were filed. With retrieval systems that generate a strict rank-ordering, the ranked order pre-empts any postretrieval reordering.

OUTPUT STREAMS

Retrieval output, traditionally in the form of a display, but increasingly in the form of a stream of objects to be used elsewhere or for some other purpose, completes the basic retrieval cycle. Such streams can be directed to visualization tools, storage for later processing, or use as Input Streams to other selection systems, or as feedback within the system itself.

FEEDBACK

There is, in principle, an opportunity for feedback from the output of any process. For example, the output from any process can constitute feedback to other processes and to the searcher. Feedback can provide the basis for expert judgement or expert systems at any stage.

INFORMATION SERVICES

Among the more important information services available to scientists have been abstracting services and data archives. In response to the developing information crisis in the social sciences, they are now being adapted to the special needs of these disciplines. Abstracting services prepare and distribute succinct synopses and summaries of the growing volume of publications and research activities, whereas archives acquire, process, and make available existing social science data.

Neither of these services has been fully able to accomplish the purposes for which it was established. This relative failure is partly due to the inadequate facilities available for solving an overwhelming challenge. It is also explained in part by the lack of concern with and knowledge about information problems, needs, and solutions in the social sciences. The dimensions of the information crisis are only now being isolated, and the tools for its resolution are still in an early stage of development. The scope of the information crisis in the social sciences, the range of responses designed to resolve the crisis,

the contributions and limitations of abstracting and archive services, and the relation of the operations and concerns of these services to broader theoretical developments in the social sciences.

THE INFORMATION CRISIS

The contemporary information crisis in the social sciences has several salient features that create special difficulties for the social science information services. First, with the increase in the size and heterogeneity of the social science community, opposing demands are often placed on information services. For example, some scholars value brief, descriptive reviews of a wide range of published articles, whereas others prefer longer, evaluative analyses of a limited range of current publications.

Second, with the growth of social science research and writing, it is becoming extremely difficult to locate and report on developments and materials relevant to the social sciences. The expansion of the social sciences around the world, together with the extensive amount of classified research conducted by governments and other groups, further adds to this difficulty.

Third, research in the social sciences is perhaps more erratic in quality than that in other sciences. As a consequence, a great volume of irrelevant and harmful materials clogs the social science communication channels, consuming valuable resources and detracting from the cumulative development of the field.

Considerable attention has been given to the consequences of the information crisis, both upon individual scientists and upon science viewed as a system (Menzel 1964). Individual scholars find it increasingly difficult, if not impossible, to keep abreast of new concepts, methods, theories, and findings, even in their narrow field of specialization, let alone in adjacent, relevant fields. This difficulty does not refer solely to the scholar's lack of time to read all the relevant literature or to his inability to remember what is relevant in what he reads. It also refers to the absence of information facilities that are capable of locating, organising, and retrieving the relevant material.

This maldistribution of information manifests itself in costly duplication of research efforts and in a failure to build upon prior scientific work. In an exploratory study of bibliographic needs of economists, psychologists, and anthropologists, approximately 60 per cent of each discipline reported that "they sometimes or often have failed to learn in time about some relevant prior work that would have made a difference in their research or teaching".

Clearly, the expansion of information is creating a major crisis for the future development of science. Unless new methods are perfected to help locate and preserve available information, it will be extremely difficult to maintain the cumulative effect of research. Abstracting services and data archives are only two of many methods that have been developed to retrieve, process, and distribute information in a more rational and effective manner.

Responses to the Information Crisis

Efforts to cope with the information challenge can be described from three different perspectives: first, overarching, multifaceted programmes that focus on the entire information system; second, specific devices such as abstracting services and archives developed to meet particular needs: and third, issues and problems related to the organisation and performance of specific kinds of information services.

National Information Programmes

An increasing number of countries are formulating national information policies involving a wide range of specific programmes designed to rationalize the nation's scientific information system. There are a number of motivations behind these developments, not the least of which relate to national security interests. For example, the United States government, especially the military sector, is a major source of research and development funds for many scientific disciplines.

In order to plan and manage their programmes, these sponsors need information as to who is engaged in what problems, how great the scope of the effort is, who is supporting

the work, what additional work is being planned, what the time schedule is, etc. However, "resources information" is only one element in planning scientific programmes. In addition, the scientists engaged in the work also need information programmes.

A major milestone in the American government's development of a national information policy occurred with the passage of the National Defence Education Act of 1958, an act empowering the National Science Foundation to establish a science information center that would support and encourage work related to indexing, abstracting, translating, and the development of mechanized systems for retrieving, storing, and disseminating information.

A number of government and private groups have made their own studies of the information crisis, and these contributed to the creation in 1958 of the National Federation of Science Abstracting and Indexing Services, a group fostering greater cooperation and coordination between its members; these efforts also contributed, partly through the encouragement of the National Science Foundation, to the creation in 1964 of the National Council of Social Science Data Archives, a cooperative venture encouraging the coordination and development of the activities of its members. These various developments have also helped to make individual scholarly associations more conscious of their own information problems. For example, the American Psychological Association has conducted a series of studies on a wide range of information problems experienced in that field.

These American programmes have major implications for social science communication in other countries, because the American services are increasing their coverage of information produced in other countries, because the American scientific output looms so large in the over-all international perspective, and because the information services in many countries are relatively weak or do not exist.

However, many countries have especially strong information programmes in the physical, natural, and medical sciences, as well as in technology. Most noteworthy is the All-

Union Institute of Scientific and Technical Information (Vsesoyuznyi Institut Nauchnoi i Tekhnecheskoi Informatsii, usually abbreviated VINITI), originally created by the Soviet Union's Academy of Sciences in 1952; a somewhat comparable group exists in Poland; both Uruguay and Argentina, as well as the state of Sao Paulo in Brazil, have established research councils that perform various information functions; and through the encouragement of the American government, research and information services have been established by several other countries, including Turkey and Thailand.

International information programmes have also been initiated. Of special significance to the social sciences are the activities of the United Nations Educational, Scientific and Cultural Organisation (UNESCO), the International Committee for Social Sciences Documentation, and the International Social Science Council. These groups encourage coordinated, international efforts in standardizing information procedures and in exchanging information; they also produce various abstracts, indexes, and bibliographies.

Range of Specific Information Services

The varied nature of the information crisis suggests the need for a wide range of information services. Furthermore, no single service is fully capable of meeting all the needs for which its genre of services is designed. For example, an abstracting service will probably not be able to facilitate casual "browsing" and also provide the detailed information that some scholars may need. However, recent developments in mechanized information-storage-and-retrieval techniques are likely to increase the variety and quality of services that any information facility will be able to offer.

There are several ways to categorize information services—by the techniques they use; by the way they are organized and financed; by their subject-matter specialization. For present purposes they. will be arbitrarily classified according to the quality and (for lack of a better word) completeness of the information they provide. At one extreme are various services that simply help locate references to larger bodies of

information, which may or may not have the relevant information a scholar requests. Midway are services that help locate information and also provide a capsule description of the information; some services also evaluate the materials. At the other extreme are services that locate, evaluate, and provide the information in a form the user requests.

Bibliographies, indexes, directories, and library card catalogues are examples of services that typically present limited information; they help the user locate materials that might be relevant to his interests. These services differ in the completeness and organisation of their files. Some attempt to refer to all publications relevant to a particular topic (such as the annual bibliographical issue of the *Journal of Asian Studies)*;others refer only to published books, thereby excluding the large volume of periodical literature.

Some organise their information by broad subject topics; others alphabetize by authors, topics, or key words. Relatively few give any detailed information about the contents of an article, although library catalogue cards typically provide some information about chapter or section headings.

These simple locator devices are perhaps most helpful to users interested in very broad topics. Primary consideration in evaluating such services would include the completeness of listings, the general categories used in organising the files, and the degree to which the lists of titles accurately indicate the content of the materials.

Information services that provide more than locator references but less than a complete copy of the entire information, fully evaluated, can be classified according to whether they emphasize descriptions or evaluations. Annotated bibliographies, abstracts, and clearing houses tend to emphasize the descriptive dimensions.

Annotated bibliographies often present less information than abstracts do, and several of the more useful ones have tended to focus on fairly specific topics, such as juvenile delinquency or the relationships between education and national development. Several clearing houses have been established to assist scholars. These facilities—such as the

Science Information Exchange of the Smithsonian Institution—provide, on request, copies of abstracts reporting on research related to the kinds of information desired. The primary concern is helping the user to contact sources and people who might be able to provide him with more complete answers to his questions.

Other information services go beyond mere description; they attempt to place current publications in some larger context, and they attempt to evaluate in various ways the quality and contribution of current scholarly output. Annual reviews, encyclopaedias, guides to literature, textbooks, and state-of-the-art reviews (such as *Sociology Today*, edited by Robert K. Merton, Leonard Broom, and Leonard S. Cottrell, Jr., and *Anthropology Today*, edited by A. L. Kroeber) represent attempts to place current research in some larger perspectives; the present encyclopaedia, for example, is a major effort to take stock of social science developments over the last three decades at the conceptual, methodological, and theoretical level.

Although these evaluation services perform invaluable functions, they have well-known limitations. Book reviews do not cover as many books as abstracts cover; they do not give equal treatment to all parts of the book; they are subject to the biases of the reviewer; and reasons of space tend to limit the review to a relatively few, cursory comments. Some social science publications attempt to emphasize quality and thoroughness of their reviews by inviting rather extensive analytical reviews of selected publications; "regular-length" reviews receive smaller space, and "book-notice" reviews are given only a few paragraphs.

Information services of the final category to be mentioned are those that not only evaluate materials but also provide all the information the user might need. In some instances this evaluation results in discarding poor-quality and outmoded materials; in other instances the service provides all available information but also evaluates its strengths, weaknesses, possibilities, and limitations.

Specialized libraries, data archives, and information centers are major examples of these kinds of services, although

none is a perfect example. These services are becoming increasingly important.

Abstracting Services

Most of the general issues relevant to the activities of any information service have already been mentioned. Four of these will serve as focuses for the following brief discussion of abstracting services: coverage, currency, quality of the abstract, and organisation of the abstracting services' files or cataloguing systems. In addition, several evolving trends and likely developments. Technical and administrative aspects of abstract operations, however, will not be considered.

Coverage

The rapid expansion in the volume of social science research, in combination with the spread of the social sciences into more and more countries, continually increases the burden of the overtaxed abstracting services. Several comparative statistics suggest that none of the social science abstracting services is likely to reach the scope of operations currently found in some of the physical and natural sciences. In the social sciences, *Sociological Abstracts* in 1964 published 3,114 abstracts from about 115 journals, published in approximately twenty countries and in eleven languages.

American and other English-language journals are by far the most important sources abstracted. *Psychological Abstracts* in 1964 published 10,500 abstracts from about 450 journals, published in approximately a dozen languages and in two dozen countries.

On the other hand, *Chemical Abstracts* published approximately 165,000 abstracts in 1962. It abstracted materials from some 8,000 journals, in more than fifty languages, from approximately 85 countries. In 1960, the Russian abstracting service VINITI was processing approximately 15,000 periodicals, published in 65 different countries. One of the largest American abstracting services in this same year had a staff of 500 and an annual budget of $5 million.

By these standards the total output of all social science abstracting services is relatively small. The country coverage of most services is rather limited and, usually, only includes several of the major producers. Coverage is least in eastern Europe and in some of the developing countries—areas where the social sciences themselves are least developed, where there are relatively few social scientists, and where the language problem is an obstacle to abstracting services.

Since some of the new periodicals being established in the developing countries (*e.g.*, *America latina.*)append summaries in one or more Western languages, geographical coverage in the social sciences may become less of a problem in the future. Problems of geographical coverage are also being handled by the establishment of regional social science documentation centers. For example, UNESCO has established such a center in Rio de Janeiro, Brazil, and one in New Delhi, India. (The latter, however, is scheduled to terminate its existence before 1970.) The creation and strengthening of abstracting services in individual developing countries will also serve to facilitate efforts of scholars to locate relevant materials from other countries.

Even the best social science abstracting services tend to focus almost exclusively on major periodicals. Their coverage is limited, leaving out the growing number of fugitive documents, government reports, reprints, master's theses, doctoral dissertations, and conference papers. This situation is likely to improve as abstracting services coordinate their efforts more closely and publish abstracts prepared by other services and as there are technological advances in computer-produced abstracts.

If these developments rapidly increase the volume of published abstracts, other technical innovations, now in the developmental stage, will probably be adopted. For example, new kinds of abstracting publications—such as science newspapers—will be produced, and new mechanical document-switching centers, similar to the Defence Documentation Center of the American government, will be created to send out abstracts or documents on request.

Currency

Time is another dimension of coverage. That is, coverage decreases with an increase in the interval between the appearance of an article and the appearance of its abstract. Since the financial and human resources of abstracting services rarely keep pace with the growth of scientific literature, the currency problem is likely to become more serious.

It is already a serious problem in some fields. For example, a study of the information situation among psychologists discovered that articles in psychological journals were based on work initiated, on the average, between 30 and 36 months prior to publication. It takes approximately another 15 months before the article is abstracted in *Psychological Abstracts*. Between the initiation of a research project and final abstracting of the article, the project directors report on their work at professional meetings, various drafts or preprints are distributed to a select audience, and about nine months pass between the submission of an article to a journal and its eventual publication.

Similar delays occur in other fields. For example, articles submitted to some Russian scientific journals in 1952 were not published until 1955. In today's rapidly developing scientific world such time lags can be very costly. A number of scholars may be working on problems already solved and spending funds that could be better used to advance, rather than to replicate, scientific findings.

Two developments are likely to help reduce the time-lag problem. First, there are a number of information services that report on research in progress. In the United States, clearing houses such as the State Department's Office of External Research, together with the Smithsonian Institution's Science Information Exchange, perform this function.

Annual reports of foundations, as well as directories of current research, also provide information on research in progress. The second development—automated, or computer-produced, abstracts—has yet to be perfected, although various groups have been working on this technique. Since many abstracting services rely on authors of articles to provide their