

In summary, there is a wide and increasing interest by colleges and universities in the use of on-line computer-based bibliographic services for obtaining scientific information. The end users are predominantly faculty and graduate students working on funded research projects. Library personnel are performing the searches, and the use of subject specialists for scientific subjects is indicated. Since it was found that users considered the information relevant to their needs all or most of the time, and since the comments were extremely favorable, the growth of the use of these services seems evident. The prevalent plan for paying for the services includes having the user pay for on-line and off-line charges, and having the library or university pay the searcher's salary and other overhead costs.

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Comparative Evaluation of Facts. The Significance of the Gmelin Handbook in Modern Science Documentation

WALTER LIPPERT

The Gmelin Institute, 6 Frankfurt/Main, West Germany

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The "Gmelin Handbook of Inorganic Chemistry" presents critically evaluated facts based on original literature and systematically arranged for a given subject. About 90,000 text pages have been published in the current Eighth Edition and the New Supplement Series. The material in Gmelin is arranged by elements and their compounds. The encyclopedic character of the Handbook plays a crucial role in providing a broad understanding of a given field. Storage of the Handbook's detailed subject index on magnetic tape is planned. This will provide a combination of Handbook and computer, capable of supplying broad information profiles as well as specific facts.

"Römpf's Chemical Dictionary" defines a handbook as the most comprehensive collection of scientific material.¹ The handbook offers a critical analysis of a specific field of knowledge, covering the subject matter exhaustively and in an organized manner. It is an indispensable and nearly all-encompassing store of information in which data are not listed as isolated facts, but are systematically grouped together with other relevant findings.

Over 150 years ago, back in 1817, Leopold Gmelin produced a handbook which bore the following caption on the title page: "Designed for use in his lectures." This indicates that Gmelin documented the science of chemistry in order to make possible a broader, deeper study of the science and also to transmit this knowledge by means of his lectures. The purpose was to encourage further research. Leopold Gmelin's plan succeeded, and the concept of his handbook was retained. Seven editions came out in rapid succession. From the fifth edition (started in 1852) on, inorganic and organic chemistry were separated and brought out as "Gmelin's Handbuch der Anorganischen Chemie" and "Beilstein's Handbuch der Organischen Chemie". In the eighth edition, initiated in 1922, the total body of knowledge of inorganic chemistry and related subjects going back to the middle of the 18th century was reevaluated on the basis of original publications and reviewed taking modern advances into account. This Eighth Edition is now being brought up to date through supplement volumes as well as by a New Supplement Series. The current status of the Handbook's publication is shown in Figure 1.

This chart illustrates the periodic system of elements

and indicates which elements and their compounds have been described in the Handbook or are still in preparation. In view of the vast mass of material and the limited staff and financial resources at its disposal, the Gmelin Institute, which prepares the Handbook, confines its active documentation work to selected areas of inorganic chemistry. For maximum timeliness, every effort is made to include papers that have appeared 6 to 12 months before the publication of the volume in question. The material contained in the volumes of the Handbook differs from the original papers as well as from reviews and abstracts in that it is not listed out-of-context, merely by date of original publication or by subject. Rather, it is a collection of all the data that have been reviewed critically and arranged within the larger context of a full description of the chemical elements along with all their characteristics.

Figure 2 is an excerpt from the Gmelin volume, Carbon, Part D, Section 1, which deals with carbon-nitrogen compounds. On page 259 of this volume, all the data pertaining to the stability of cyanamide are given. Included in the more general description is the finding by A. E. Baughen to the effect that, contrary to results obtained by other researchers, when cyanamide is heated to 150°C an instantaneous explosive polymerization to melamine occurs. The Gmelin text is compared with the corresponding reference on cyanamide in *Chemical Abstracts*, Volume 39, 1945.

A noteworthy aspect of the Gmelin Institute is that it functions not only as a scientific institution but also as a manufacturer of foundation stones for the sciences of tomorrow. As a manufacturer—like any economic enterprise—

Ammonium Lanthanide: Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu Actinide: Th, Pa, U, Np, Pu, Am, Cm, Bk, Cf, Es, Fm, Md, No, Lr

■ Hauptband der 8. Auflage erschienen
□ Ergänzungsband erschienen oder erscheint in Kürze
■ Hauptband in Bearbeitung

Figure 1.

Stabilität. Cyanamid neigt in wässriger Lösung zur Wasseranlagerung und vor allem zur Dimerisation, s. dazu S. 279 bzw. 272. Auch das kristalline Cyanamid ist nicht sehr beständig und neigt zur Dimerisierung zu Dicyandiamid (s. S. 272). Dies kann durch Spuren eines sauren Stabilisators wie NaH_2PO_4 und durch Lagerung bei niedrigen Temperaturen unterdrückt werden, J. R. McADAM, F. C. SCHAEFER (in: KIRK, OTHMER, 2. Aufl., Bd. 6, 1965, S. 560). Die Dimerisierung erfolgt im festen Zustand bereits bei gewöhnlicher Temperatur, L. A. PINCK, H. C. HETHERINGTON (Ind. Eng. Chem. 18 [1926] 629/30), bei längerem Aufbewahren, F. BEILSTEIN, A. GEUTHER (Liebigs Ann. Chem. 108 [1858] 88/102, 99, 123 [1862] 241/5). Beim Schmelzpunkt ist es 2 h haltbar, E. COLSON (J. Chem. Soc. 111 [1917] 554/61, 555). — In reinem Äthylacetat ist es beständig, A. J. COURTIER (Bull. Soc. Chim. France 1948 528/9), ebenso in ätherischer Lösung, A. FRANSSEN (Bull. Soc. Chim. France [4] 43 [1928] 177/93, 185), W. TRAUBE, F. KEGEL, H. E. SCHULZ (Z. Angew. Chem. 39 [1926] 1465/9). In verdünnter Essigsäure ist es stundenlang haltbar, H. NEUBAUER (Z. Angew. Chem. 33 [1920] 247/8, 254/6). — Oberhalb 110°C ist Cyanamid nicht beständig, W. H. FLETCHER, F. B. BROWN (J. Chem. Phys. 39 [1963] 2478/90, 2479). Es bildet sich zunächst Dicyandiamid, aus diesem durch weiteres Erhitzen Melamin, E. DRECHSEL (J. Prakt. Chem. [2] 13 [1876] 330/3). Während F. BAUM (Biochem. Z. 26 [1910] 325/32, 331) bei einer Erhitzungstemperatur von 150°C und auch N. CARO (Z. Angew. Chem. 23 [1910] 2405/7) beim Erhitzen die Bildung von Dicyandiamid angeben, findet A. E. BAUGHEN (Can. Chem. Process Ind. 28 [1944] 805/11) bei 150°C eine explosionsartige Polymerisation zu Melamin, die auch A. E. WERNER (J. Chem. Soc. 107 [1915] 715/28, 720) oberhalb 200°C feststellt.

Cyanamide. Arthur E. Baughen. Can. Chem. Process Ind. 28, 805-11 (1944). — A discussion of the properties, reactions and applications of cyanamide. Dicyandiamide has become an important chemical. Its manu- in-

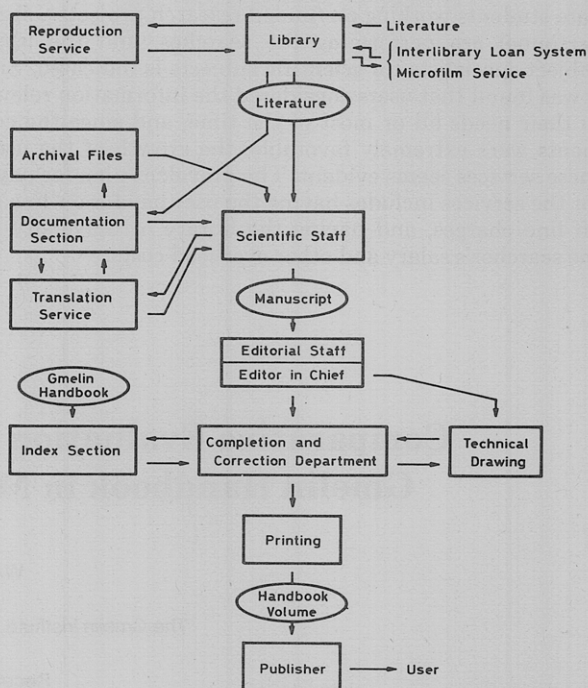
volves 3 main steps: (1) prep. of a free cyanamide soln. by the extrn. of com. CaCN_2 ; (2) the polymerization of the soln. and (3) crystn. and drying of the finished product. W. H. Boynton

Figure 2.

the Institute strives for maximum productivity. This requires organization and planning. About 130 full-time employees are engaged in the preparation of the Handbook; they are housed in the Carl-Bosch-Haus at Frankfurt/Main. Activities involved in the production of the Handbook are given in Figure 3. In view of the great intellectual effort required in the preparation of the manuscript and the high cost involved, every effort is made to relieve the scientific worker of the more routine functions. Those responsibilities are performed by several work teams. There is a library to procure the original publications; it belongs to the interlibrary loan system and is thus connected with many libraries in the country and throughout the world. In addition, it has its own extensive collection of monographs and periodicals (approximately 72,000 volumes). A special team scans current literature and conducts targeted research in order to provide the scientific workers preparing the manuscripts with the necessary source material. In this connection, the Institute has made extensive use of the magnetic tapes of the *Chemical Abstract Condensates* as well as ASCA from the Institute of Scientific Information in Philadelphia. A technical department prepares the edited texts for the printer and proofreads them. The completed Handbook finally reaches the user through the publisher.

The arrangement of the subject matter taken from the international literature is by chemical elements and their compounds. Within this scheme, the characteristics of each substance are treated. The subjects are arranged according to the "Gmelin principle of the last position." The elements are assigned system numbers which, for practical

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Work Flow at the Institute

Figure 3.

reasons, differ from those of the periodic system of elements in that the anion-forming elements have smaller system numbers than the cations. The volume for the system number n contains all compounds and combinations of the element with all elements having the system numbers 1 to $n - 1$.² A compound or combination of elements will thus be found in the volume on the element that bears the highest system number.

The Gmelin classification system has the advantage that every compound is entered and described in the Handbook in a uniquely defined place. Thus, one can be sure that, regardless of the author's description, a given compound will always be found in the same place in the Handbook.

NEW SUPPLEMENT SERIES

A New Supplement Series has been started to take the place of a Ninth Edition of the Handbook. The term New Supplement Series signifies that the volumes in question, while constituting an addition to the Eighth Edition, are quite distinct from the regular supplement volumes. The vast expansion of chemical literature has made it impossible to revise, in a new edition, all the work of the Eighth Edition, or gather anew in a handbook series all information on all the chemical elements and their inorganic compounds. The Eighth Edition will remain the basic reference system, followed by the New Supplement Series which will contain new knowledge developed in inorganic chemistry. The New Supplement Series cannot and will no longer attempt to cover, as before, the entirety of the field, but rather will concentrate on specific subjects. In some areas of inorganic chemistry the advances have been particularly rapid, and they seem to hold special interest for the future. The literature pertaining to those areas should be turned into handbook form as quickly as possible so that it may be promptly available for research and development in the coming years. By contrast, there are other areas of inorganic

ic chemistry where progress has been so slow that it is still relatively easy for the researcher to scan the literature, even without the use of a handbook.

One of the subjects on which development has come to a temporary standstill is that of noble gas compounds which are treated in the first volume of the New Supplement Series. One of the fastest growing areas is that of the relationship of inorganic chemistry of metallic and nonmetallic elements to organic chemistry; hence, a number of volumes of the New Supplement Series deal with the organic compounds of metals and perfluorohalogen organic compounds of the main group elements. Other volumes of the New Supplement Series deal with boron compounds and transuranium elements. The latter are of particular interest since the authors are distinguished transuranium scientists in the United States, England, France, and Germany who wrote in their respective languages. Sections of the texts are in English, French, and German. One of the contributors to the transuranium volumes is Glenn T. Seaborg, president-elect of the American Chemical Society for 1976. Other texts that are entirely in English are the double volume on organozirconium and organohafnium compounds as well as the water desalination volume which contains the latest literature on the increasingly vital problem of recovering fresh water from the sea with full coverage of all the technological problems involved.

The purpose of the New Supplement Series is to focus on subjects that are of particularly vital interest to science and research at the present time and to bring the Eighth Edition up to date in regard to those subjects.

THE INDEX

The Gmelin Handbook has, from the very start, been the sole comprehensive source of information for the entire science of inorganic chemistry. By the end of 1974, 281 volumes were published with 92,361 pages of text. It constitutes a unique monographic collection which has been described as "extremely systematic and lucid..."³ "As a source of useful and correct information, it has no competitor",⁴ and "carries the unmistakable seal of exactness and thoroughness of detail..."⁵

An index facilitates search. For some system numbers index volumes have been prepared. A ten-volume main subject index is in preparation; it will provide references to the elements and compounds covered in the 281 volumes published to date. The first index volume will be issued some time in 1975. The material will be arranged according to the alphabetical order of the summation, or empirical, formula, followed by the chemical formulas understandable to all chemists. An additional subdivision by subject headings in English will further facilitate search for specific properties of given compounds. This will then be followed by a page reference to the relevant volumes. The main subject index will list the elements and compounds and in-

dicate where they are described in the Gmelin Handbook. According to the Gmelin system, a given compound is treated at length in its proper place, but it may also be referred to elsewhere in the Handbook, for example, in its capacity as a coreagent. Such data can be useful and valuable as a supplement to the information given under the main subject especially where the volumes in which they appear are more recent than the basic volume on the subject.

All the necessary cross-referencing will be provided in a general index that will follow the main subject index. Such a general index providing specific retrievable information should answer the ever growing need of the future for prompt information on specific substances and properties. Through the Handbook an information seeker will be able to gain an overview of the current state of knowledge which he could obtain otherwise only by tedious reading of countless individual publications. In view of the intention to keep the material continually up to date, the Gmelin storage system, together with the Handbook, will constitute the sole comprehensive source of documentation and information in the field of inorganic chemistry.

The Gmelin Institute plans to develop an index for retrieval of specific information which may be consulted by means of the simplest possible inquiry profile. This index is intended to serve as a reference guide to the Handbook. Consideration is currently being given to the possibility of transferring the entire Handbook onto microfilm so as to make mechanical searching possible. The ultimate objective is to obtain, in reply to specific inquiries, reprints of pages from the relevant volumes of the Handbook. Because the literature closing date of the included material is known, the necessity of searching in abstracting journals prior to that date would be obviated. After consulting the Handbook the researcher need search only publications that appeared subsequent to the Handbook. It is conceivable that the day will come when the chemist may have direct access at his place of work to the Handbook's information store.

In order for the Handbook to be of utmost value and reliability, some time must be allowed to elapse between the latest findings and their critical assessment. Hence, additional information sources will be required to close the gap between the closing date of the Handbook literature and the present. The computer might help in this objective.

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