES

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Introduction

The parameters of biology can be set to extend from living material derived from a single cell or from living particles smaller than a cell on up to the most complicated organism, thinking man. The simplest numerical data would be the values which represent physical or chemical properties of material derived from living things. At the other extreme, we have the complex organization and behaviour of living things having a brain with a choice of decision. Somewhere in the range of increasing complexity, with multiple variables, there will come a point at which values will become meaningless, because of the inability to reproduce them at another point in time. Thus, the speed of reaction or the time factor must always be taken into consideration in dealing with a living organism, as well as with material derived from living things.

The word "critical" has been defined as: "Exercising or involving careful judgment or judicious evaluation". By extension, critical data would be those numerical values generated by observation and measurement which, after publication in the original literature, are *resubjected* to review and evaluation. Ultimately, they would be selected by expert scientific appraisers as the most reliable data available in a specialized area. By using the word "resubjected", we imply that numerical values have already been reviewed and evaluated. In other words, we assume that the scientist generating the data is an individual highly trained in the scientific method and is capable of accurate observation and careful recording of experimental results. Before his paper is submitted for publication, he must check and recheck his values many times to be sure that they are correct. Before the author's data get into the literature, they are usually reviewed for the journal by one or more experts of high repute in the field in which the paper has been prepared. Therefore, in the steps that move the data from the laboratory into the literature, they have been reviewed and evaluated by the author, and by one or more referees; then in order to qualify as critical data the findings must be resubjected to review and evaluation prior to selection by the scientific appraisers.

Evaluation Procedures

By taking you through the steps involved in the production of tables of reference data prepared for the Biological Handbooks Series, we can best explain one of the methods for retrieving scattered information from diverse sources for the purpose of recasting data into an organized, uniform tabulation.

When a request for a table is mailed to a prospective contributor, guidelines for preparation of the material are enclosed for his use. The accuracy and precision characteristic of much of the numerical data appearing in the literature of the physical sciences is not so typical of values in the biological sciences. The differences are inherent in living as opposed to non-living subject matter. In the life sciences, measurements are not only affected by known variables, but by unknown as well. Therefore, mean values should always be qualified by the standard deviation, the standard error, or the range of variation. When a variable has been purposely introduced, such as a drug, a decrease in temperature, or an increase in acceleration, then a control value must be given as a basis for comparison.

To provide the scientist-user of critical biological data with sufficient information to account for species variation, it is necessary that the scientific name of the organism be included. Variation from species to species may be so great that though all other criteria meet the highest standards of scientific measurement, the reliability of the data becomes suspect if the experimental organism is simply listed as "frog", or "beetle", or "fern". This is a common fault of the older literature, but unfortunately it occurs all too often even today. In some cases the genetic strain within a species must also be given.

Other important criteria for judging the reliability of a value are the number of subjects, as well as the number of determinations, and pertinent information about the subject, such as age, sex, and size. Experimental conditions should be included – for example, if the subject was a vertebrate, was it resting or exercising, anesthetized or unanesthetized, standing or prone; if it was an invertebrate, what was the stage of development, pH and salinity of the medium, the environmental temperature; and if it was a plant, what was the soil pH, the water availability, the plot spacing? Any environmental conditions which produce significant differences in values should be listed and the method of determination must be given.

It is extremely important that the user of the data be able to refer to the original article from which the value was obtained. Therefore, it is absolutely necessary that the contributor be asked to provide literature citations for the data. Life scientists are completely justified in rejecting information for which the sources are not provided.

After a table is received in the Office of Biological Handbooks, a biologist trained as a data analyst recasts the table in a format designed to juxtapose related information for maximum utility by the subsequent user. In so doing the analyst is able to recognize values which are out of line with other values in the same table, means outside a range of variation, or misplacement of the decimal point in a fraction. Mistakes are also frequently noted by the editor, the director, the proofreaders, and at times even the compositors who prepare the manuscript copy. The references are checked for accuracy by the bibliographer.

Once a first draft of the table is prepared, a copy is submitted to the contributor for his approval or possible alteration. Questions about the values, the variables, or any other aspect of the material in the table are submitted to the contributor for his resolution. First drafts are also sent to at least four other specialists in the same field who are requested to check for inaccuracies, inadequacies, omissions, and to supply or substitute new data as required. You may ask, why four reviewers? Why not two or six? From experience we have concluded that the reviewers fall into a Mendelian ratio of 1:2:1.

On the average, one of four reviewers will never find fault with a table; he assures us that he has checked the original literature, and to the best of his knowledge all of the data are absolutely correct. Half of our reviewers will usually find that more reliable values exist, and will suggest that they be substituted; they will note some minor errors and assure us that after these changes have been made, the table will represent the best information available. Finally, there will be one reviewer who is extremely critical; he will provide newer and more reliable values for many of the items. He will submit detailed comments on why the table as originally constituted can be improved, and will frequently provide a far better table than the one first contributed. Therefore, four appraisers seem better than two, and six are more than required if the practical aspects of production and publication are to be considered. After all reviews are received, the original contributor is afforded an opportunity to examine the comments of his colleagues. Almost without exception the table is improved as a result of this review process.

Based on a consensus of the contributor and reviewers, a second and usually a final draft of the table is prepared. However, if certain values are still in doubt, the table may be returned once again to the same scientists or additional authorities for appraisal before a third draft is prepared. As you can see, the table has now undergone scrutiny by four individuals in the Handbooks Office and evaluation by four independent, scientific experts. The above procedure has been designed to assure maximum efficiency and accuracy in the selection of numerical data for use by scientists in need of such information.

It would be ridiculous to tell you that every item in the Biological Handbooks Series has undergone the critical examination and review outlined above. We are aware that some contributors and some appraisers do a far better job than others. We are also aware that depending upon the subject matter, some information is far more reliable than other information. However, we are striving to achieve the standards outlined.

There are those who would argue that until the level of criticality has reached an absolute standard of accuracy, such compilations should not be attempted. Still others argue that the preparation of tables of critical data takes a great deal of time, effort, and money. And this is true! But these arguments become inconsequential when we consider the day-to-day needs of the working scientist for tables of values which will serve his requirements. It is no longer possible for each scientist to review and appraise all the numerical data in his field of interest appearing in original papers in the literature. Generally the data would be difficult to locate among the millions of papers in technical journals and among the hundreds of thousands of books, monographs, and special reports. Many precious hours and days would be consumed searching indexes, abstracts, and papers, and even after the data are located, the user must frequently make a choice from conflicting values for a physical property, constituent, or function. Surely the expert scientist with specialized knowledge of the material being evaluated is best qualified to derive from the detailed context of all the measurements that value which is most reliable and is most likely to be nearest the true value.

Dr. Frederick D. Rossini, President of CODATA, and a prime mover in the quantitative scientific information field, has summarized the data communication process in four steps:

1) the generation and publication of the data by the original investigator;
2) the collection, calculation, analysis and correlation of the data, and the compilation of critical tables of standard reference data;
3) the dissemination of these critical tables in appropriate form; and,
4) the use of the tables by the scientific and technical community.

In fulfilling the important second step in this process, we must always strive to perfect the level of scrutiny and analysis in the preparation of tables of data rather than wait for that limitless future in which all values will be absolute. Editors of biological journals, together with referees, can assist in assuring higher quality in the data which goes into the original literature. They can insist that the author include the Latin name when an organism is simply identified as "monkey", or "fly", or "bean". They can check to see that essential information about the subject is provided, as well as the pertinent environmental conditions. They can question values unqualified by a standard deviation or a range of variation.

In the physical sciences the work of assembling selected values of properties into some useful form is already being aided and expedited by automation. In the near future, automation will have its impact on the compilation of critical data in the biological sciences. Therefore, it becomes most important that biology editors adopt the international standards agreed upon for units of measurement, terminology, abbreviations, symbols, and approved constants.

We must rely upon a specialist, a person of mature experience in an area of biology whose judgment is respected by other experts, to evaluate and select critical data. Editors can help provide him with information of higher quality at the source through their influence on authors and referees. Then the scientific users of reference data, whether in educational institutions, government agencies, or private industry, can pursue their objectives, secure in the knowledge that they have at their disposal the essential existing numerical data in the literature reduced to some usable form of critical, reference data.

Published Data Books

The Biological Handbooks Series of reference volumes in various fields of biology was initiated 21 years ago within the United States National Academy of Sciences-National Research Council. In 1959, the project was transferred to the Federation of American Societies for Experimental Biology (FASEB). Since that time, the FASEB Office of Biological Handbooks has prepared five reference volumes and is currently engaged in completing a sixth. Together they represent more than 4,000 pages of tables, diagrams, charts and nomograms, supported by more than 30,000 literature citations.

The *Biology Data Book* (1964), which was designed for persons at all levels of biology, has the widest range of biological material. The expert research worker will find authoritative material in fields outside his speciality with complete references so that he can get the detailed information he may desire. The beginning student of biology will also be able to find simple materials such as life spans or pathways of metabolism for plants and animals commonly used for study in schools and universities. It represents a general data book derived in part from the specialized books described below. A revision of this book has been initiated which is expected to be ready for publication in the autumn of 1972.

Environmental Biology (1966) is closely related to the concept that this planet Earth is in reality a space vehicle with a recycling life support system. This life support system has been altered on occasion, making it more favourable to different forms of life. At one time, it supported tremendous plant growth, at another the development of enormous reptilian forms. Currently it is supporting a rapid expansion of the human race. In the milieu of this space vehicle, a living entity, be it virus, tree or man, is being influenced constantly by the environment. The contact can be with liquid ocean, lake and river, gaseous atmosphere, the solid earth, or in more recent experience, space. Each of these is in a state of change, and the changes are of great importance to living things. Environmental biology can, therefore, be interpreted as including a wide variety of external factors. A data book must, of course, exclude those conditions or changes for which insufficient scientific data have been collected. Other environmental conditions which were excluded from this book were those that were rare, catastrophic or extremely pathologic, and thus not within the limitations of normal biological experience.

In contrast, changes due to products produced by mankind in the course of development of urbanization and industry have been included, since these are now a definite part of our environment. Not only man, but other flying, walking, crawling, and swimming creatures, as well as growing plants, must live, grow, and reproduce in this changing milieu of earth, air, and water. The effects of temperature, radiant energy, sound, vibration, impact, acceleration and gravity are all represented by numerical data in this book.

Growth, Including Reproduction and Morphological Development (1962) presents comprehensive data on various aspects of normal growth, specifically compiled for reference purposes, and critically evaluated. It ranges from chromosome numbers and linkage groups through cell volumes, tissue growth, hypertrophy, regeneration, and tissue culture. Reproduction in all forms of life, prenatal and postnatal vertebrate development, comparative morphology, sex ratios and life spans are all considered. This book, like the two previously described, is so wide-ranging that it represents all degrees of numerical exactitude.

Metabolism (1968) is made up in large part of biochemical data, except for the sections on animal energy exchange and on plant metabolism, which are non-chemical. This comes from the fact that all chemical processes that are constantly taking place in living organisms are included under the term "metabolism". In some cases, energy is used to convert simple substances into more complex tissue and cell components, anabolism, and at the same time complex substances are being changed to simple ones, often with the release of energy, catabolism. The composition of materials taken into the plant or animal, the ways in which these nutritional materials become part of the organism ,the energy exchange, and metabolic end-products are dealt with in various sections of this data book. Some tables show how too much or too little of some apparently minor component may profoundly influence a life process. Metabolic pathways with intermediate products are diagrammed to show as clearly as possible the multiple steps that may occur in several ways and over very short periods of time.

Blood and Other Body Fluids (1961) is another volume that includes a great deal of biochemical material. Physical properties and general chemical components of blood have been determined. These include electrolytes, nitrogenous substances, lipids, carbohydrates, miscellaneous organic acids, vitamins, hormones, and enzymes. In addition, there are analyses of cerebro-spinal fluid, fluids of body cavities, digestive and reproductive secretions, milk, skin secretions, and fluids of the ear and eye. Data are given not only for man but also for domestic and laboratory animals, and some birds and reptiles. Information about the hemolymph of insects, crustaceans and mollusks is included, as well as an interesting section about water excretion by aquatic amphibians and fishes.

Respiration and Circulation (January 1971) deals primarily with oxygen and the way it is brought from the atmosphere or the liquid environment to the point at which it can be used for energy production. With oxidation, there are by-products which must then be either further utilized or rejected. In a multicellular organism there must be some form of liquid circulation. This ranges from a simple pumping of fluid in and out of a sac, to the complex circulatory system with the heart pump and the varieties of conducting vessels found in the higher mammals. Consideration is also given to mechanisms by which the internal environment is maintained within remarkably close limits (homeostasis). A great deal of critically evaluated numerical information will be found in this newest volume.

Forty-five years ago, an ambitious project for biology began with the publication in Germany of the first volume of *Tabulae Biologicae* (1925). It was considered a new literary aid developed in response to a practical need by the biological investigator

requiring data in a field peripheral to his own. The objective of this compilation was to produce a physical, chemical, immunological, zoological, and botanical handbook. The foreword to the first volume says, "What we hope to offer is none other than a Landolt-Börnstein of the whole of biology". The project flourished until 1963, and in the 38 years of its existence 22 volumes of *Tabulae Biologicae* were produced.

Another useful compilation is the *Atlas of Protein Sequence and Structure* which contains extensive information of increasing significance for evolutionary biology and taxonomy, as well as for biochemistry. It is interesting to note, as an indication of the rapid growth of the field, that the 1969 edition of this Atlas contains nearly twice as much information as the previous edition published only one year earlier. It attempts to collect all of the known covalent chemical structures of proteins and nucleic acids, and related quantitative information including three-dimensional structures from X-ray crystallography and the structures of the abnormal human hemoglobins. Chemical structural information is fundamental data, independent of the calibrations of the instruments used to determine it and of the particular methods used to obtain the pure polymers. Because the staff members of the National Biomedical Research Foundation are also engaged in theoretical and computer studies based on the sequence data, they have a professional interest of their own in having the material correct and complete. The professional staff performs the following functions:

1) The experimental technique is reviewed;
2) Work from different laboratories is compared;
3) Sequences are compared with homologues from other species;
4) The fit of the data into general phylogenetic schemes is considered;
5) Discrepancies are resolved through personal communications;
6) One sequence of each kind of protein is selected for inclusion in the Atlas. This sequence is presented in a uniform format reflecting experimental ambiguities. Comments and references to the work of other laboratories are included.

Data pages are sent back to the research workers for their changes or corrections. A whole section of the data is sent to one or more prominent workers in the area for review.

Primary Sources

Thirty-five years devoted to the needs of users of the Library of Congress enabled Verner Clapp to say: "Exactitude is one of the hallmarks of scholarship. But exactitude is impossible without access to sources. How often the secondary text proves corrupt! How often the footnote citation, traced to its source, fails to support the statement it seemed to imply! How still more often are the meaningful details abridged! For the truth one must go to the sources. But exactitude is no monopoly of scholarship. It is in increasing measure a requirement of all human activity" (1). Mr. Clapp's further remarks on this subject are well worth reading, but will not be quoted here.

In science and technology, the most significant source is the original research article in a serial, periodical, journal, or other published record. The Council of Biology Editors have accepted the following definition: "An acceptable primary scientific publication must be the first disclosure containing sufficient information to enable peers to 1) assess observations; 2) to repeat experiments; and 3) to evaluate intellectual processes; moreover, it must be susceptible to sensory perception, essentially permanent, available to the scientific community without restriction, and available for regular screening by one or more of the major recognized secondary services".

As a result of the study conducted for the Council on Library Resources on the characteristics of a quality journal (5) we would add: 1) that the journal should be easily available after identification by one of the abstracting or indexing services; 2) that the article (including title and abstract) has it editorial process been subjected to critical review by or more peers familiar with the subject matter being pres by the author; and 3) has user confidence as evidence substantive citation.

Since one of the sessions at this Conference is being de to a discussion of the primary research journal in the fur ance of the aims of CODATA, we need not elaborate or theme. However, we would like to call attention to a boc scientific writing for graduate students prepared by the Co of Biology Editors Committee on Graduate Training in S tific Writing (4), and a book on writing technical repor Dwight E. Gray (3).

N. Ertl (2) has suggested that an article on animal experim tion or a clinical paper should contain certain elements esse for the complete understanding of a new discovery. They 1) formulation of the question or aim of the investigatio objects investigated and treatment carried out; 3) findin outcome of the treatment on the investigation object; 4) n ods applied in the investigation; 5) method of evaluatin results; 6) particulars of the subject; and 7) complete re and their consequences. These could be presented in tal form so that the details can be seen at a glance and might represent the complete publication. The purpose would t have authors standardize reports and thus help the scie reader to keep up with current progress. Collection of info tion for electronic data processing would be facilitated.

While the principle is excellent, putting it into practice w be much more difficult and would only achieve its goal majority of authors and editors would agree on the format the publishers would see that these summaries appeared formly in every article. This is a large order and represer tendency to put a greater burden on the primary rese journal for the benefit of secondary services.

International Aspects

In the three most recent data books of the FASEB series, list of contributors includes 160 people from 28 countries o than the United States of America. As might be expected, widest range is in Environmental Biology, with 65 contribu from 19 countries.

If the International Union of Biological Sciences at its mee in Washington, D.C., in October 1970, decides to increas co-operation with CODATA, then one may expect to inte many persons or groups working on critical evaluation of in specialized fields of biology.

Within the next decade, man, his institutions, and his gov ments will be faced with complex problems of a high biolo content. Let us make sure that critically evaluated biolo data will be available to the decision-makers. We hope that time has come for the biological sciences to be include this note-worthy international undertaking of CODATA.

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4. F. Peter Woodford, Ed., *Scientific Writing for Gra Students: A Manual on the Teaching of Scientific Wr* The Rockefeller University Press, 1968.
5. R. L. Zwemer, "Identification of Journal Character Useful in Improving Input and Output of a Ret System", *Federation Proceedings* **29** [5], 1970.

CODATA NATIONAL MEMBERS

At their 5th Annual Meeting, the Members of CODATA unanimously approved the admission of the **German Democratic Republic, Israel,** and **The Netherlands** to national membership on CODATA, bringing the number of National Members on CODATA to twelve. The Chairmen of the National Committees for CODATA are the National Representatives on CODATA, except where indicated.

GERMAN DEMOCRATIC REPUBLIC

The Deutsche Akademie der Wissenschaften zu Berlin (German Academy of Sciences, Berlin) has nominated Prof. H. JANCKE, Vizepräsident, Deutsches Amt für Meßwesen und Warenprüfung, Wallstraße 16, 102 Berlin, as representative of the German Democratic Republic on CODATA.

ISRAEL

The Israel National Committee for CODATA has been established by the Israel Academy of Sciences and Humanities, with the following membership:

Chairman: Prof. S. PATAI,
The Hebrew University, Jerusalem

Members: Prof. I. ELIEZER,
The Institute of Chemistry, Tel-Aviv University, Ramat-Aviv
(National Representative on CODATA)

Prof. A. JAFFE,
The Hebrew University, Jerusalem

Mr. K. KEREN,
Center of Scientific and Technological Information, Tel-Aviv

Prof. A. S. KERTES,
The Hebrew University, Jerusalem

Dr. J. PADOVA,
Soreq Nuclear Research Center, Yavne

Dr. Z. RAPPOPORT,
The Hebrew University, Jerusalem

Prof. D. SAMUEL,
The Weizmann Institute of Science, Rehovot

Prof. S. STRICKMAN,
The Weizmann Institute of Science, Rehovot

ITALY

The membership of the Italian National Committee for CODATA was officially approved by the Consiglio Nazionale delle Ricerche in May 1970, as follows:

Chairman: Prof. M. CAPUTO,
Istituto di Fisica "A. Righi",
Università di Bologna, Via Irnerio, 46,
40126 Bologna

Members: Prof. E. ANTONINI,
Ordinario di Biologia Molecolare,
Università di Camerino, 62032 Camerino

Prof. M. CARAPEZZA,
Istituto di Mineralogia,
Via Marchese Ugo, 29, 90141 Palermo

Dr. A. ROSSI,
Direttore Ricerche SORIN, 13040 Saluggia

Prof. G. SARTORI,
Istituto di Chimica Generale, Università di Roma,
Città Universitaria, 00100 Roma

Prof. A. SCORTECCI,
Ordinario di Siderurgia,
Facoltà di Ingegneria,
Università di Genova, 16100 Genova

JAPAN

The Japanese National Committee for CODATA (JNCC) has been organized as a division of the National Committee for Scientific Information (Chairman: Prof. Masao KOTANI), under the Science Council of Japan (President: Dr. Fujio EGAMI). The Members of the JNCC, with their fields of specialization, are as follows:

Members: Prof. Yuichi KAWADA,
Tokyo Metropolitan University (Materials Science)

Prof. Koreo KINOSITA,
Gakushuin University (Physics)

Prof. Masao KOTANI, President,
Science University of Tokyo
(Physics and Biophysics)
(National Representative on CODATA)

Dr. Yoichiro MASHIKO, Director,
Government Chemical Industrial
Research Institute (Chemistry)

Prof. Tadahisa NAKAMURA,
Tokyo Institute of Technology (Metallurgy)

Prof. Michinori OKI,
University of Tokyo (Chemistry)

Dr. Daitaro SHOJI,
Hydrographic Department, Marine Safety Agency
(Geophysics)

Prof. Yoshio TAKEUCHI,
University of Tokyo (Crystallography)

Prof. Masumi YAMADA,
Waseda University (Nuclear Physics)

Liaison Members, invited from the following Government departments:

Higher Education and Science Bureau, Ministry of Education
Planning Bureau, Science and Technology Agency
Agency of Industrial Sciences and Technology

The Japanese National Committee is assisted by an Advisory Group, composed mainly of CODATA Task Group Members from Japan and Directors of Japanese data centres, as follows:

Prof. Makoto KISAWA,
Osaka University
(CODATA Task Group on Computer Use)

Prof. Masao KOIZUMI,
Tohoku University
(CODATA Task Group on Data for Chemical Kinetics)

Prof. Teruo MOMOTA,
Tohoku University (Japan Nuclear Data Centre)

Prof. Kazuo SATO,
Science University of Tokyo
(Materials Constants Data Programme)

Prof. Shuzo SEKI,
Osaka University (Thermochemistry)

Prof. Takehiko SHIMANOUCHI,
University of Tokyo (Infrared Data Centre)

Prof. Takashi MUKAIBO,
University of Tokyo
(Thermodynamics Data Centre)

Prof. Jiro OSUGI,
Kyoto University (High Pressure Data Centre)

Prof. Ichimatsu TANISHITA,
Keio University
(Research Committee on the Properties of Steam)

Dr. Kentaro YAMAMOTO, Director,
National Research Laboratory of Metrology
(CODATA Task Group on Fundamental Constants)

THE NETHERLANDS

The Royal Netherlands Academy of Sciences and Letters has established a National Committee for CODATA with a membership as follows:

Chairman: Dr. W. M. SMIT, Director,
Institute for Physical Chemistry TNO,
Zeist

Members: Mr. S. T. GROENMAN, Assistant Director,
The Netherlands Organization
of Pure and Applied Research,
The Hague

Prof. J. H. P. JONXIS,
Professor of Pediatrics,
State University, Groningen

Mr. J. van der LAND,
National Museum of Natural History, Leiden

Mr. P. J. WEMELSFELDER, Chief Engineer,
Department for Water Management
and Water Research,
Ministry of Public Works, The Hague

UNITED KINGDOM

The British National Committee on Data for Science and Technology is now under the Chairmanship of CODATA Vice President, Sir GORDON SUTHERLAND, The Master's Lodge, Emmanuel College, Cambridge. Sir HARRIE MASSEY has succeeded Prof. M. J. Lighthill as Physical Secretary of the Royal Society, and becomes an Ex officio Member of the Committee. Dr. Olga KENNARD, University Chemical Laboratory, Cambridge, has been appointed a Committee Member.

U.S.A.

The advisory committees on numerical data within the National Academy of Sciences of the U.S.A. have been reorganized in the past year (see page 7, CODATA Newsletter 4, May 1970). The Executive Committee of the Office of Critical Tables (OCT) has been replaced by the Numerical Data Advisory Board (NDAB), with the following membership:

Chairman: Dr. J. Ross MACDONALD,
Texas Instruments, Inc.,
P. O. Box 5936, MS 136, Dallas, Texas 75222

Members: Dr. Sydney P. CLARK, Jr.,
Department of Geology, Yale University,
New Haven, Conn. 06520

Dr. H. I. FUSFELD,
Kennecott Copper, 161 East 42nd Street,
New York, N.Y. 10017

Dr. H. C. GATOS,
Department of Metallurgy,
Massachusetts Institute of Technology,
Cambridge, Mass. 02138

Dr. Robert M. HAYES,
Institute for Library Research,
University of California at Los Angeles,
Los Angeles, California 90 024

Dr. G. G. JOHNSON, Jr.,
Department of Materials Science,
Pennsylvania State University,
University Park, Penna. 16802

Dr. William KLEMPERER,
Department of Chemistry,
Harvard University, Cambridge, Mass. 02138

Dr. H. W. KOCH,
American Institute of Physics,
335 East 45th Street, New York, N.Y. 10017

Mr. John S. MURDOCK,
Battelle Memorial Institute,
505 King Avenue, Columbus, Ohio 43201

Dr. R. W. SCHMITT,
General Electric Co., Schenectady, N.Y. 12301

Mr. W. O. TAFF,
Esso Research,
50 Rockefeller Plaza, New York, N.Y. 10020

The Numerical Data Advisory Board, in its advisory capacity to the National Bureau of Standards Office of Standard Reference Data (OSRD), has, in the past year, organized meetings of the following groups: Ad Hoc Panel on Interatomic Distances; Joint Committee on Atomic and Molecular Physical Data; Ad Hoc Panel on Mossbauer Spectroscopy Data; and the National Research Council Committee on Fundamental Constants.

The U.S. National Committee for CODATA is linked to the NDAB, and is now chaired by Prof. Robert B. Brode. The membership of the Committee is as follows:

Chairman: Dr. Robert B. BRODE,
Department of Physics,
University of California, Berkeley, California 94720

Members: Dr. Lewis M. BRANSCOMB, Director,
National Bureau of Standards,
Washington, D.C. 20234
(National Representative on CODATA)

Dr. W. S. BROWN,
Bell Telephone Laboratories,
Mountain Avenue, Murray Mill, N. J. 07974

Dr. Sydney P. CLARK, Jr.,
Department of Geology, Yale University,
New Haven, Conn. 06520

Dr. John W. COLTMAN,
Westinghouse Electric Corp.,
Pittsburgh, Penna. 15235

Dr. J. Ross MACDONALD,
Texas Instruments, Inc., P.O. Box 5936, MS 136,
Dallas, Texas 75222

Mr. Donald E. ROSENHEIM,
IBM Research Laboratory, Box 218,
Yorktown Heights, N.Y. 10598

Dr. Edgar F. WESTRUM, Jr.,
Department of Chemistry,
University of Michigan,
Ann Arbor, Michigan 48104

Ex Officio Members: Dr. E. L. BRADY,
Associate Director for Information Programs,
National Bureau of Standards,
Washington, D.C. 20234

Dr. Harrison BROWN, Foreign Secretary,
National Academy of Sciences,
2101 Constitution Avenue, Washington, D.C. 20418

Dr. Bruce S. OLD, Foreign Secretary,
National Academy of Engineering,
2101 Constitution Avenue, Washington, D.C. 20418

Dr. Frederick D. ROSSINI,
University of Notre Dame,
Notre Dame, Indiana 46556

Dr. Charlotte M. SITTERLY,
National Bureau of Standards,
Washington, D.C. 20234

Dr. Guy WADDINGTON,
2950 Foul Bay Road,
Victoria, British Columbia, Canada

CODATA UNION MEMBERS

INTERNATIONAL ASTRONOMICAL UNION (IAU)

The closest link between the International Astronomical Union (IAU) and CODATA is provided by IAU Commission 14, which deals with "Fundamental Spectroscopic Data". This work is handled through five Committees which specialize in the following fields of research: Standards of Wavelength, Transition Probabilities, Collision Cross Sections and Line Broadening, Structure of Atomic Spectra, and Molecular Spectra. A current review of each of these subjects, with references, is given in a comprehensive report prepared for the 14th IAU General Assembly held in Brighton, Sussex, U. K., on 18-27 August, 1970. This report, together with a report on the General Assembly, has been published by the Union [*Trans. Intern. Astrom. Union* **14A**, 125-140 (1970); **14B**, in press (1970)].

The permanent Working Group on Numerical Data for Astronomers and Astrophysicists, formed to co-ordinate data activities within IAU on an inter-Commission basis, held its first meeting during the recent IAU General Assembly. The first task of the Group is to prepare a complete listing of all data projects within the Union and to circularize this information to all IAU members. Chairman of the Working Group is Dr. G. A. Wilkins, H. M. Nautical Almanac Office, Royal Greenwich Observatory, Herstmonceux Castle, Hailsham, Sussex, U.K., who has also succeeded Dr. Charlotte M. Sitterly as the IAU representative on CODATA.

INTERNATIONAL GEOGRAPHICAL UNION (IGU)

The new IGU representative on CODATA is Prof. Torsten Hägerstrand, Department of Social and Economic Geography, University of Lund, Sölvegatan 13, S-223 62 Lund, Sweden, who is also a Vice-President of the Union.

Of the 24 Standing Commissions of IGU, those on Geographical Data Sensing and Processing (Chairman: Mr. R. F. Tomlinson, 226 O'Connor Street, Ottawa, Ontario, Canada) and on Quantitative Methods (Chairman: Prof. B. J. L. Berry, Department of Geography, University of Chicago, Chicago, Ill. 60637, U.S.A.) are concerned with the collection, processing, storage, and dissemination of geographical data.

INTERNATIONAL UNION OF BIOLOGICAL SCIENCES (IUBS)

At the IUBS Executive Committee meeting in Naples, Italy, on 6 and 7 November, 1970, it was resolved that IUBS will continue its adherence to CODATA. Dr. Philip L. Altman, Director, Office of Biological Handbooks, Federation of American Societies for Experimental Biology (FASEB), 9650 Rockville Pike, Bethesda, Maryland 20014, U.S.A., was subsequently nominated as the new IUBS representative on CODATA.

INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS (IUGG)

The Assistant Secretary General of the International Union of Geodesy and Geophysics, Prof. M. Caputo, Istituto di Fisica "A. Righi", Università di Bologna, Via Irnerio, 46, 40126 Bologna, Italy, is the new IUGG representative on CODATA.

INTERNATIONAL UNION OF GEOLOGICAL SCIENCES (IUGS)

In January 1967, the Executive Committee of IUGS established a Committee on Storage, Automatic Processing and Retrieval of Geological Data (COGEODATA), under the Chairmanship of Dr. S. C. Robinson, Geological Survey of Canada, 601 Booth Street, Ottawa 4, Ontario, Canada. The general tasks of the Committee are as follows:

1) Establishment of those factors that are common to record of data of all or most fields of the geological sciences geographical co-ordinates, reference numbering, standar descriptive terminology, mnemonic coding, provisions t ensure consistency in the data recorded, and in the term units, and codes to record them.
2) Choice and development of formats for machine-process able files in fields such as: mineral deposits, petrochemistry exploration geochemistry, mineralogy, geochronology, pa leontology, petroleum geology (or fossil fuels), etc.
3) Appraisal of existing systems for storing geological an allied data, and of uses made of data stored in machine processable form.
4) Production of an international index to geological data and the equivalence of multilingual terms.

In order to gather information on the above four topics, an particularly on the existence of geological data files, both ma nual and computerized, as a first step in the production of th world-wide index to such files, COGEODATA is at presen conducting an enquiry, by means of a questionnaire, through out the international geological community. Further informa tion and copies of the questionnaire are available from: Dr. A Hubaux, CETIS, EURATOM, 21020 Ispra (Varese), Italy.

CODATA LIAISON REPRESENTATIVES

WORLD FEDERATION OF ENGINEERING ORGANIZATIONS (WFEO)

At the inaugural meeting of the WFEO Committee on Engineering Information held in Warsaw, Poland, on 13 and 14 May, 1970, the following appointments were made:

Chairman: Mr. D. H. BARLOW,
WFEO/FMOI,
Savoy Place,
London, WC2, U.K.

Secretary: Mr. S. JANISZKIEWICZ,
Naczelna Organizacja Techniczna,
Czackiego 3/5,
Warsaw 1, POLAND

The Committee will aim principally to increase among engineers the awareness and appreciation of the value of effective communication of engineering information, and will also endeavour to promote the continuous improvement of information communication techniques and to identify and overcome deficiencies in present information systems, having particular regard to the needs of developing countries.

In order to further these aims, the Committee has established Working Groups on User Needs to prepare a comprehensive questionnaire for use in investigating the needs of engineers for information services, and on User Services to identify and examine existing information services, initially in the fields of electrotechnology and construction. A third project at present under consideration by the Committee is the preparation of lexicographic tools, in particular classifications and thesauri. The next meeting of the Committee on Engineering Information will take place at the Institution of Electrical Engineers, London, U.K., on 2 and 3 March, 1971.

Several important proposals are at present being considered for the association of the WFEO with the **ICSU ABSTRACTING BOARD (ICSU AB).** These developments would include the immediate admission to ICSU AB of the following engineering information services: The Engineering Sections of Referativny Zhurnal, Bulletin Signalétique, Science Abstracts, and Japanese Information Centre for Science and Technology; Engineering Index; and Technische Zentralblatt. Changes in the Constitution and membership of the Executive Committee of ICSU AB would accordingly be made to allow for representation of the WFEO and of the engineering information services. If the WFEO were to create bodies corresponding to the International Scientific Unions, i.e., international committees covering particular fields of engineering, for example, mechanical

electrical, they could be given representation equal to that of the Scientific Unions. The proposed title of the reconstituted board is INFIS (International Federation of Information Services), with the sub-title ICSU-WFEO Board of Information Services.

A primary long-range goal of the ICSU AB is the design, implementation, and operation of a world system for abstracting and indexing services for science and technology. At its Annual Meeting in Columbus, Ohio, U.S.A., in July 1970, the ICSU AB agreed to proceed with a first stage plan for the system, aimed primarily at reducing costs and duplication of effort, and increasing completeness of coverage of the Member Services. The plan defines guidelines for co-operation between the Member Services in journal and document acquisition, selection and exchange. The Member Services in each scientific discipline would assume responsibility for acquiring and selecting articles for coverage from the most productive journals in their discipline. Articles in these journals that are of potential interest to other disciplines would be forwarded in micro-form, together with the author abstract and a standard computer-readable bibliographic description, to other appropriate Services, either directly or through a central redistributing unit. Responsibility for the acquisition and selection of articles from a substantial number of journals primarily devoted to scientific fields outside those covered by the Member Services would be allocated to the Member Services according to the journal language, with articles of potential interest routed to the appropriate Services for coverage. Each Member Service would then in effect be able to acquire information from the total current journal coverage of all the Services, which is estimated to be approximately 35,000 journals.

The first steps towards implementing the plan will be agreement upon common definitions of subject coverage, selection procedures, and forms for bibliographic citations, and studies of the degree of overlap that now exists in journal coverage. The plan also calls for a detailed inventory of the computer-readable records produced by the various Member Services to identify the degree of compatibility and convertability among these records, and analysis of the indexing approaches presently used, with the ultimate aim of direct exchange of abstracts and index entries among the Services.

Member Services of the ICSU AB at present include eleven of the world's major abstracting and indexing services from France, Federal Republic of Germany, U.K., U.S.A., and U.S.S.R., as follows: Astronomy and Astrophysics Abstracts, Bibliographie des Sciences de la Terre, Bibliography and Index of Geology, BioSciences Information Service of Biological Abstracts, Bulletin Signalétique, Chemical Abstracts Service, Chemischer Informationsdienst, Science Abstracts, Physikalische Berichte, Referativny Zhurnal, and Zentralblatt für Mathematik.

The Proceedings of the 1970 Annual Meeting of the ICSU AB, which include details of the first stage of the plan for a world system for abstracting and indexing services, are available from the ICSU AB Secretariat, 17 rue Mirabeau, Paris 16e, France, at a price of $ 15.00, plus postage.

WORLD METEOROLOGICAL ORGANIZATION (WMO)

The World Meteorological Organization has recently issued a second report concerning the collection, storage and retrieval of meteorological data. It is World Weather Watch (WWW) Planning Report No. 32, entitled "Further Planning of the Storage and Retrieval Service".

The report reviews three major areas where international standards for meteorological data storage and retrieval are desirable and makes recommendations for specific steps to be taken to achieve this standardization. It begins by considering both manual and computerized quality control of data exchanged over the WWW Global Telecommunication System and proposes interim measures to be taken by any meteorological centre, computerized or not, with the aim of ensuring that all data exchanged internationally are subjected to some minimum degree of quality control commensurate with the ability of the centre first placing the data into international exchange. A specific proposal is made for a world classification and cataloguing system for meteorological data, archived on storage media such as punched cards, magnetic tape or microfiche, which can be expanded to include information contained in meteorological literature. Standard formats for retrieval of various types of archived meteorological data are proposed with the aim that research workers requiring such data will be able to obtain the same type of meteorological data in the same format, irrespective of where it is stored. The report concludes by recommending what the responsibilities of the various World, Regional and National Meteorological Centres should be in implementing the WMO storage and retrieval service.

The WMO Executive Committee Panel on Collection, Storage and Retrieval of Data for Research held its first session in Geneva from 14-17 April, 1970, immediately following the informal planning meeting of experts whose conclusions and recommendations are reflected in WWW Planning Report No. 32. The Panel, formed to act as a focal point for all WMO activities in this field, reviewed the progress achieved thus far in implementing the WMO storage and retrieval service and made several recommendations concerning its long-range development. These included suggestions concerning the types of environmental data which, along with meteorological data, should be included in the WMO storage and retrieval service, and recommendations for reducing potential duplication of effort among data-archiving centres of various geophysical sciences including meteorology. The Panel also recommended principles for the storage and retrieval of the large amounts of data expected to accrue from the several experiments of the Global Atmospheric Research Programme (GARP) sponsored jointly by ICSU and WMO. The Panel will meet again in 1971 to formulate specific guidelines on the scope and organization of the storage and retrieval service and to consider the progress achieved in the three major areas described in WWW Planning Report No. 32.

The membership of the WMO Executive Committee Panel on Collection, Storage and Retrieval of Data for Research is as follows:

Mr. J. F. BOSEN,
Environmental Data Service,
NOAA, Room 703, Gramax Building,
8060 13th Street,
Silver Spring, Md. 20910, U.S.A.

Mr. J. M. CRADDOCK,
Meteorological Office,
London Road,
Bracknell, Berkshire RG12 2SZ, U.K.

Dr. P. K. DAS, Director,
Northern Hemisphere Analysis Centre,
India Meteorological Department,
Lodi Road, New Delhi 3, INDIA

Mr. B. M. KAMP,
Koninklijk Nederlands Meteorologisch Institut,
Utrechtseweg 297,
De Bilt, THE NETHERLANDS

Dr. N. K. KLYUKIN,
Scientific Institute for Aeroclimatology,
28/35 Caikovskovo,
Moscow G-69, U.S.S.R.

Mr. J. V. MAHER,
Bureau of Meteorology,
P.O. Box 1289 K,
Melbourne, Vic. 3001, AUSTRALIA

Dr. K. WEGE,
Deutscher Wetterdienst Zentralamt,
Frankfurter Straße 135,
605 Offenbach, GERMANY, FED. REP.

Other interested organizations will continue to be asked if th
wish to participate in the work of the Panel.

CODATA TASK GROUPS

TASK GROUP ON KEY VALUES FOR THERMODYNAMICS

At a three-day meeting at the National Physical Laboratory, Teddington, Middlesex, U.K., from 1-3 September, 1970, the CODATA Task Group on Key Values for Thermodynamics completed a first tentative set of key values. The report of the Task Group has been published in **CODATA Bulletin 2,** November 1970, *Tentative Set of Key Values for Thermodynamics — Part 1, Report of the ICSU — CODATA Task Group on Key Values for Thermodynamics, October 1970,* which is available on request and free of charge from the CODATA Central Office.

The report contains in tabulated form the Task Group's first set of proposed key values with estimated uncertainties for the standard enthalpies of formation at 298.15 K, the standard entropies at 298.15 K, and the standard enthalpy increments between 0 K and 298.15 K, of 32 species, as follows: O(g), O_2(g), H(g), H^+(aq), H_2(g), H_2O(l), H_2O(g), He(g), Ne(g), Ar(g), Kr(g), Xe(g), Cl(g), Cl^-(aq), Cl_2(g), HCl(g), Br(g), Br^-(aq), Br_2(l), Br_2(g), HBr(g), I(g), I^-(aq), I_2(c), I_2(g), HI(g), N(g), N_2(g), C(c), C(g), CO(g), and CO_2(g). The values were based upon selections and calculations made at the National Bureau of Standards, U.S.A., and the Institute for High Temperatures of the Academy of Sciences of the U.S.S.R., and agreed by the whole Task Group. Explanatory footnotes to the tables and a comprehensive bibliography are also included in the Report.

The Task Group on Key Values for Thermodynamics welcomes comments from thermodynamicists on the aptness of the proposed values, which will help in the formulation of a first set of recommended key values, to be published in approximately one year's time. Until then, the Task Group wishes to emphasise that any author who cites a value from the table should make it clear that the value he quotes is tentative. It should also be noted that the values proposed in the Report are not fully consistent with the values in any previously published thermodynamic tables. The achievement of consistency between the various thermodynamic tables is a long-term objective which the Task Group hopes to facilitate, but for some time to come, inconsistency between the Task Group's recommended values and values already tabulated in other series is inevitable.

The second set of species planned for consideration by the Task Group in the immediate future is likely to include the following: S(g), S(rh), SO_2(g), SO_4^{2-}(aq), NH_3(g), NH_4^+(aq), NO_3^-(aq), OH^-(aq), Na(g), Na(c), Na^+(aq), K(g), K(c), K^+(aq), Li(g), Li(c), Li^+(aq), Rb(g), Rb(c), Rb^+(aq), Cs(g), Cs(c), Cs^+(aq), F(g), F_2(g), HF(g), and F^-(aq).

It would assist the Task Group, if researchers who have completed measurements that are relevant to the Task Group's work on the second set of species would communicate their results to the Chairman of the Task Group in advance of publication.

Both comments on the first tentative set of key values for thermodynamics, and information relevant to the second proposed set, should be forwarded to Prof. Stig Sunner, Chairman, CODATA Task Group on Key Values for Thermodynamics, Thermochemistry Laboratory, Lund University, POB 740, S-22007 Lund 7, Sweden.

TASK GROUP ON DATA FOR CHEMICAL KINETICS

The Executive Committee of the International Union of Pure and Applied Chemistry (IUPAC) has recently approved the nomination of three IUPAC representatives to the CODATA Task Group on Data for Chemical Kinetics, as follows:

Prof. G. A. SCHUIT,
(IUPAC Commission on Colloid and Surface Chemistry)
Technische Hogeschool,
Eindhoven,
THE NETHERLANDS

Dr. R. TAMAMUSHI,
(IUPAC Commission on Electrochemistry)
Institute of Physical and Chemical Research,
Yamato-machi, Kita-adachi-gun,
Saitama, JAPAN

Dr. V. I. VEDENEEV,
(IUPAC Physical Chemistry Division Committee)
Institute of Chemical Physics,
Academy of Sciences of U.S.S.R.,
Vorobyevskoye Chaussee 2-b,
Moscow V-334, U.S.S.R.

TASK GROUP ON FUNDAMENTAL CONSTANTS

The following report was presented by the Task Group Chairman, Dr. E. Richard Cohen, to the 5th Annual Meeting of CODATA.

Membership

The Task Group was increased during the past year with the addition to membership of Dr. B. N. Oleinik, Deputy Director of the Mendeleev All-Union Scientific Research Institute of Metrology, Leningrad, U.S.S.R.

Activities

The Task Group has functioned during the past year primarily through correspondence. In this preliminary exploration of scope and direction, the Task Group has been able to define its general aims and objectives.

An informal meeting of a majority of the Task Group was held on 6 August, 1970, at the U.S. National Bureau of Standards, Gaithersburg, Maryland, U.S.A. This meeting was made possible because of the presence of several Task Group members at the International Conference on Precision Measurement and Fundamental Constants (see report below). It is regrettable that the Soviet members, Mamyrin and Oleinik, who had been scheduled to participate in the Conference, were unable to be present. The meeting was attended by Professor F. D. Rossini, President of CODATA, who outlined the history of the formation of the Task Group and his concept of its raison-d'être.

The Group will continue to conduct the major portion of its work by correspondence during the coming year, and will hold a formal meeting in 1971 at the National Physical Laboratory, Teddington, Middlesex, U.K., during the International Conference on Atomic Masses and Related Constants (see page 21).

It is hoped that a recommended set of fundamental constants will be available in time for CODATA to take official action at its 1972 Annual Meeting.

Recommendation

It is now well-established, by recent measurements and by some significant advances in quantum electrodynamic calculations, that many of the values given in the 1963 Cohen-DuMond adjustment of the fundamental constants are in error by several tens of parts per million. For work which requires the maximum attainable accuracy, therefore, these numbers should not be used. The recent evaluation of Taylor, Parker and Langenberg [*Rev. Mod. Phys.* **41,** 375 (1969)] represents a closer approximation to the true values. There is, however, growing evidence that these numbers are in error by several parts per million, particularly the magnetic moment of the proton and the Faraday.

These numerical values, therefore, cannot be recommended as the "best values" of the physical constants, but since they constitute a consistent set of numbers which are more accurate than the Cohen-DuMond set, they should be used (in preference to the latter) as an interim list until a new evaluation is completed.

Where maximum accuracy is required, or where the numbers are to be used to evaluate the consistency of theoretical relationships, it will be necessary for the worker to consult the primary literature and consider all of the available data in order to determine what he considers to be the most accurate values. As of August 1970, there are several important measurements being pursued in laboratories around the world, the results of which will be important to any complete re-evaluation. It is hoped that final results will be available within the next year.

During the course of the International Conference on Precision Measurement and Fundamental Constants, the IUPAP Commission on Atomic Masses and Related Constants adopted the following statement, which was read into the Conference record by Prof. A. H. Wapstra, President of the Commission:

"The IUPAP Commission on Atomic Masses and Related Constants in its meeting of August 3, 1970, recognized that the tabulation of the numerical values of the fundamental physical constants developed by Cohen and DuMond in 1963, and subscribed to by it at that time, should now be considere obsolete. It urges IUPAP and CODATA to assist in determin ing what new values should be recommended for general use It expresses its opinion that such values should more nearl coincide with those recently calculated from the available ex perimental data in the thoughtful evaluation of Taylor, Parke and Langenberg".

It is recommended that CODATA accordingly recognize th evaluation of Taylor, Parker and Langenberg as the most ac curate available set of consistent numerical values for the fundamental constants and that these values be used for the general purpose of reporting the results of experimental data in the interim until a new evaluation which includes more recent data is available.

The above recommendation of the Task Group was considered by the Members of CODATA at their 5th Annual Meeting. Although it was recognized that the numerical values of the presently accepted fundamental constants are in error in some cases by several tens of parts per million, and that consequently where maximum accuracy is required they should not be used, CODATA did not consider a change in the recommended values of the fundamental constants to be desirable at the present time, since such a change would be interim, and would be likely to lead to confusion, or at least to unnecessary changes in large amounts of numerical data, most of which are not accurate enough to be significantly affected by the change.

REPORT ON PERSONAL IMPRESSIONS OF INTERNATIONAL CONFERENCE ON PRECISION MEASUREMENT AND FUNDAMENTAL CONSTANTS

Gaithersberg, Maryland, U.S.A., 3-7 August, 1970

E. RICHARD COHEN

Science Center, North American Rockwell, Thousand Oaks, California, U.S.A.

The Conference on Precision Measurement and Fundamental Constants was held from 3-7 August, 1970, at the laboratories of the U.S. National Bureau of Standards, Gaithersburg, Maryland, U.S.A. It was sponsored by the following organizations: International Union of Pure and Applied Physics (IUPAP), Committee on Data for Science and Technology (CODATA), Committee on Fundamental Constants, U.S. National Academy of Sciences-National Research Council (NAS-NRC), U.S. National Bureau of Standards (NBS), and International Bureau of Weights and Measures (BIPM).

Financial support for the Conference came from IUPAP, the U. S. National Science Foundation, and from several industrial organizations in the U.S.A.

In keeping with its international character, there were 39 attendees from 13 countries other than the U.S.A., in a total attendance of 193. More significant is the breakdown of participation in the programme; half of the 20 invited papers and approximately one quarter of the 72 contributed papers came from outside the U.S.A.

The scope of the Conference is adequately given by its title – the relationship between precision measurement and the fundamental constants of physics. In two areas the precision of measurement now available or soon to become available is such that the measurement will be more accurate than the existing standards, and in these areas questions concerning the basis for the establishment of standards for units falls within the realm of the Conference discussion. Measurements of the frequency/voltage ratio for the ac Josephson effect have reached the point where intercomparison between two laboratories is as much a comparison of each laboratory's voltage standards, as it is a check on the value of the fundamental quantum of magnetic flux, $hc/2e$. Although one may not yet be willing to replace a bank of standard cells by a Josephson junction as the primary voltage standard, such a junction has already established itself as a valid instrument for monitoring possible drift in a voltage standard with reproducibility of a few tenths of a part per million.

Most of the first day of the Conference was devoted to frequency and length standards, and the velocity of light. The second is defined in terms of a hyperfine transition in ^{133}Cs, $\nu = 9.19263177$ GHz and frequencies of the order of 1-30 GHz can be compared with reproducibilities and stabilities better than 1 part in 10^{12}. These measurements are being extended to higher frequencies and in the foreseeable future will reach optical frequencies which can then be easily compared with the ^{86}Kr length standard. Other experiments are directed toward wavelength comparisons of optical and microwave radiation. Both of these approaches will soon provide a determination of the velocity of light with a precision which could exceed 1 part in 10^{10}. At such a level of precision it is worthwhile to consider the possibility of defining the velocity of light as some convenient exact value and consolidating length and frequency into a single standard.

Spectroscopic measurements of resolved fine structure patterns of hydrogen and ionized helium (He II) avoid the problem of the uncertain relative intensities of the fine-structure components. Within the next year, E. Kessler of the U.S. National Bureau of Standards should have a new value of the Rydberg constant with a precision of a few parts in 10^8.

The Faraday constant is one of the most important concepts of physical chemistry and pervades the entire field of thermophysical measurements. It is also the essential factor in the mass-energy conversion factor from atomic mass units to electron volts. At the present time there exists only one accurate modern measurement, using the electrolysis of silver. Indirect determinations of the value of F indicate that there may be an error in this value which could be as large as two or three times its assigned standard deviation. It is therefore important that additional independent determinations be undertaken, and a new measurement, using an iodine coulommeter, has been undertaken at the U.S. National Bureau of Standards.

An important result from the Conference was the new data on the magnetic moment of the proton by Fystrom (U.S.A.), Petley and Morris (U.K.), and Gubler, *et al.* (Switzerland), which indicate that the value for this constant recommended in the Taylor, Parker, and Langenberg evaluation is probably too small by as much as 20 ppm (approximately three times the quoted standard deviation). Such a shift would destroy the existing internal consistency of the data of the adjustment and shift many of the numerical values by perhaps 5 to 10 ppm. It also casts doubt on the present value of the Faraday (as mentioned above).

Quantum electrodynamics is one of the most precise and sophisticated theoretical structures of modern physics. Its ability to predict such subtle effects as the Lamb Shift provides a challenge to the experimentalist as well as a severe test on the overall consistency of the theory. Precision microwave spectroscopy of hydrogen and deuterium (and to a lesser extent He II) now verify the predictions of QED to an accuracy of the order of 1 part in 10^{10} of the binding energy of the electron! This agreement has been achieved only in the last year and is the result of improved calculational techniques and careful and detailed analysis of the possible systematic errors of the pertinent experimental data. The agreement has now removed all existing discrepancies between theory and experiment to the precision with which either is presently capable. [It is hoped that this agreement is not an example of "intellectual phase-locking" – the subconscious tendency of experimentalist or theorist to obtain the answer he thinks is correct, or at least to stop looking for further corrections if he has reached that value.]. It would appear, however, that, in the realm of the electromagnetic interaction, there are no fundamental conceptual discrepancies and that QED is in fact a correct, if not fully understood, theory.

The meaning of the term "precision measurement" varies with the quantity being measured. The Conference started with the subject of frequency measurement and frequency standards in which precision is measured in parts in 10^{12}; it concluded with the new measurements of the Newtonian constant of gravitation, G, which is known with a precision that is scarcely better than 1 part in 10^3. New measurements now underway (at Trieste, Italy, and at University of Virginia, U.S.A.) show promise of increasing this precision by as much as a factor of 100.

The Conference was a stimulating review of the broad field of precision measurements in physics. It is unfortunate that a great many of the papers constituted only progress reports on current work and did not present final results. This, in another sense, made the Conference much more interesting and vividly demonstrates the breadth of activity in these areas of physics, and the importance of measurement to our understanding of the nature of things.

Note: Following the enthusiastic response to the above Conference, the Office of Standard Reference Data (OSRD) of the U.S. National Bureau of Standards is to establish an information centre on precision physical measurement and related theoretical work relevant to the determination of the fundamental physical constants. It is proposed that all scientists who submit papers for publication which are pertinent to the areas covered by the Conference send a preprint to the OSRD at the time of submission. A file of these preprints will be maintained and a periodic announcement, entitled *Preprints on Precision Measurement and Fundamental Constants* (PPMFC), will be made, initially bi-monthly, beginning in January, 1971. It is anticipated that a list of bibliographic citations of the papers after they are published will be compiled and circulated at longer intervals. In addition, the mailing will serve as a newsletter in which conferences and other information of interest can be announced. Further information from: PPMFC, Office of Standard Reference Data, National Bureau of Standards, Washington, D.C. 20234, U.S.A.

FORTHCOMING CONFERENCES

4th INTERNATIONAL CONFERENCE ON ATOMIC MASSES AND FUNDAMENTAL CONSTANTS, sponsored by the Commission on Atomic Masses and Related Constants of the International Union of Pure and Applied Physics (IUPAP), 6-10 September, 1971, National Physical Laboratory, Teddington, Middlesex, U.K.

The Conference will be concerned with achieving a coherent and comprehensive picture of the present status of precise measurements of atomic masses and related atomic, gravitational and thermodynamic constants. The provisional conference topics include: relative mass determinations by mass doublet spectroscopy; nuclear reaction energies including alpha and beta decay; nuclear binding energies; atomic (electronic) effects on binding energies; binding energy systematics; theoretical (empirical) mass formulae; mass determinations for far-off stability nuclides; the mass-energy conversion constant (Faraday constant); velocity of light; Rydberg constant; fine structure constant; proton and muon magnetic moments; proton gyromagnetic ratio; $2e/h$ and the Josephson effects; related constants; gravity; and problems of data evaluation and adjustment.

Further information from: B. W. Petley, Division of Quantum Metrology, National Physical Laboratory, Teddington, U.K.

INTERNATIONAL CONFERENCE ON INFORMATION SCIENCE, sponsored by the Israel Society of Special Libraries and Information Centres (ISLIC) and supported by the National Council for Research and Development, Prime Minister's Office, 29 August – 3 September, 1971, The Sheraton Hotel, Tel Aviv, Israel.

The Conference programme will include technical sessions in four areas: 1) Information Analysis and Information Analysis Centers (including trends in classification schemes: compilation and development of thesauri and other forms of dictionaries; use of codes in special subjects; data extraction, storage and retrieval; information analysis centers in science and/or technology environment), 2) Retrieval of Information (including evaluation or retrieval effectiveness; users' responses to various information media; economics of information storage and retrieval; commercially available services), 3) Selection, Education and Training of Personnel, and 4) Publishing and Reproduction (including mechanization in publication, e.g., mechanical type-setting; trends in reprographic equipment and methods; microforms).

Registration forms and further information from: The Organizing Committee, International Conference on Information Science, P.O. Box 16271, Tel Aviv, Israel.

NEW PUBLICATIONS

NUCLEAR PROPERTIES

Two critically evaluated data compilations were published during 1970 by the Berkeley Particle Data Center, Lawrence Radiation Laboratory, University of California, U.S.A.

NSRDS-UCRL-20 000 YN, A Compilation of YN Reactions, January 1970, by Odette Benary, Naomi Barash-Schmidt, LeRoy R. Price, Arthur H. Rosenfeld, and Gideon Alexander, is a compilation of 17 papers that report the cross sections, angular distributions, and polarizations of Ap, Σ^+p, and Σ^-p interactions. Indices to the papers are included, together with a complete listing of the selected YN data.

NSRDS-UCRL-20030 πN, πN Partial-Wave Amplitudes, A Compilation, February 1970, by David J. Herndon, Angelo Barbaro-Galtieri, and Arthur H. Rosenfeld, is a collection of the results of ten partial-wave analyses performed on the elastic $\pi^{\pm}$p scattering from 0 to 2 BeV/c incident momentum. The amplitudes and various parameters deduced from the amplitudes are plotted and tabulated, and the necessary definitions are included.

Both publications are available from: Dr. Arthur H. Rosenfeld, Director, Berkeley Particle Data Center, Lawrence Radiation Laboratory, University of California, Berkeley, Calif. 94720, U.S.A.

The Berkeley Particle Data Center was established in 1958 for the purpose of compiling, referencing, averaging and summarizing property data of elementary particles (leptons, mesons, baryons) and resonant states on a current basis. It is supported by the U.S. Atomic Energy Commission through its Lawrence Radiation Laboratory, and since 1968 by the Office of Standard Reference Data of the National Bureau of Standards.

Review of Particle Properties, by the Particle Data Group [Matts Roos, Claude Bricman (CERN, Geneva, Switzerland), Angela Barbaro-Galtieri, LeRoy R. Price, Alan Rittenberg, Arthur H. Rosenfeld (Berkeley Particle Data Center), Naomi Barash-Schmidt (Brandeis University, Waltham, Ma. 02145, U.S.A.), Paul Söding (DESY, Hamburg, Germany, Fed. Rep.), Chih Yung Chien (The Johns Hopkins University, Md. 21218, U.S.A.), Charles G. Wohl (Oxford University, Oxford, U.K.), and Thomas Lasinski (University of Chicago, Chicago, Ill. 60637, U.S.A.)], *Physics Letters,* Vol. 33B, No. 1, August 1970, North-Holland Publishing Company, P.O. Box 3489, Amsterdam, The Netherlands.

The August 1970 issue of *Physics Letters* is devoted entirely to a 125 page review and compilation of the properties of leptons, mesons, and baryons, by the Particle Data Group, and constitutes an up-dating through June 1970 of an earlier review by the same Group [*Rev. Mod. Phys.* **42,** 87 (1970)]. The Review has also been published as NSRDS-UCRL-8030, August 1970.

All particles are considered as falling into one of three groups: stable particles, immune to decay via the strong interaction; meson resonances; and baryon resonances. These divisions are maintained within the two main parts of the compilation, tables of particle properties and "data card listings".

The data card listings contain the original information (data, references, etc.), together with weighted averages, comments including reasons for non-inclusion of data in the averages, and "mini-reviews" for particle data receiving special treatment or presenting particular problems. The tables summarize the output of weighted averages and some critical evaluation, which is explained in footnotes to the tables.

The Review also includes a listing of all previous compilations by the Particle Data Group, among which is a pocket-sized particle data booklet, "Particle Properties August 1970", containing only tabulated data selected from the Review, and useful supporting information including a listing of high energy physics laboratories and agencies throughout the world.

The next edition of "Review of Particle Properties" is to be published in *Reviews of Modern Physics* in January, 1971.

Copies of the above publications and further information are available from Scientific Information Service, CERN, Geneva 23, Switzerland, or Technical Information Division, Building 90, Lawrence Radiation Laboratory, Berkeley, California 94720, U.S.A.

Low Energy Hadron Interactions – Compilation of Coupling Constants and Low Energy Parameters, Editor, G. Höhler, Institut für Theoretische Kernphysik, Universität Karlsruhe, Karlsruhe, Germany, Fed. Rep., Springer-Verlag, Heidelberger Platz 3, 1 Berlin 33, or 175 Fifth Avenue, New York, N.Y. 10 010, U.S.A., Springer Tracts in Modern Physics, Volume 55, 1970, approx. 300 pp, DM 78,–, $ 21.50.

Electron-Photon Shower Distribution Function: Tables for Lead, Copper and Air Absorbers, by H. Messel and D. F. Crawford, School of Physics, University of Sydney, Australia, Pergamon Press, Headington Hill Hall, Oxford OX3 OBW, U.K., 1970, 1488 pp, £ 25, $ 67.00.

These computer-produced tables describe the behaviour of particles in electron-photon cascades. Data relating to the propagation of high-energy electrons and photons through matter are given in 2,946 tables, covering electron and photon primaries of energies from 100 MeV to 100,000 MeV and secondary energies commencing at 1 MeV.

Photon Cross Sections from 1 KeV to 100 MeV for Elements $Z = 1$ to $Z = 100$, by Ellery Storm and Harvey I. Israel, Los Alamos Scientific Laboratory, New Mexico, U.S.A., *Nuclear Data Tables* **A7,** 565-681 (June 1970), Academic Press, 111 Fifth Avenue, New York, N.Y. 10003, U.S.A., or Berkeley Square House, London W1X 6BA, U.K.

This compilation of photon interaction data, together with a similar earlier evaluation by W. H. McMaster, *et al,* Lawrence Radiation Laboratory [UCRL-50174, Sec. II, Rev. 1 (May 1969)] for energies less than 1 MeV and for elements $Z =$ 1-83, 86, 90, 92, and 94, are available on tape from the Radiation Shielding Information Center (RSIC), Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tenn. 37831, U.S.A., as DLC-15 and DLC-7 respectively.

NBS Special Publication 322, Photonuclear Data Index, produced by the Photonuclear Data Center (Director: Dr. E. G. Fuller), Institute for Basic Standards, National Bureau of Standards, Washington, D.C. 20234, U.S.A., 1970, $ 0.75, SD. Catalog No. C13.10:322*, is the second in a series of cumulative supplements to NBS Miscellaneous Publication 277, Photonuclear Data Index (1966, 96 pp, $ 0.55, SD Catalog No. C13.10:277*), and covers data published on photonuclear reactions from 1 January, 1965, to 31 January, 1970.

The index is intended to facilitate the location of experimental data on photonuclear reactions, and for this purpose quantitative information is given on the content of each paper referenced. Each index entry corresponds to the measurement of a specific photonuclear reaction for a specific nuclide or group of nuclides. The type of measurement is given, together with the range of excitation energies covered, the type of detector used and its energy response, and the type of angular distribution data obtained. Each measurement is described as completely as possible in a single line, so that relevant references for specific types of data can be quickly and precisely located. Eight categories are used to describe a given paper: reference number, nucleus excited, reaction, type of information, excitation energy range, source type and energy range, detector type energy and angular range, and remarks.

For further information on the Photonuclear Data Center, refer to section 3.1.18., CODATA *International Compendium of Numerical Data Projects.*

BNL – 400, Third Edition, Angular Distributions in Neutron-Induced Reactions, Volume 1, $Z = 1$ to 20, by D. I. Garber, L. G. Strömberg, M. D. Goldberg, D. E. Cullen, and V. M. May, National Neutron Cross Section Center (NNCSC), Brookhaven National Laboratory, Upton, N.Y. 11973, U.S.A., January 1970, 452 pp.

This compilation (also known as EANDC(US) – 138 "U") was prepared largely by computer means from the CSISRS (Cross Section Information Storage and Retrieval System) experimental data storage library; the graphs and tabulations are photographs of cathode-ray tube displays of computer-arranged data and computer-fitted curves. Volume II of BNL-400 is now being prepared in the same way.

Publications of the NNCSC are available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151, U.S.A.

The NNCSC has also recently issued on tape Version II of the Evaluated Nuclear Data File **(ENDF/B-II),** a revised and extended compilation of evaluated neutron cross section data.

Newsletter Bulletin 12 (CCDN-NW/12) of the European Nuclear Energy Agency (ENEA) Neutron Data Compilation Centre, B. P. No. 9, 91-Gif-sur-Yvette, France, provides an up-dated listing through October 1970 of evaluated neutron cross section data available from the Centre. Recent important revisions to the United Kingdom Nuclear Data Library (UKNDL), Kerndaten Karlsruhe (KEDAK), and ENDF/B files are included.

Requests from the U.S.A. and Canada for both experimental and evaluated neutron data should be addressed to the NNCSC; from OECD member countries and Japan to the ENEA Neutron Data Compilation Centre; and from all other countries, except the U.S.S.R., to the Nuclear Data Unit, International Atomic Energy Agency (IAEA), Kärntner Ring 11, A – 1011 Vienna, Austria. Requesters in the U.S.S.R. are served by the Nuclear Data Information Centre in Obninsk.

These four centres comprise a world-wide network for the compilation, evaluation, storage, exchange, and dissemination of neutron data and information; their organization, publications, and services are described in detail in the CODATA *International Compendium of Numerical Data Projects,* sections 3.1.7., 3.1.11., 3.1.8., and 3.1.12. respectively.

CINDA 69, An Index to the Literature on Microscopic Neutron Data, Second Supplement (Cumulative), USAEC Division of Technical Information Extension, P.O. Box 62, Oak Ridge, Tenn. 37830, U.S.A., U.S.S.R. Nuclear Data Information Centre, ENEA Neutron Data Compilation Centre, and IAEA Nuclear Data Unit, August 1970, 375 pp.

CINDA is a computerized index to the world literature on microscopic neutron cross sections, and is organized as a co-operative programme by four centres. For users in the U.S.A. and Canada, CINDA is available from the USAEC Division of Technical Information Extension; all other countries are serviced by the ENEA, IAEA, and Obninsk centres according to their location (see requests for data, above).

Nuclear Physical Constants for Neutron Activation Analysis, Atomizdat Publishing House, Moscow, U.S.S.R., 1969, ca. 240 pp, 53 k. This reference book contains the latest data on the activation characteristics of the elements for different types of neutron sources, charged particles, and gamma rays. Information on types of nuclear reaction and activation cross sections is included.

Isotopes, Reference Tables, by I. P. Selinov, Academy of Sciences of the U.S.S.R., Nauka Publishing House, Moscow, U.S.S.R., 1970, Vol. I, 623 pp, 4 r. 44 k., Vol. II, 608 pp, 4 r. 44 k., Vol. III, 255 pp, 2 r. 88 k.

Volumes I and II of these reference tables detail property data for stable and radioactive isotopes of atomic numbers 1-62, and 63-105 respectively. The reference tables were prepared from a survey of relevant experimental work covering the years 1892 to 1969. Volume III includes this bibliography, together with tables of atomic masses, elementary particles, and fundamental physical constants, and a diagram of the periodical system of atoms and atomic nuclei.

ATOMIC AND MOLECULAR PROPERTIES

NSRDS – NBS 34, Ionization Potentials and Ionization Limits derived from the Analyses of Optical Spectra, by Charlotte E. Moore, September 1970, $ 0.75, SD Catalog No. C13.48:34. Tables of ionization potentials expressed in electron volts and of the ionization limits from which they have been derived are included for the elements $Z = 1$-95. For each spectrum the ground term is given, with the limit as the ground state. The energy levels of terms of the lowest configuration determined from ground state zero are also included for selected spectra. A bibliography of 200 entries is provided.

NSRDS – NBS 3, Section 3, Selected Tables of Atomic Spectra, Atomic Energy Levels and Multiplet Tables, C I, C II, C III, C IV, C V, C VI, by Charlotte E. Moore, 1970, SD Catalog No. C13.48:3/Sec. 3*, the most recent publication in the NBS-NSRDS series, provides the third compilation in the current NBS programme for the revision of data on atomic spectra derived from analysis of optical spectra. These data were originally published in two sets of tables both by Charlotte E. Moore; *Atomic Energy Levels,* NBS Circular 467, comprised three volumes (1949, 1952, and 1958), while *An Ultraviolet Multiplet Table,* NBS Circular 488, was published from 1950 to 1962.

The present series, also by Charlotte E. Moore, combines the two types of data. Separate sections on individual species are published as they are completed, so that the material is available to users as rapidly as possible. Previously published sections of NSRDS – NBS 3 are Section 1 (1965, $ 0.35, SD Catalog No. C13.48:3/Sec. 1) and Section 2 (1967, $ 0.20, SD Catalog No. C13.48:3/Sec. 2), which covered Si II, Si III, and Si IV, and Si I respectively.

X-Ray Emission Line and Absorption Wavelengths and Two – Theta Tables (DS37A), 1970, 306 pp, $ 54.00.

X-Ray Emission Wavelengths and KEV Tables for Nondiffractive Analysis (DS46), 1970, 40 pp, $ 5.00.

Two compilations of X-ray emission lines have been produced and published by the American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, Pennsylvania 19103, U.S.A., as part of their Data Series (DS).

The larger tabulation (DS37A) includes all X-ray emission lines and their wavelengths up to 160 Å, incorporating approximately 3400 first order lines. Low-intensity diagram and satellite lines are included, and two-theta values are calculated for each line for 23 commonly used analyzing crystals.

In DS 46, X-ray emission lines shorter than 50 Å are given in two tables, arranged according to increasing atomic number and increasing wavelength.

Wavelength Tables with Intensities in Arc, Spark, or Discharge Tube of more than 100,000 Spectrum Lines most strongly emitted by the Atomic Elements under Normal Conditions of Excitation between 10,000 Å and 2000 Å, arranged in Order of Decreasing Wavelengths, 1969 edition, with errata and certain revisions; measured and compiled under the direction of George R. Harrison, Professor of Physics, by staff members of the Spectroscopy Laboratory of the Massachusetts Institute of Technology; assisted by the Works Progress Administration. M.I.T. Press, Cambridge, Massachusetts 02142, U.S.A., 1970, 429 pp, $ 25.00.

This publication is a revision of the *M.I.T. Wavelength Tables,* first published in 1939. In view of the size of the original volume, experimental work and data compilation and reduction for a completely up-dated volume were considered financially impracticable. The tables have therefore been reissued with corrections using the "Table of Corrections to the M.I.T. Wavelength Tables" set up with the help of the U.S. National Bureau of Standards.

NSRDS – NBS 31, Bond Dissociation Energies in Simple Molecules, by B. de B. Darwent, The Catholic University of America, Washington, D.C. 20017, U.S.A., 1970, $ 0.55, SD Catalog No. C13.48:31*, comprises a critical tabulation of bond dissociation energies of simple compounds. Organic compounds are excluded, except for those containing one carbon atom (the groups >CO and —CN are not considered to be organic). The values are usually quoted at 0 or 298 K and are referred to the gaseous state. They represent the energy required to break a bond at the specified temperature with all substances in the ground vibrational and electronic state. Recommended values with estimated uncertainties are given, and a bibliography of 203 references is provided.

SPECTRA

Infrared Analysis of Essential Oils, by J. Bellanato and A. Hidalgo, Sadtler Research Laboratories, Inc., 3316 Spring Garden Street, Philadelphia, Pa. 19104, U.S.A. (in U.K. and Western Europe, Heyden and Son, Ltd., Spectrum House, Alderton Crescent, London, N.W. 4, U.K.), 1970, $ 28.00, £ 11.75. This book includes 214 infrared spectra of essential oils, and of component compounds of these oils.

Infrared Vapour Spectra, Group Frequency Correlations, Sample Handling, and the Examination of Gas Chromatographic Fractions, by David Welti, Sadtler Research Laboratories, Inc., and Heyden and Son, Ltd., 1970, $ 21.00, £ 8.50.

In addition to a compilation of 300 reference vapour spectra scanned by the author, this volume includes sections on the group frequency correlation of infrared vapour spectra, sample handling, the band contours of vapour spectra, and the combination of gas chromatography and infrared spectroscopy. An index to 2,000 spectra from the IBM/ASTM cards of the commercially available reference spectra is also included.

The Sadtler collections of over 125,000 Standard Reference and Commercial Spectra (infrared prism and grating, ultraviolet, nuclear magnetic resonance) are being continuously updated and extended. Spectra are available in volumes or on microfilm, and with a variety of indexing methods, including computer retrieval systems. Further information from Sadtler or Heyden.

Atlas der Kunststoff-Analyse, Band I, Hochpolymere und Harze, Spektren und Methoden zur Identifizierung, by D. Hummel, Institut für physikalische Chemie und Kolloidchemie der Universität Köln, Germany, Fed. Rep., 1968, 849 pp (1758 spectra and 64 tables), DM 260,– (DM 228,–, subscription price); Band II, Zusatzstoffe und Verarbeitungshilfsmittel, Spektren und Methoden zur Identifizierung, by F. Scholl, Analytisches Zentrallabor der Robert Bosch GmbH, Stuttgart, Germany, Fed. Rep., 1970, ca. 400 pp (ca. 1000 spectra), Verlag Chemie GmbH, Postfach 129/149, 6940 Weinheim/Bergstr., Germany, Fed. Rep.

The second volume (Band II) of this atlas for the analysis of synthetic materials has recently been published, covering additives for manufacturing and processing, for example, solvents, plasticizers, stabilizers, fillers, and dyes. A compilation of approximately 900 infrared and 100 ultraviolet spectra is included, together with supporting information (in English and German), such as manufacturer, composition, uses, and physical property data. Volume I published in 1968 gives similar information, including 1758 infrared spectra, for high polymers and resins, e. g., plastics, natural and synthetic rubbers and fibres, lacquers, varnishes, and natural resins. Over 1200 literature references are included in the bibliographies to the two volumes.

Spectral Data and Physical Constants of Alkaloids, edited by J. Hobulek, Research Institute for Pharmacy and Biochemistry, Prague, Czechoslovakia, Academia, Publishing House of the Czechoslovak Academy of Sciences, Vodickova 40, Prague 1, Czechoslovakia (world distribution rights, except for Eastern Europe, Heyden and Son., Ltd). Volume VI of this v known compilation of spectral, physical, and optical data alkaloids is scheduled for publication in early 1971.

The five previously published volumes (1965-1970) prese data and information necessary for the unique identifica of 700 alkaloids, including their infrared and ultravi spectra, structural formulas, melting points, specific rotati apparent dissociation constants, botanical origin and oc rence, and bibliography.

Absorption Spectra in the Ultraviolet and Visible Reg edited by L. Láng, Akadémiai Kiadó, Publishing House of Hungarian Academy of Sciences, Budapest, Hungary (Dis butors: KULTURA, P.O.B. 149, Budapest 62), and Acade Press, 111 Fifth Avenue, New York, N.Y. 10003, U.S.A.

Volume XIII (400 pp, DM 72,–, $ 18.00) of this extensive lection of ultraviolet/visible spectra of complex inorganic organic compounds, including compounds used in the phar ceutical industry, was published in June 1970. In common v the previously published volumes, this most recent collect includes spectra and physical property data for approximat 200 compounds.

Table of Ion Energies for Metastable Transitions in M Spectrometry, by J. H. Beynon, R. M. Caprioli, A. W. Kundr and R. B. Spencer, Department of Chemistry, Purdue Univ sity, W. Lafayette, Indiana, U.S.A., Elsevier Publishing Co pany, P.O. Box 211, Amsterdam, The Netherlands, 1970, pp, Dfl. 70.00. These tables are designed to aid in the int pretation of ion kinetic energy spectra, with particular ref ence to the determination of the ionic reaction which gives to any meta-stable peak in a mass spectrum; they are intenc to supplement the information given in the *Table of Metasta Transitions for Use in Mass Spectrometry,* by J. H. Beyn R. A. Saunders, and A. E. Williams, Elsevier, 1965, 329 Dfl. 50.00.

Zahlentafeln zur Massenspektrometrie und Elementaranaly Ermittlung von CHNO (S) – Summenformeln [Tables Mass Spectrometry and Elementary Analysis, Determinat of CHNO (S) Molecular Formulae; Tableaux pour la spect métrie de masse et l'analyse élémentaire, Détermination formules moléculaires de CHNO (S)], by Günter Ege, Or nisch-Chemischen Institut der Universität Heidelberg, G many, Fed. Rep., Verlag Chemie GmbH, Weinheim/Bergs and John Wiley and Sons, Ltd., Baffins Lane, Chichester, S sex, U.K., 1970, 352 pp, DM 80,–.

These tables include analytical data, ordered by mass num and by CH percentage, for the determination of the mass f mulae of organic compounds containing up to 40 carbon ato 6 nitrogen atoms, and 12 oxygen atoms; sulphur can also considered by substituting one sulphur atom for two oxy atoms. The text is given in German, English, and French.

The Systematic Identification of Flavonoids, by T. J. Mab K. R. Markham, and M. B. Thomas, The Cell Research stitute and Department of Botany, The University of Texas Austin, Texas, U.S.A., Springer-Verlag, Berlin, Heidelbe New York, 1970, 354 pp, DM 98,–, $ 27.00.

This book comprises a collection of ultraviolet (UV) proton nuclear magnetic resonance (NMR) spectral data flavonoids, together with detailed procedures for their det tion, identification, isolation, and purification. Six UV spec for each of 175 flavonoids and 128 NMR spectra are includ

Tables of Nuclear Quadrupole Resonance Frequencies, by I. Biryukov, *et al,* translated from the Russian by J. Schmor Daniel Davey, Hartford, Conn., U.S.A., 1970, 135 pp, $ 7.0(

Originally published by the Khemia Publishing House, M cow, in 1968, this comprehensive data compilation includes bulated values of the nuclear quadrupole resonance frequ cies of individual compounds, as reported in the literature u the end of 1966.

SOLID STATE PROPERTIES

CRYSTALLOGRAPHIC PROPERTIES

Molecular Structures and Dimensions is a new series of reference volumes published by the International Union of Crystallography (IUCr), in conjunction with the Crystallographic Data Centre, Cambridge, U.K. (Director: Dr. Olga Kennard). The aim of the series is to make the results of structural investigations by X-ray, neutron, and electron diffraction and related methods readily and quickly available to all scientists interested in molecular structures. The new series is a continuation and extension of *Tables of Interatomic Distances and Configurations in Molecules and Ions*, and its *Supplement 1956 to 1959* (Editor: L. E. Sutton, Special Publications Nos. 11 (1958) and 18 (1965), The Chemical Society, London), which covered the literature until the end of 1959.

The first two volumes of *Molecular Structures and Dimensions* were published in October, 1970, and contain classified bibliographic information for over 4,000 structures, arranged in 86 chemical classes. Literature coverage is comprehensive (150 primary journals) from 1935 to 1 January, 1969, and there are 500 additional references to 1969 publications. Volume I, "Bibliography 1935-1969 General Organic Crystal Structures" (413 pp + 76 index pp., $ 9.00, £ 3.75, for personal copies, $ 12.50, £ 5.25, for library copies) and Volume II, "Bibliography 1935-1969 Complexes and Organo-Metallic Structures" (264 pp + 80 index pp, $ 7.50, £ 3.15, for personal copies, $ 10.00, £ 4.20, for library copies) represent the first output from a computerized structural data file at the Crystallographic Data Centre, from whom copies are available on magnetic tape. The late literature cut-off dates were made possible by the use of computerized text and index preparation, and typesetting.

The series is a continuing one, and it is intended to issue further bibliographic volumes annually with cumulative indexes. Volume 3 on the 1969-1970 X-ray and neutron diffraction data, and Volume 4 on electron diffraction and microwave data are now in preparation.

Orders for Volumes I and II of *Molecular Structures and Dimensions*, and standing orders for future volumes, should be made to the bookseller, or directly to A. Oosthoek, Domstraat 11-13, Utrecht, The Netherlands, or Polycrystal Book Service, P.O. Box 11567, Pittsburgh, Pennsylvania 15238, U.S.A.

MINERALOGICAL PROPERTIES

Calculated X-ray Powder Patterns for Silicate Minerals, by I. Y. Borg and D. K. Smith, The Geological Society of America, P.O. Box 1719, Boulder, Colo. 80302, U.S.A., in association with The Mineralogical Society of America, 1970, 896 pp, $ 15.00.

This book presents a collection of powder patterns of 193 silicates, calculated from single-crystal structural data. Source data (cell dimensions, site occupancy, space group, cleavage and habit) precede tabulated spacings, and integrated and peak intensities associated with each calculated silicate pattern. A simulated diffractometer trace is also given with each table. Since calculated patterns are not influenced by sample irregularities or by geometrical and instrumental aberrations, they are useful principally for identification (in this case, silicate phases in minerals), as standards for quantitative analysis, and as a guide to indexing of peaks used for calculations of accurate cell dimensions. The collection is intended as a supplement to the ASTM X-ray Powder Diffraction File, and includes a table of the five strongest diffraction maxima arranged in Hanawalt Groups.

Tables for Microscopic Identification of Ore Minerals, Second revised edition, by W. Uytenbogaardt and E. A. J. Burke, Elsevier Publishing Company, P.O. Box 211, Amsterdam, The Netherlands, 1970, ca. 400 pp, ca. Dfl. 60.00 ($ 16.75).

Quantitative information, including micro-identation hardness (VHN), reflectance in air, and polishing hardness, for the microscopic identification of 500 ore mineral species is presented in tabular form. Data for the following mineral types are given: selenides, tellurides, Ag-sulphosalts and Ag-Fe-sulphides, Pb-Sb-sulphosalts, Bi-sulphosalts, Pb-As- sulphosalts, Sn-sulphosalts and Sn-sulphides, platinoid minerals, and oxidic manganese minerals. An extensive bibliography is included.

ELECTRICAL AND MAGNETIC PROPERTIES

Electrical Conductivity of Ferroelectric Crystals, by V. M. Gurevich, GSSSD (State Service for Standard and Reference Data), Moscow, U.S.S.R., 1969, 383 pp, 1 r. 47 k.

This monograph presents data on the electrical conductivity and related properties of 60 compounds, 58 solid solutions, and 10 technical ferroceramics, which have ferro- and antiferroelectrical properties.

Electrical Properties of Inorganic Dielectrics in the Ultra-high Frequency Band, by M. D. Mashkovich, Radio Council, U.S.S.R., 1969, ca. 240 pp, 50 k.
Dielectric properties of various classes of glass and ceramics in ultra-high frequency fields, together with recent information on the stability of inorganic dielectrics under similar conditions, are included in this Soviet publication.

Landolt-Börnstein, Numerical Data and Functional Relationships in Science and Technology, New Series, Editors, K.-H. Hellwege and A. M. Hellwege, Group III, Crystal and Solid State Physics, Volume 4, **Magnetic and Other Properties of Oxides and Related Compounds, Part b** – Magnetische und andere Eigenschaften von Oxiden und verwandten Verbindungen, Teil b, by D. Bonnenberg, E. L. Boyd, B. A. Calhoun, V. J. Folen, W. Gräper, A. P. Greifer, C. J. Kriessman, R. A. Lefever, T. R. McGuire, M. Paulus, R. Vautier, and H. P. J. Wijn, Springer-Verlag, Berlin, Heidelberg, New York, 1970, 666 pp, DM 428,–, $ 117.70.

This most recent volume of the New Series of "Landolt-Börnstein" covers the magnetic properties of non-iron garnets, spinels, and hexagonal ferrites. An index of substances for both this volume and Volume III/4a, published earlier in 1970, is included.

MECHANICAL AND PHYSICAL PROPERTIES

Mechanical Properties of Glass, by P. Ya. Bokin, Grebenshikov Institute of Silicate Chemistry, U.S.S.R., Nauka Publishing House, Leningrad, U.S.S.R., 1970, ca. 360 pp, 79 k.
This recent Soviet publication provides basic information on the structure and mechanical properties, and the interdependence of these quantities, of one-, two- and multi-component glasses. The book collates a large amount of experimental results on the mechanical properties of glasses which have appeared in the scientific and technical literature over the past 15 to 20 years.

Reference Book on Materials Deformation, by S. P. Fezikh, Budivel'nik Publishing House, U.S.S.R., 1970, ca. 600 pp, 1r. 60 k.
The mechanical properties of construction materials are discussed and cited in this Soviet reference book.

Crystal Fibres, by G. V. Bereshkova, Institute of Crystallography, Nauka Publishing House, Moscow, U.S.S.R., 1969, ca. 240 pp, 69 k.
This monograph is one of the first to be published on crystal fibres, and unifies a wide range of experimental information on their production, properties, and applications.

Crystallization and Physico-chemical Properties of Crystalline Substances, by E. V. Khamskii, Nauka Publishing House, Leningrad, U.S.S.R., 1970, ca. 168 pp, 50 k.
The physical properties of crystalline substances are included in this book, together with information on the kinetics of crystallization of various salts in water solutions, and the influence of contaminants on these processes.

THERMODYNAMIC PROPERTIES

Thermochemistry of Organic and Organometallic Compounds, by J. D. Cox, National Physical Laboratory, U.K., and G. Pilcher, University of Manchester, U.K., Academic Press, 111 Fifth Avenue, New York, N.Y. 10003, U.S.A., or Berkeley Square House, London W1X 6BA, U.K., December 1970, 643 pp, $ 26.00.

This is a comprehensive compilation of data selected from the literature published since 1926 on the standard heats of formation and vaporization at 25°C for organic and organometallic compounds. The book includes a 38 page bibliography arranged chronologically.

Steam Tables (Industrial) in SI Units, published by agreement with the Ministry of Technology, U.K. (U.K. Committee on the Properties of Steam), Edward Arnold (Publishers) Ltd., 41 Maddox Street, London W1R OAN, U.K., 1970, ca. 160 pp.

For a complete description of other tables of thermodynamic and transport properties published under the auspices of the "International Conference on the Properties of Steam", refer to section 3.4.16., CODATA *International Compendium of Numerical Data Projects.*

Thermodynamic and Thermochemical Constants, Collection of Studies from the Soviet "Journal of Physical Chemistry", U.S.S.R., 1970, ca. 480 pp, 1 r. 92 k.

This handbook deals with the definition and new methods of measurement of thermodynamic constants. Many thermodynamic and thermochemical constants of compounds and substances, determined during 1966-1968 and not cited in other compilations, are included.

Selected Values of Thermodynamic Properties of Metals and Alloys, by Ralph R. Hultgren, Raymund L. Orr, Philip D. Anderson, and Kenneth K. Kelley, Department of Mineral Technology, University of California, Berkeley, California, U.S.A., John Wiley and Sons, Inc., 605 Third Avenue, New York, N.Y. 10016, U.S.A., 1963, 963 pp, $ 12.50. Supplements in loose-leaf form to this comprehensive compilation of thermodynamic data for metallic elements and binary alloys have been issued since 1964. The September 1970 supplement includes the elements Cs, Ga, K, Li, Na, Rb, and Tl, and the alloy systems Ag-Ga, Ag-Ge, Au-Cu, Au-Co, Au-Mn, Au-Pt, Au-Si, Cu-Mn, Fe-Si, and Ga-Mg.

High-Temperature Chemistry of Cerium-Oxygen Compounds, by A. I. Leonov, Grebenshikov Institute of Silicate Chemistry, U.S.S.R., Nauka Publishing House, Leningrad, U.S.S.R., 1970, ca. 360 pp, 90 k.

This monograph provides a systematic description of the properties of cerium-oxygen compounds, and contains physical and chemical property data on elementary cerium, cerium dioxide, and cerium sesquioxide. Data on phase relations in systems of cerium oxides with oxides of aluminium, chromium, gallium, titanium, silicon, and zirconium, and on the influence of the gas medium upon phase equilibria in the above systems, are included. The information provided will be of particular value for the application of cerium-containing multi-component oxides in electronics, and ceramic and refractory materials.

THERMOPHYSICAL PROPERTIES

NSRDS-NBS 32, Phase Behavior in Binary and Multicomponent Systems at Elevated Pressures: *n* – Pentane and Methane – *n* – Pentane, by V. M. Berry and B. H. Sage, 1970, $ 0.70, SD Catalog No. C 13.48:32*, is another recent compilation of selected data in the NSRDS-NBS series.

The properties of *n*-pentane covered are critical constants, vapour pressure, and density of saturated coexistent phases as functions of temperature. For the methane-*n*-pentane system, the compositions and densities of the coexisting phases are given as functions of temperature and total pressure. Data for the unique states of the two-component system are also presented. The reliability of the selected values and the differences between the selected values and the various measured values are discussed, and a list of references is included.

Thermophysical Properties of Organic Coolants, by M. P. Vukalovich, *et al,* Atomizdat Publishing House, Moscow, U.S.S.R., 1970, ca. 288 pp, 1r. 40 k.

This handbook covers the thermophysical properties of organic liquids used as coolants and moderators in nuclear reactors. Experimental methods and basic research on the thermophysical properties of these organic substances are also described.

Thermophysical Properties of Substances and Materials, 2nd Edition, GSSSD (State Service for Standard and Reference Data), Moscow, U.S.S.R., 1970, 299 pp, 1 r. 20 k.

The second edition of this compilation in the series "Physical Constants and Properties of Substances and Materials" includes experimental and evaluated data on the thermophysical properties of technically important gases and liquids.

Thermophysical Properties of Solid Substances at High Temperatures, 1969, 496 pp, 1 r. 84 k., **Thermophysical Properties of Gases, Liquids, and Plasmas at High Temperatures,** 1969, 407 pp, 2 r. 78 k., edited by Corresponding Member of the Academy of Sciences of the U.S.S.R., I. I. Novikov, and Prof. A. I. Gordov, GSSSD, Moscow, U.S.S.R.

Reports presented at the Conference on Thermophysical Properties of Substances at High Temperatures, Novosibirsk, U.S.S.R., 1966, are included. Analyses of experimental results on solid substances are covered in Volume I, and on gases, liquids, and plasmas in Volume II.

Thermal Conductivity of Gases and Liquids (Reference Data), by N. B. Vargaftik, L. P. Filippov, A. A. Tarzimanov, and R. P. Yurchak, GSSSD, Moscow, U.S.S.R., 1970, 153 pp, 54 k.

In this handbook, the available thermal conductivity data on helium, neon, argon, krypton, xenon, hydrogen, nitrogen, oxygen, air, carbon dioxide, ammonia, carbon tetrachloride, ethyl alcohol, water, and several hydrocarbons, have been systematically compiled and critically evaluated. Tables (70) of the most reliable values of the thermal conductivity over wide ranges of temperature and pressure of the above substances in both the gaseous and liquid states are included, together with a bibliography of 256 references.

Thermal Conductivity of Gas Mixtures, by T. N. Abramenko and A. G. Shashkov, Energiya Publishing House, U.S.S.R., 1969, ca. 336 pp, 80 k.

Recommendations on the selection of formulae for the calculation of thermophysical properties of gas mixtures are included in this Soviet reference book.

Landolt-Börnstein, Zahlenwerte und Funktionen aus Physik, Chemie, Astronomie, Geophysik und Technik, Sechste Auflage (6th Edition), Editors, H. Borchers, H. Hausen, K.-H. Hellwege, K. Schäfer, and E. Schmidt, Band II, Eigenschaften der Materie in ihren Aggregatzuständen, Teil 1, **Mechanisch-Thermische Zustandsgrößen** (Thermal and mechanical quantities of state), Editors, K. Schäfer and G. Beggerow, Springer-Verlag, Berlin, Heidelberg, New York, 1970, 955 pp, DM 560,–, $ 154.00.

This most recent volume of the 6th Edition of "Landolt-Börnstein" covers density values of gaseous, liquid, and solid substances, both pure and mixed, as a function of temperature and pressure. For gases, pressure-volume-temperature relationships are detailed (second and higher virial coefficients), together with fugacity (activity) coefficients; for liquids and solids, expansion coefficients and compressibility are also given. These tabulated data are supplemented by a table of equilibria of non-ionized substances. Data on densities of mixed systems are not given in great detail here, since they will be covered principally in the New Series of "Landolt-Börnstein".

TRANSPORT PROPERTIES

NSRDS-NBS-33, Electrolytic Conductance and the Conductances of the Halogen Acids in Water, by Walter J. Hamer and Harold J. DeWane, 1970, $ 0.50, SD Catalog No. C13.48:33*, is the second in a series of compilations of thermodynamic and transport property data of aqueous and non-aqueous electrolyte solutions, produced by a group at the Institute for Basic Standards of the U.S. National Bureau of Standards (see CODATA *International Compendium of Numerical Data Projects,* 4.3.9.).

Tabular data on the equivalent conductances of the halogen acids (hydrofluoric, hydrochloric, hydrobromic, hydriodic) in water are given for wide ranges of concentration and temperature. All data have been converted to absolute ohms, and the ^{12} C scale of atomic weights, and constitute an internally consistent compilation. Definitions relating to the conductance of electrolytic solutions are given, together with general laws and considerations of the migration of ions, conductance relations, and a condensed treatment of the Debye-Hückel-Onsager-Fuoss theories of electrolytic conductance.

CHEMICAL KINETICS

High Temperature Reaction Rate Data, No. 5, June 1970, is the fifth report in the series *Critical Evaluation of Rate Data for Homogeneous, Gas Phase Reactions of Interest in High Temperature Systems,* by D. L. Baulch, D. D. Drysdale, and D. G. Horne, School of Chemistry, The University, Leeds LS2 9JT, U.K.

The report covers the following seven reactions leading to the production of NO in high-temperature systems:

$$NO_2 + O = NO + O_2$$
$$NO + O_2 = NO_2 + O$$
$$NO_2 + M = NO + O + M$$
$$NO + O + M = NO_2 + M$$
$$NO + O = NO_2 + h\nu$$
$$NO + NO + O_2 = NO_2 + NO_2$$
$$NO_2 + NO_2 = NO + NO + O_2$$

As in previous reports, the available experimental rate data are tabulated for each reaction, together with the experimental method and evaluator's comments. For each reaction, a recommended value of the rate constant is derived, and a discussion and bibliography are provided.

The High Temperature Reaction Rate Data Project is supported by the U.K. Office for Scientific and Technical Information (OSTI), and is directed by Dr. D. L. Baulch, from whom copies of this and earlier compilations, and further information, may be obtained.

NSRDS – NBS – 21, Kinetic Data on Gas Phase Unimolecular Reactions, by Sidney W. Benson and H. Edward O'Neal, 1970, $ 7.00, SD Catalog No. C13.48:21*.

All available rate data on thermally induced unimolecular, homogeneous, gas phase reactions of molecules and free radicals are listed and referenced, and where possible critically evaluated. The literature up to 31 December, 1966, has been covered, and reaction rate data of special interest appearing in print between 1 January, 1967, and 1 February, 1968, are also included.

The compilation is limited to reaction kinetics of thermally equilibrated molecules and free radicals; not included are ionic species, and vibrationally and/or electronically energetic reactive intermediates produced photochemically, by chemical activation, or by high-energy radiation. "Unimolecular" reactions that are not first-order (i.e., those in their low-pressure or pressure-dependent regions) are reviewed only in those cases where extrapolations or calculations were made to provide estimates of the limiting high-pressure first-order rate constants.

Molecular reactions are classified according to four reaction types: 1. Molecular eliminations (or complex fissions); 2. Isomerizations of non-cyclic compounds; 3. Cyclic compound reactions; and 4. Simple bond fissions. Free radical reactions are treated as a fifth and separate type. Within the four major categories, reactions are grouped by mechanistic and structural similarities, so that data for many reactions of the same type may be readily compared. Reactions are indexed alphabetically according to the reactant molecules, and a section index lists the categories and groups into which each reactant molecule has been placed.

OPTICAL PROPERTIES

Optical Properties of Air at High Temperatures, by M. V. Avilov, Nauka Publishing House, Moscow, U.S.S.R., 1970, ca. 960 pp, 3r. 37 k.

The techniques, programmes, and results are presented for the computer calculation of the optical properties of air in the temperature and pressure ranges, 2,000-20,000 K and 0.001-100 atm.

EARTH SCIENCES

Handbook of Geochemistry, Vol. II/2, Executive Editor, K. H. Wedepohl, Springer-Verlag, Heidelberger Platz 3, 1 Berlin 33, 1970, 667 pp, DM 212,–, $ 58.30 (Subscription price applicable to orders for complete Handbook, DM 169,60, $ 46.70).

Physical Properties of Rocks at High Temperatures, by A. P. Dmitriev, *et al,* Nedra Publishing House, U.S.S.R., 1969, ca. 336 pp, 1r. 65 k.

This reference book includes thermal, mechanical, and electrical properties of a number of rocks, and also describes the variation of physical properties of rocks at high temperatures.

Geochemistry of Molybdenum and Tungsten, Nauka Publishing House, Moscow, U.S.S.R., 1970, ca. 240 pp, 1r.

Both original experimental data and those from the literature are compiled in this recent Soviet handbook. Information for mineralogists and geochemists on the most important geochemical and crystallographic properties of molybdenum and tungsten, and their behaviour in basic natural processes, are included.

Environmental Isotope Data No. 2: World Survey of Isotope Concentration in Precipitation (1964-1965) [Technical Reports Series No. 117-STI/DOC/10/117], International Atomic Energy Agency (IAEA), Kärntner Ring 11, P.O. Box 590, A-1011 Vienna, Austria, 1970, 404 pp, $ 8.00, £ 3.33.

Reference Book of Physical Parameters of the Atmosphere, by M. V. Glagolev, *et al,* Kharkov University, U.S.S.R., 1970, 80 k.

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* Order by SD Catalog No. from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, U.S.A.

BIO-SCIENCES

The sixth in the well-known series of biological data handbooks produced by the Office of Biological Handbooks of the Federation of American Societies for Experimental Biology (FASEB), entitled **Respiration and Circulation,** 930 pp, $ 30.00 (including postage world-wide), and edited by Philip L. Altman and Dorothy S. Dittmer, is scheduled for publication in early January, 1971. Further information from: FASEB, 9650 Rockville Pike, Bethesda, Maryland 20014, U.S.A.

Three comprehensive handbooks have recently been published in the U.S.A. by The Chemical Rubber Company, Cleveland, Ohio, and in Europe by Blackwell Scientific Publications Ltd., 5 Alfred Street, Oxford, U.K., and Verlag Chemie GmbH, Postfach 129/149, 6940 Weinheim/Bergstr., Germany, Fed. Rep., as follows:

Handbook of Biochemistry with Selected Data for Molecular Biology, 2nd Edition, Editor, Herbert A. Sober, 1970, 1700 pp, £ 18.00, DM 140,–.

Handbook of Analytical Toxicology, Editor, Irving Sunshine, 1970, 720 pp, £ 17.00, DM 114,–.

Handbook of Radioactive Nuclides, Editor, Yen Wang, 1970, 974 pp, £ 16.50, DM 122,–.

NOMENCLATURE, SYMBOLS, UNITS, STANDARDS, CONSTANTS

International Union of Pure and Applied Chemistry (IUPAC)

Information Bulletin, three issues per year, £ 1.00, $ 2.50, IUPAC Secretariat, Bank Court Chambers, 2/3 Pound Way, Cowley Centre, Oxford OX4 3YF, U.K.

No. 37, April 1970, 48 pp (includes "Table of Atomic Weights 1969"), No. 38, November 1970, 60 pp.

Appendices (to Information Bulletin) on Tentative Nomenclature, Symbols, Units, and Standards, irregular, free of charge, IUPAC Secretariat.

No. 3, January 1970, 84 pp, *Manual of Definitions, Terminology and Symbols in Colloid and Surface Chemistry* (Commission on Colloid and Surface Chemistry),

No. 4, January 1970, 3 pp, *Recommendations for Presentation of NMR Data for Publication in Chemical Journals* (Commission on Molecular Structure and Spectroscopy),

No. 5, January 1970, 8 pp, *Recommendations on Ion-Exchange Nomenclature* (Commission on Analytical Nomenclature),

No. 6, September 1970, 4 pp, *Nomenclature for Vitamins B_6 and Related Compounds* (IUPAC – IUB Commission on Biochemical Nomenclature),

No. 7, September 1970, 79 pp, *Carbohydrate Nomenclature* – 1 (Commission on Nomenclature of Organic Chemistry, and IUPAC – IUB Commission on Biochemical Nomenclature),

No. 8, September 1970, 36 pp, *Nomenclature of Inorganic Boron Compounds* (Commission on Nomenclature of Inorganic Chemistry).

Pure and Applied Chemistry, The Official Journal of the International Union of Pure and Applied Chemistry, four issues per volume (£ 12.00, $ 36.00), four volumes in 1970, Butterworth, London.

Volume 21, No. 1 (1970), included:

"Manual of Symbols and Terminology for Physicochemical Quantities and Units" (Commission on Symbols, Terminology, and Units), pp 1-44; also published under the same title in book form, Butterworth, London, 1970, 44 pp, £ 1.00, $ 3.00.

"A Study of the Accuracy and Precision of Methods for the Determination of Carbon and Hydrogen in Organic Compounds" (Commission on Microchemical Techniques), pp 45-84

"An Enquiry into the Purity of Commercial Radiochemicals" (Commission on Analytical Radiochemistry and Nuclear Materials), pp 85-90

"Atomic Weights of the Elements 1969" (Commission on Atomic Weights), pp 91-108

"Recommended Nomenclature for Liquid-Liquid Distribution" (Commission on Analytical Nomenclature), pp 109-114

"Co-operative Determination of the Melting Point of Alumina" (Commission on High Temperatures and Refractories, pp 115-122.

Volume 21, No. 4 (1970), included:

"Recommended Nomenclature for Automatic Analysis" (Commission on Analytical Nomenclature), pp. 527-532.

Volume 22, Nos. 3-4 (1970), included:

"A Report on the International Practical Temperature Scale of 1968" (Commission on Thermodynamics and Thermochemistry), pp 555-570.

Richtsätze für die Nomenklatur der anorganischen Chemie (Commission on Nomenclature of Inorganic Chemistry), Verlag Chemie GmbH, Postfach 129/149, 6940 Weinheim/Bergstr., Germany, Fed. Rep., 1970, 40 pp.

American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, Pennsylvania 19103, U.S.A.

Nomenclature and Definitions Applicable to Radiometric and Photometric Characteristics of Matter – STP 475, 1970, 30 pp, $ 3.00.

Two recently published books which include information on astronomical standards are as follows:

A New System of Astronomical Constants, by K. A. Kulikov, Nauka Publishing House, Moscow, U.S.S.R., 1969, 192 pp, 28 k. (includes the new system of astronomical constants adopted by the International Astronomical Union [IAU] in 1964).

Handbook of Tables for Mathematics, 4th Edition, by Samuel M. Selby, Mathematics Department, Hiram College, Ohio, U.S.A., The Chemical Rubber Company, Cleveland, Ohio, U.S.A., Blackwell Scientific Publications Ltd., 5 Alfred Street, Oxford, U.K., and Verlag Chemie GmbH, Weinheim/Bergstr., Germany, Fed. Rep., 1970, 1072 pp, £ 14.00, DM 99,– (includes nomenclature and symbols used in astrodynamics and celestial mechanics).

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