cards on steroids disclosed in patent classification # 260. Only steroids which fall into certain subclasses are coded. Excluded are all homo- and seco-type steroids. During 1958–1960, a part of the steroid literature was coded for the Patent Office on an experimental basis.

The Patent Office classifies patents on claimed subject matter rather than on subject matter disclosed, but once the patent fits one of the specific classes the information disclosed in the title, text, claims or configurations of possible substituents is extracted and coded. The patent number is also coded and punched. One of the disadvantages of this system is that the steroids are overcoded; *i.e*, many steroids listed in the patent are coded on the same card. This results in many false drops during a retrieval search.

SUMMARY

Many of the existing secondary literature sources in the chemical and biological fields are described. The plea is made that new journals and services be made available only if they can replace existing ones. To add to the working scientists's present reading burden is intolerable.

Information-Gathering and Use Habits of Chemists*

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Information-gathering and use-habits studies, abbreviated throughout this paper as "IGS," are aimed at determining why, how, how much, and with what effect information and information services are used. The information specialist—and this includes the information scientist, the documentalist, librarian, literature chemist, and information researcher—knows why information services should be used. He can, and does, point out that information services are useful as a source of ideas, for translating ideas into research projects (or abandoning the idea if someone else has preempted the field), for providing background information on research projects, and for determining specific facts. However, information services are intended for the final user of information, not for the information specialist. Differences therefore exist between how information services should be used and how they are used in fact. Mooers has pointed this out in some generalizations on why some information retrieval systems are not used:

> "An information retrieval system will tend *not* to be used whenever it is more painful and troublesome for a customer to have information than for him not to have it... Having information *is* painful and troublesome. We all have experienced this. If you have information, you must first read it, which is not always easy. You must try to understand it. To do this, you may have to think about it. The information may require that you make decisions about it or other information. The decisions may require action in the way of a troublesome program of work, or trips, or painful interviews. Understanding the information may show that your work was wrong, or that your boss was wrong, or may show that your work was needless. Having information, you must be careful not to lose it. If nothing else, information piles up on your desk unread. It is a nuisance to have it come to you. It is uncomfortable to have to do anything about it. Finally, if you do try to use the information properly, you may be accused of puttering instead of working. Then in the end, the incorporation of the information into the work you do often may not be noticed or appreciated. Work saved is seldom recognized. Work done—even in duplication—is well paid and rewarded."[1]

IGS are potentially useful in bridging the gap between the kind of information services needed and the kind in existence, and between how information services should be used and are used. Studies reported in the literature deal with different phases of the subject and different types of user populations and make use of different study techniques. The aim of this paper is to present a brief review of the literature of and about IGS, and to determine whether and how IGS can assist in improving information systems in general and/or, more specifically, in planning and evaluating information services for a particular research organization.

For a fuller survey of IGS, the reader is referred to reports by Tornudd[2] and Columbia University's Bureau of Applied Social Research.[3] Both of these reports attempt to compare results of IGS. Tornudd has also prepared a summary of 72 studies arranged by subject field of users. IGS in progress are reported in Section 1, "Information Needs and Uses," of the National Science Foundation's semi-annual publication, "Current Research and Development in Scientific Documentation."[4]

IGS are concerned with the interaction between information and the user and producer of information. IGS attempt to determine how ideas and facts are generated, recorded, disseminated, and obtained from the recorded and remembered body of knowledge. Such studies are thus concerned with the entire spectrum of communication of technical and related information, of which information services are a part.

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Techniques used in IGS are grouped in the previously cited report of Columbia University's Bureau of Applied Social Research into the following seven categories:

1. Examination of library circulation records and tracing of specific withdrawals.
2. Examination of records of reference questions.
3. Observations by self or by others.
4. Diaries.
5. Questionnaires.
6. Interviews.
7. Reference counts.

Examples of each of these techniques drawn from reports presented at the 1958 International Conference of Scientific Information are given by Herner.[5]

The Validity and Utility of IGS.—The validity of IGS has been questioned on a number of grounds. Bernal, for example, points out that a user of information may well know what he *wants* from an information system but that he is in no position to know what he *needs* from it, namely, what variation in the system would help most in his work. He further argues that in all matters involving human behavior it is very difficult to infer from measured behavior in one set of circumstances, even subject to some variation, what they would be under different circumstances.[6] Rees also concludes that there has been confusion between users' wants and needs, and that needs of users have been conditioned by existing systems.[7] Taube questions the rationale behind IGS by stating that information service is a professional service (such as medicine), as opposed to a consumer service (such as the packaging of breakfast food), and that IGS cannot provide a measure of effectiveness or a guide to the design of information systems. He admits, however, that IGS may have utility in determining optimum size of the information package and in determining need for user education.[8] Shaw questions the utility of IGS as a firm basis for planning communication programs, either because of variation in the assumptions or inadequacy of the method or of interpretation, and also because of inadequate sampling of user population.[9] Of his own study he concludes that the diary method, even with better-than-average cooperation and supervision, is not reliable enough for studies over extended periods of time.[10] A similar criticism of IGS was made in the Columbia University's Bureau of Applied Social Research study. The authors point out that problems of diverse and ill-defined population, diverse units of observation and basis of computation, diverse classification of communication channels, and paucity of analysis in depth lessens the value of IGS and makes their intercomparison difficult.[11] Herner cites as potential pitfalls of IGS the use of unrepresentative population, atypical time-period studies, reluctance of people to keep records over extended periods of time, overinterpretation or anticipated responses by the interviewer, and what is known as the "spotlight effect"—a change in normal pattern of behavior when under observation.[12] Fry points out that needs for information services vary with subject fields, type of research conducted and related activities, geographic situation, and human ability. Furthermore, he indicates that needs for an information system vary from time to time, depending on current interests and activities.[13] There is yet another factor that must be taken into consideration when determining applicability of IGS: the date when the study was conducted. A readership survey of *Chemical Abstracts* conducted in 1950 brought out the fact that 84% of the 7000 respondents personally paid for their copies of *Chemical Abstracts*.[14] I am certain that a similar study conducted today would yield different results.

There seems to be agreement among workers in the field that presently used IGS techniques are imperfect and that results obtained from such studies are, therefore, not completely reliable. Yet if information services are intended for the final user of such information, and if existing information services can and should be improved it would appear that a logical first step in designing improved information systems is to review our knowledge of users' information needs and to attempt to fill gaps in such knowledge. This step requires knowledge of communication habits of users, in general terms, and information needs in a given organization, in particular. If our tools for determining this information are imperfect, it should be remembered that we are dealing with multicelled animated objects that cannot be studied with the tools of the chemists. Consequently, we cannot expect or obtain precise answers. The problem is one which has plagued the social and psychological sciences constantly. Furthermore, our tools for providing information services are also imperfect, and they are likely to remain so. The latter point is, of course, not an argument against attempts at improvement. This seems to be the gist of the argument by Herner, Tornudd, and Fry for utilization of results of IGS and for further and better studies. Herner observes that IGS, imperfect as they are, can still be an important source of guidance in the design of information storage and retrieval systems. He believes that results obtained thus far form the basis for useful generalizations. He also argues that such studies can tell us what information does not have to be included in the information system and what a system does not have to do, an important point in view of the persistent tendency to over-generalize and to inflate system requirements.[15] Tornudd concludes her review of IGS by stating that local studies directed to the user of information to clarify questions connected with service will continue to be a necessity.[16] Fry notes that studies dealing with what scientists are doing in their present situation are a first step toward better understanding of the information problems. This first step is to be followed by experimentation with improved information services.[17]

Highlights of Results of IGS.—Highlights of results from a select number of IGS in which the user population consisted exclusively or partly of chemists will now be reported.

A study reported by Martin and Ackoff, based on 25,000 random observations of 1500 chemists, has shed some light on how the chemist spends an average of 90 hr. per week, the time that he is not asleep. Time spent on other than personal or social endeavors (39.1 hr. per week) is used in the following way:

16.5 hr. per week—scientific communication
10.4 hr. per week—equipment set-up and use
6.7 hr. per week—business communication
3.0 hr. per week—data treatment
2.5 hr. per week—thinking and planning (not too much of that)[18]

The amount of time spent on reading scientific and technical documents was found to be 5.3[19] and 5.2[20] hr. per week in two studies. In one, journal reading accounted for about 2.7 hr. per week.[21]

The prevalence of personal indexes was determined in three studies. It was found that 45,[22] 57,[23] and 66%,[24] respectively, of the surveyed scientists had and/or used a personal index. Subscribers to American Institute of Chemical Engineers publications have recently been surveyed by Herner and Company on (among other things) their use of key words with roles and links, bibliographic citations, and abstracts printed with these publications. This study is intended to determine actual use by the final user of information of an information system intended *for* the final user of information.

The use of Soviet translations by American chemists was investigated in another recent study by Herner. He determined that Soviet translations are used widely but infrequently, that such usage is likely to be the result of chance encounters rather than of specific searches of the Soviet literature, and that translations are most frequently obtained by borrowing library copies.[25]

Another aspect of information use is the portion of reading done in the an organization's library. Three studies reported that this turned out to be 13.7,[26] 14,[27] and 3%,[28] respectively, of the reading acts. Additional seating space and more convenient facilities in the library were provided during the later part of Shaw's study. This did not, however, result in increased use of material in the library.[29]

The importance of informal channels of communication was brought out in a study by Menzel on planned and unplanned scientific communication.[30] A study of how 50 scientists learned of work of importance to them was conducted by Glass and Norwood. Such work was represented by 346 items from the literature. The sources cited most frequently were casual conversations (22.6%), journals regularly scanned (22.0%), journals subscribed to (8.4%), and citation in a paper (6.9%), respectively.[31]

The level of information service that a scientist is likely to require has been discussed by Herner.[32] He maintains that the pure scientists are not likely targets of the efforts of documentalists in the design of ornate, centralized information storage and retrieval programs, because the relatively concentrated nature of their work makes it unlikely that they will delegate their information chores to outside agencies. On the other hand, evidence exists that applied scientists can be helped by large and centralized information storage and retrieval systems because literature for the applied scientists is not as intimate a part of the research process as for the pure scientist, because of the degree of dispersal of the literature, and because the applied scientist already customarily delegates searches when he can.

Related Studies in Various Stages of Completion.—The recorded use of information as exemplified by records of reference requests has been investigated by Herner,[33] Mote,[34] and Cole,[35] as well as other workers. The records are analyzed to aid in planning the acquisition program, the organization of material, and staffing. Reference questions are analyzed in terms of number of concepts per search headings, types of bibliographic tools in which answers were found, and type of training required by the person answering the question. The documents provided as answers are examined also in terms of age, form, language, and subject of publication in some of these studies.

Users' reactions to new information services are reported in several studies. Two recent publications which deal with this in more than incidental fashion are papers by Freeman and Dyson and by Resnick and Hensley. In the development of *Chemical Titles*, the key-word-in-context index published by the American Chemical Society, users' reactions at various stages of development and changes resulting from users' reactions were reported by Freeman and Dyson.[36] Users' reactions to a selective-dissemination-of-information service, a service which utilizes the aid of computers to direct potentially pertinent new documents to users by matching key words in newly received documents against key words that represent users' interests, has been described by Resnick and Hensley.[37]

Bernal suggests competition in scientific research in the same field by three teams which have the best available, the present average, and no information service, respectively.[38] A similar suggestion has also been made by Tornudd.[39] A study of biographies and autobiographies of highly creative individuals to determine how they get their ideas is suggested by Borko.[40] The question of motivation is raised by Menzel, who suggests studies to determine what motivates individuals to keep informed.[41]

Implications of IGS to Managers of Technical-Information Services.—It is axiomatic that managers of technical-information services have to provide information here and now, and that they cannot await the arrival of the perfect information system. It is equally obvious that there is an urgent need to improve information services in most if not all organizations. Where and how such improvements need to be made and how much such improvements are worth to the organization are less obvious points, because we have not been able to formulate specifications for technical-information services. This, in turn, is at least partially because we are insufficiently familiar with the information requirements of the final users of information. Despite the limitations of previously conducted IGS studies, results of such studies form the beginning of generalizations on how much time a scientist spends on technical reading, what and where he reads, and what his bibliographic blindspots are. Results of IGS cannot be used, *per se*, in a local situation, because of differences in user population, aims of organization, information environment, and other factors. However, results of such studies can and should be used as a point of departure for local IGS. Thanks to the efforts of workers in the field, techniques for conducting local studies of the use and user of information are now available.

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