

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

### III. CLOSING REMARKS

The oceans provide an excellent forum for broad-scale, multinational, interdisciplinary research. As the world seems to become smaller and the demand for food and energy ac-

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

## Historical Development of Abstracting<sup>†</sup>

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Received April 11, 1979

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

### THE BEGINNING

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

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

### HELLENISTIC PERIOD

During the Hellenistic period, when the Greek civilization was dispersed throughout the Mediterranean area, Ptolemy I (367–285 B.C.) founded the famous Alexandrian Library, which was enlarged by Ptolemy II (309–247 B.C.). The Alexandrian Library contained over 500 000 scrolls, which are equivalent to about 100 000 books of today. Every scroll brought to Alexandria by its owner had to be deposited in the Library and exchanged for a copy. Another great library of the period was the one in Pergamum, which had a collection of about 200 000 scrolls. The Alexandrian collection was

classified on 120 scrolls. Scholars and scribes busily engaged themselves in these libraries, copying, abstracting, extracting, and annotating these scrolls to aid their memories or to repackage the information into histories, biographies, philosophies, etc. Through the decline of Greece and the ascendancy of the Roman empire, the Alexandrian Library was the means by which the heritage of the Greek civilization was transmitted throughout the Roman world and into the stream of history.

### DARK AGES AND MIDDLE AGES

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

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

<sup>†</sup> Presented before the Division of Chemical Information, 177th National Meeting of the American Chemical Society, Honolulu, Hawaii, April 4, 1979.

sources, humanists from the 13th century on reintroduced the encyclopedic concept for communicating information. The 18th century in France is known as the Encyclopedist Period. An outstanding example is the 17 volumes plus supplements of the work by Diderot and d'Alembert, "Encyclopédie ou dictionnaire raisonné des sciences, des arts et des métiers".

During the Middle Ages, beginning about the 10th century, universities were developed, first to teach clerics in holy orders, then law, and finally medicine. Then as now, students absorbed the words of their teachers by taking notes, i.e., by abstracting.

## RENAISSANCE

The Renaissance, the transitional period in Europe between medieval and modern times, 14th to the 17th century, saw the establishment of learned societies and academies of learning, such as the Accademia dei Lincei in Rome in 1603, the Royal Society of London in 1660, and the Académie Royale des Sciences in Paris in 1666. It was during the Renaissance that scientists communicated with each other throughout the civilized world by letters. Full letters would be sent to one or two friends, as each letter had to be written completely by hand, and abstracts would be sent to other friends. It is quite apparent that abstracting was a widely understood and used process since the time of antiquity.

Gutenberg's introduction of movable type in the 1450s democratized communication by the printed word. Within a few years, a flood of pamphlets and books became generally available. Many of these books, such as Biringuccio's "De la Pirotechnia", a 10-volume work printed in 1540, Agricola's "De Re Metallica" printed in 1556, and others initiated the rise in technology. Agricola's 12-volume work extensively reviewed the existing literature on mining and metallurgy.

The first scientific journal, "Le Journal des sçavans", was introduced as a weekly on January 5, 1665, by the French Académie des Sciences, to disseminate news of its activities, list new books with annotations, publish obituaries with summaries of the work of famous scientists, and inform readers of new developments with abstracts of papers reporting them. The abstracts of papers and annotations of books were highly critical. A few months later, also in 1665, the Royal Society of London founded the "Philosophical Transactions", which, in addition to publishing papers, also reported the work of other publications by means of abstracts. According to Barnes, 330 periodicals were introduced in seven European countries between 1665 and 1730, but only a few lasted more than a few years, some for only one or two issues. Many of these journals carried an abstract section, particularly of articles in foreign journals. Journals became the favored medium of communication in the 17th and 18th centuries, displacing encyclopedias and handbooks by virtue of the speed of producing journals.

## 18TH CENTURY

The first completely abstract journals tended to be universal, covering all subject areas, but concentrating mostly on literary articles and books. Possibly the first of these was Christian Gottfried Hoffman's "Aufrichtige", which was issued in two volumes of 12 issues between 1714 and 1717. The first abstract journals in England were the "Universal Magazine of Knowledge and Pleasure" (1747-1815) and the "Monthly Review", 1749-1844. In 1778, the "Monthly Review" carried abstracts of scientific papers, such as from the "Philosophical Transactions" and from the journals issued by the French, Belgian, other academies, and scientific societies. In 1825, the "Monthly Review" became strictly a critical literary review journal.

Lorenz von Crell is credited with founding the first wholly chemical journal in 1778 with the title "Chemisches Journal fuer die Freunde der Naturlehre, Arzneygelertheit, Haushaltungskunst und Manufacturen", popularly known as "Crell's Chemical Journal", which was issued under this title in six volumes for three years, until 1781. The name was then changed to "Die neuesten Entdeckungen in der chemie", and thereafter again in 1783, 1784, 1798, and 1801. Crell was very much interested in informing his readers of what he considered to be significant publications of others by means of extracts or abstracts. The French journal "Annales de Chimie" is the oldest chemical journal that is still being published. It was introduced in 1789.

## 19TH CENTURY

With the demise of the phlogiston theory in the 18th century and the gradual emergence of chemistry as a discipline of science in the 19th century, many chemical journals were introduced. As early as 1817 Leopold Gmelin felt compelled to issue his "Lehrbuch der Chemie" and in 1819 his "Handbuch der anorganischen Chemie", and in 1821, the rising journal literature prompted Jons Jacob Berzelius to start his "Jahresbericht ueber die Fortschritte der physichen Wissenschaften", the first review journal in science with emphasis on chemistry. Berzelius produced this yearly review for over 25 years, restricting the review after several years to only chemistry as reported in books and journals.

In the early part of the 19th century, the number of journals in chemistry reached the point where Gustav Theodor Fechner, at the age of 29, introduced the "Pharmaceutisches Zentralblatt" in 1830, the first abstract journal in chemistry. It was issued on a two-week schedule by the Verlagshandlung Leopold Voss in Hamburg; by September of 1830, it became a weekly. The objective as stated in the January 15, 1833, issue was to cover the journal literature in pure chemistry with concise and accurate abstracts of the pertinent scientific facts. The second editor was Wilhelm Knop, serving from 1848 to 1862, who changed the name to "Chemisch-Pharmaceutisches Zentralblatt" in 1850 and to "Chemisches Zentralblatt" in 1856 to emphasize chemistry as being different from pharmacy.

The French Chemical Society began to publish abstracts with the 1858 issues of its "Bulletin de la société chimique de France". The German Chemical Society published abstracts in its "Berichte der deutschen chemischen Gesellschaft" from 1868 through 1896 when it took over and began to publish "Chemisches Zentralblatt" in 1897. The Chemical Society and the Society of Chemical Industry in England published abstracts in the "Journal of the Chemical Society" from 1871 on and in the "Journal of the Society of Chemical Industry" from 1882 on. In 1926, these two British societies founded "British Abstracts". Japanese chemical literature has been abstracted since 1877 and in 1923 Riko Majima expanded it under the name "Nippon Kagaku Seran" (Complete Chemical Abstracts by Japan), which is now being published by the Japan Information Center for Science and Technology. The American Chemical Society included abstracts in its "Journal of the American Chemical Society" from 1897 through 1906, when it introduced "Chemical Abstracts" in 1907. According to Crane, Patterson, and Marr, the number of abstract journals had grown from "Crell's Chemisches Journal" to over 60 by 1907. There are now over 1500 abstracting/indexing publications throughout the world, according to the 1969 edition of the International Federation for Documentation's "Abstracting Services". The introduction and growth of abstract journals is related to the growth and size of the journal literature, and thus abstract journals have shown an exponential growth very close to that of the primary literature.

## 20TH CENTURY

The early abstract journals were restricted in coverage both geographically and by subject. Coverage expanded first geographically to include the foreign literature within a given subject area and then to broaden into more areas of chemistry. But even now, no abstract journal, not even *Chemical Abstracts* with its monitoring of about 14 000 journals, includes all the journal and patent literature that is relevant to the complete spectrum of what is going on in chemistry and in the laboratories of chemical industry. Chemistry today is expanding both in terms of new disciplines and of new interdisciplinary interests, such as material science whose literature embraces that of chemistry, physics, biology, and mathematics as well as that of engineering, especially that of mechanical engineering. In recent years, new abstracting services oriented more or less to interdisciplinary interests have been introduced. Highly computerized abstracting services, such as Chemical Abstracts Service, are now serving the specialized information needs of chemists with selective publications, such as "CA Selects", which include all abstracts of references on a specific subject from the total database. Numerous databases are now on-line, easily accessible via a terminal to a database broker, such as SDC, Lockheed, and others. Relatively few of these on-line databases, however, include abstracts. For the most part the user must judge relevancy by the title or keywords from the title or abstract of the reference.

There are two important aspects in every information system: (1) an indexing or classification system that directs the user to the body of documents of interest; (2) abstracts that enable the user to select from the body of documents only those which are relevant. The larger the document collection, the more critical it is that these two aspects be designed to serve the needs of the defined user community. Over the centuries, these two aspects were associated rather closely. With the introduction of the abstracting journals in chemistry, the two aspects became highly differentiated and each abstracting journal evolved its own unique way of preparing abstracts and of indexing the contents of journal articles. More recently, computerized databases have tended to deemphasize or ignore the abstract, and some of the more traditional abstracting services are using author abstracts rather than preparing abstracts that encompass the purpose or scope of the article, the experimental methods and equipment, the results, and the conclusions of the work. An author's abstract too often merely introduces the paper or emphasizes the conclusions, and rarely tells the reader what's new. The title of the paper too often is more misleading than informative of the contents. Not only is less attention being paid to abstracting as an art and science, indexing and classification of information also are being neglected by computerized databases.

At its best, an abstract is an abbreviated, accurate representation of a document, a repackaged surrogate of information in a condensed form. An abstract by necessity, however, involves a considerable loss of information. It is in no way the equal of the original document. From the historical perspective, abstracting is a process of selecting and ignoring information and of generalizing that which is selected primarily to enable the potential user to determine the relevancy of only pertinent documents in a large collection of documents.

## SYNONYMS OF ABSTRACT

An abstract, semantically, denotes and connotes a spectrum of meanings which have evolved over the centuries:

*Abridgement*—a shortened or reduced form of a work which retains the general sense and unity of the original.

*Abstract*—a summary of the pertinent points in a document. As originally conceived and developed, an abstract was not

intended to have value independent of the original document.

*Annotation*—a note, explanation, or comment added to a reference.

*Aperçu*—a brief survey or sketch giving an abbreviated impression of the whole.

*Aphorism*—a terse statement embodying a result or conclusion; see C. L. Bernier's paper, "Condensed Technical Literatures" in bibliography.

*Brief*—a short and concise statement of selected arguments and information, generally employed by lawyers. Briefing of pilots consists of a summary of the details of a flight mission.

*Compendium*—a summary of many works in a field of knowledge, gathering together and presenting in a concise form the essential facts and details from a document collection, e.g., Gmelin and Beilstein.

*Conspectus*—a quick overall view of a large document or a set of documents.

*Digest*—a highly condensed summary or classification, originally of a collection, but more recently of a single document.

*Epitaph*—a brief statement epitomizing a past event; some historians, such as W. Durant, have used this concept as the end of an historical treatment to summarize the salient features of a long discussion.

*Epitome*—a summary, with independent value, of a document.

*Excerpt*—an extract.

*Extract*—a verbatim portion or portions of a document.

*Hypothesis*—a summary of the play in ancient Greece in which occurrences in the play were explained by a series of propositions.

*Précis*—a concise statement of the essential facts or points in a document.

*Resumé*—a summary.

*Summary*—an abstract or abridgment, originally at the end of a document, stating the salient points.

*Survey*—a relatively concise but comprehensive treatment presented generally as a preliminary to further study.

*Syllabus*—a series of statements, propositions, or headings giving a comprehensive view of a large subject.

*Synopsis*—a summary giving a view of the whole. A few publishers of chemical journals, including The Chemical Society (London) and the American Chemical Society, have been introducing the "synopsis" journal containing a condensed version of the larger original paper. The first synopsis version was introduced in 1974 by "Chemie Ingenieur Technik", and The Chemical Society's (London) "Experimental Synopsis Journal" was introduced in 1976.

## EPILOG

Abstracting over the centuries has meant many things. Yet, from note taking to marginalia and annotations to abstracts of the quality produced by *Chemical Abstracts*, many of which contain sufficient information to be independent of the original document, abstracting has served as an important link in the chain of communication between the originator of a document and those who have a potential need for some or all of the information in a given document. Almost from the very beginning, abstracting has been practiced as a device of planned parsimony. Abstracting did not evolve as an art or science except as exercised and controlled by each individual abstracting service, such as Chemical Abstracts Service or by those who publish compendia, such as Gmelin and Beilstein.

The concept of abstracting is embedded in a spectrum of meanings which are illustrated better by examples. In an important sense, this paper is an abstract, or more properly an abridgment of my reading over the years and most directly of the references listed in the bibliography.

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## Using Bibliometric Analyses of Patent Literature for Predicting the Clinical Fates of Developing Drugs<sup>†</sup>

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Received June 1, 1979

Certain bibliometric features of the early literatures of developing drugs can be used to predict their ultimate clinical fates. The chronological sequence of publications is expressed as a binary vector with 1 for a patent and 0 for a nonpatent. The decimal equivalents for standardized vector lengths provide scalar values for comparing one drug with another. In order to incorporate concordant patents, fuzzy subsets are employed, with the number of attempts required to achieve transitive closure being the values for comparison. The methods involved are described using minoxidil as an example.

"Just as the twig is bent the tree's inclined."<sup>1</sup> This may well be true for certain biological situations, but there is some indication to suspect that it may also hold for literature-based information systems. Information tends to spring from previous information, knowledge seems to beget more knowledge, and publications emerge from previous papers. At least, it was felt, such an approach to the literature might be worth investigating.

Consider the publications on a drug as forming a discrete information system. A drug literature does not spontaneously happen. Each publication is the end result of a dynamic interaction involving authors, editors, referees, printers, publishers, and even subscribers and readers. Once published, the paper becomes an individual element in another complex system, the body of literature itself. Unlike a static filing operation, a published document is related to other documents by the citation process.<sup>2</sup> The literature is a dynamic system composed of a citation network which changes each time a new publication cites previous papers.

The human forces that launch a publication all have their own motives. What they are is not too important, but their existence, per se, can be exploited.

As documents are published, they form numerous patterns with respect to one another. One paper comes before the next; one is a patent and the other is not; one reports on humans while another is about rats while still another is about chromatography; several appear in the same journal whereas others appear elsewhere, and so on.

These publication patterns are the combined outward expressions of all the social motives that launch the publications. As such, these patterns are characteristic of their antecedent literatures, fingerprints of individuality as it were—reflections of the motives that generated them. Or, put more simply, "by their fruits you will know them".<sup>3</sup>

When it comes to new drugs, the people who know the most about a particular drug are those who work with it. Investigators who realize they have a great drug will act with motives far different than if they have a mediocre drug. The resulting publication patterns reflect this. Therefore, if these patterns can be recognized, classified, and compared, they can be used to discern the great drugs from the mediocre ones, at a very early stage in their development—which is, in effect, a prediction of clinical success.

Patents are publications.<sup>4</sup> They must be treated as such. No bibliography on a drug is complete if it omits the patents. Unfortunately, the regular journal literature does not often cite the patent literature, and vice versa! There is a curious

<sup>†</sup> Presented at Annual Meeting, Science Information Subsection, Pharmaceutical Manufacturers Association, March 6, 1979.