(10) We are still far from producing the storehouse of mankind's knowledge, as envisioned by Vannevar Bush, in a form which will be usable in a system of memexes.

(11) The limits on information systems really are what people can and will do and are not due to technology.

Lest these lessons seem too negative and give the wrong impression, please remember that my assignment was to interpret history. If it had been to forecast the future potential for impact of technology on chemical information, I would have been as "bullish" as anyone on what opportunities exist and what could be achieved. The final lesson from history is that reality is achieved much more slowly and with more difficulty than the "vision" initially discloses, but without the hope and expectations and optimism, the real progress would not be attempted or achieved at all. Sometimes too much experience can be a burden.

Therefore, despite history, the vision of the memex is still worth achieving, and giant strides have been made in technology toward it. The challenge is to use that technology effectively. That leaves plenty to work on.

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ARTICLES

Chemical Information Flow across International Borders: Problems and Solutions†

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While we are deeply enmeshed in many of the changes needed to bring the basic functions and parts of information delivery into a highly coordinated and integrated international system, barriers to the uninhibited international flow of scientific and technical information continue to increase. Recently, there have been some new initiatives and approaches to information access and the issues of information flow across national borders. Networks are emerging as alternatives to bureaucratic hierarchies as ways to get things done and as the basic building block for a "New International Chemical Information Order".

INTRODUCTION

During the past four decades, I have seen many changes at Chemical Abstracts Service (CAS). We have evolved from the manual processing and production of print on paper to almost wholly electronic methods of processing and delivering chemical information. The American Chemical Society (ACS) and CAS have, indeed, over the past 2.5 decades, been on the cutting edge of these technological changes. We have been leaders in developing many of them. Being a futurist, and knowing that technological innovation and trends usually snowball, I have become very concerned about how inadequately we are prepared for moving into what I call the "New International Chemical Information Order". This is the critical issue for us to address today. We are, at this time, deeply enmeshed in the changes desired and needed for a New International Chemical Information Order, and I strongly believe that there has not been sufficient attention to, and discussion of, these many challenges.

† Herman Skolnik Award Address, presented at the Symposium on Challenges in Moving toward a New International Chemical Information Order, Division of Chemical Information, 191st National Meeting of the American Chemical Society, New York, NY, April 16, 1986.

THE NEW INFORMATION ORDER

I am most certain that the next millennium will bring a New Information Order. It will have, at least, the following components:

- A continued, rapidly evolutionary movement from the print-on-paper era into an era of electronic information delivery;
- Integration (or blurring) of, as well as reduction of, the discrete, value-added steps in the infor-

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mation-transfer chain from authors to users; and

- A large and growing complex of interrelated processes and institutions involved in design, production, distribution, marketing, and use of scientific and technical information, which will be highly organized, coordinated, and efficient. The systems also will be largely homogeneous and transparent for the circulation of information.

The New Information Order should ideally bring all the basic functions and parts of information delivery into highly coordinated and integrated systems through a combination of agreed-upon public (and international) policies and voluntary collaboration. While we are not all motivated to change in the same way—while we probably do not share a holistic view of an ideal worldwide scientific and technical information order—I strongly believe that our attitudes and behavior will change as

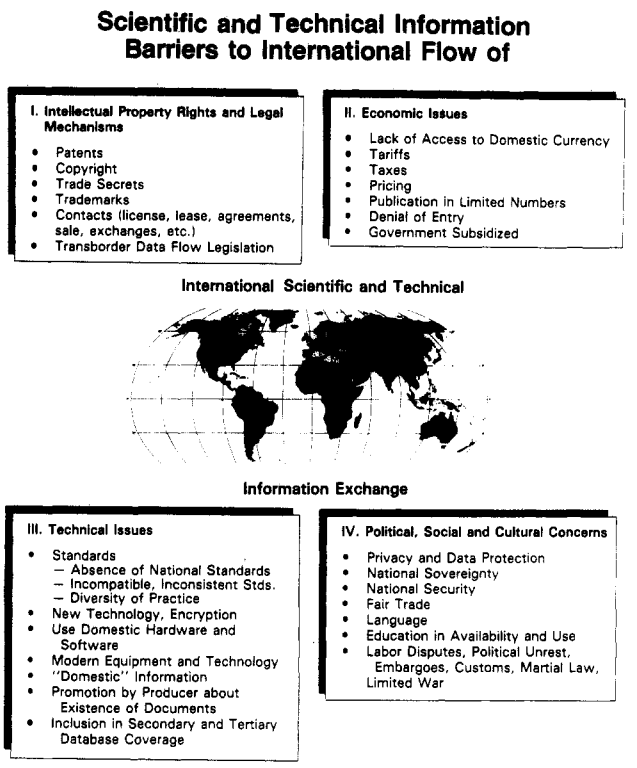
- Users demand more, new, timely, high-quality, and complete information services;
- Developing technology induces increased efficiencies and effectiveness in information flow; and
- Economics force sharing of resources and bartering and exchange of information wherever possible.

This New Information Order does not imply that there will be no room for new competition or that competition will decrease. It does mean that we are going to have to give up isolationism and protectionism in order to live in a pluralistic world and to find ways to coexist in a competitive environment. I anticipate that increased competition will spur innovation, promote efficiency, stimulate increased demand by new users for new databases, and result in the formation of new information communities. This new global order will not permit nations to export to the world while refusing to allow imports to cross their own boundaries. The increasing political and economic interdependence of nations is a key factor in the developments.

A great deal of effort has been expended during the several hundred years of the print era (a very short period in the complete history of human communication) to determine what national and international rules, codes of ethics, standards, or good practices were necessary for the efficient flow of national scientific and technical information. Certainly not all the guidelines, laws, and practices applicable to print technology are even yet accepted or consistently used today. But we are part of a new and different kind of frontier in this Information Age, with its exciting new technologies, and, thus, the rules and guidelines need to change rapidly in the years ahead.

It has taken us some three decades to learn how to adapt computers, which were designed by mathematicians and engineers and developed for handling numeric values or numbers, to process information efficiently. I still cringe at the use of the term "database building" when we are dealing with conceptual or subjective information processing and delivery. I also cringe at how our computer systems are not very "friendly" or very "transparent" to our information users today. People say that we are in the fifth generation of computers, but we are barely into the first generation of online searching. Whether we wish to recognize it or not at this early stage, the problems of electronic transfer of information are getting more severe each year. The plethora of barriers and regulations today is adversely affecting the optimum transfer and use of chemical information as a productive resource. The demands for increased protection and extension of property rights are growing. In a recent survey by the Conference Board of multinational companies based in the United States, some 25% said they had already experienced "serious obstacles or restrictions" in international information flow, and 86% of the companies reported "serious concern about future regulations by governments which will adversely affect their international business operations".[1]

Chart I



BARRIERS TO INTERNATIONAL CHEMICAL INFORMATION FLOW

The transfer of information more and more is recognized as being as significant as the transfer of goods and capital in the economic relationships among nations. Governments in the world have increasingly been reacting since the early 1970s to what they perceive to be the effect of electronic international information flow on their countries, especially as it related to the privacy of their citizens, the shifts of revenue for taxation, or the loss of jobs domestically. The increase in barriers to the uninhibited flow of scientific and technical information continues unabated. A list of barriers, classified in four categories for purposes of clarity and simplification, is shown in Chart I.

It is not the purpose here to discuss any or all of these barriers in detail, but it behooves us to analyze and understand each of them from our separate points of view. Further, through national and international bodies we should mutually determine the consequences of the proliferation of these barriers and what needs to be done to overcome them. This assumes that we believe strongly enough in the continued free flow of scientific and technical information worldwide.

Recent examples of barriers abound. The president of the Polish Chemical Society several years ago wrote letters, sent cables, and spoke in person with the president of the American Chemical Society, asking him to do everything feasible to eliminate the U.S. trade restrictions on shipping computer-readable tapes to Warsaw. Collectively, the chemists in Poland strongly felt their research was suffering from the lack of this information flow. More recently, hampered by their economic situation and political interference, the Polish access to western database systems has been suspended. The Soviets, since the late 1970s when they announced a plan for a 10% reduction in their publications program, have been restricting the flow of scientific and technical information out of the Soviet Union.

The number of papers from the USSR abstracted by Chemical Abstracts Service was 56 579 (14.9% of the total CAS coverage) in 1985, compared to 80 765 (23.2% of the total coverage) in 1977. In a 1983 talk at the American Society for Information Science, the director of VINITI advocated "rights to information in a social context with due account to their rankings according to their roles in social production".[2] As late as Oct 28, 1985, the director of VINITI wrote: "We regret to inform you that due to technological change in the process of deposited manuscripts preparation, we had to terminate our sendings of the mentioned documents. Please cancel the U.S. titles which we were to receive in return for microfilms of deposited manuscripts in 1986" (A. I. Mikhailov, 1985, personal communication).

ACS COLLABORATION WITH OTHER ORGANIZATIONS

In January 1968, Dr. Milton Harris, then chairman of the American Chemical Society Board of Directors, made a proposal to the Organization for Economic Cooperation and Development (OECD) Panel for Cooperative International Action in which he said:

> "Attack on the total problem of science information handling needs an internationally-based approach. The American Chemical Society is willing and prepared to share initiative and to use its experiences with handling chemical information for cooperative work with interested countries in the development of an international chemical information network".[3]

Subsequently, the American Chemical Society consummated cooperative agreements with The Chemical Society (now the Royal Society of Chemistry) in the United Kingdom, Gesellschaft Deutscher Chemiker in West Germany, the Japan Association for International Chemical Information in Japan, and Centre National de l'Information Chimique in France. While these agreements have been modified in recent years and the organizations involved in West Germany have changed, they continue to operate to the mutual benefit of all the parties involved.

The American Chemical Society's Board of Directors at a meeting in December, 1984, adopted unanimously the following important statement of policy:

> "In keeping with the Society's Charter, it has been a major, longstanding goal of the Society to provide the best possible chemistry-based information services. We reaffirm the Society's commitment to that goal. We also reaffirm the Society's longstanding commitment to the philosophy and principle of cooperating and sharing resources in practical ways with scientific and technical societies and other organizations in the U.S. and other nations, with the aim of developing comprehensive international information systems, services, and networking arrangements".[4]

NEW INITIATIVES AND APPROACHES TO THE ISSUES

Among the specialized agencies of the United Nations, UNESCO sponsors a wide range of general information programs, which in 1985 produced a set of methods, norms, standards, and guidelines designed to help "in the creation of compatible information systems and services and their interconnection in order to facilitate information exchange throughout the world". This PGI/UNISIST proposed global network is best summarized as consisting of (1) strengthened information systems and services, (2) training in information handling procedures, (3) use of standards for information handling, and (4) adequate computer and telecommunication facilities. This UNESCO program is not considered to be a Utopian concept. Task groups are presently working on projects for development of the network "sequentially and in an evolutionary fashion, so as particularly to meet the needs of the developing countries".[5]

The Commission of the European Communities, under the Directorate General XIII, recently unveiled a new "information market policy program aimed...at unblocking the barriers and moving closer to a new information order". The commission has embarked on a work program for creating "a common information market for advanced European information services". This program is primarily aimed at the information content aspects of databases, rather than technology. It will "reduce the uncertainties and obstacles, stimulate demand, and promote convergence of policies within the Community in view of the developments in this international field". The work program identifies eight areas including convergence of national and community policies, economic aspects, fiscal and commercial environment, role of the public sector (both in supplying information and supporting information services), and legal aspects. Senior representatives of the national ministries of CEC member states will form an advisory group to help the commission carry out their program.[6,7]

Recently, the International Council for Scientific and Technical Information completed an initial survey of members on all the legal aspects of information systems, services, and transfer, identifying those of most concern. In May, 1986, at the ICSTI General Assembly in York, England, the task group responsible will develop a program of activities in pursuit of those dimensions of information law that can be helpful in assuring the economic viability and social acceptance of member services in years ahead.

Probably the most comprehensive national information program made publicly available to date is that of the Federal Republic of Germany for specialized information. It is aimed at improving the provision and utilization of specialized information in the Federal Republic, guaranteeing mutual access within the framework of transborder data flow and promoting international cooperation in building, providing, and utilizing information banks and developing an international information network. Government–industry roles are clearly delineated, so as not to impair competition. The program calls for expenditure of some 939 million deutschmarks over the 1985–1988 period.[8]

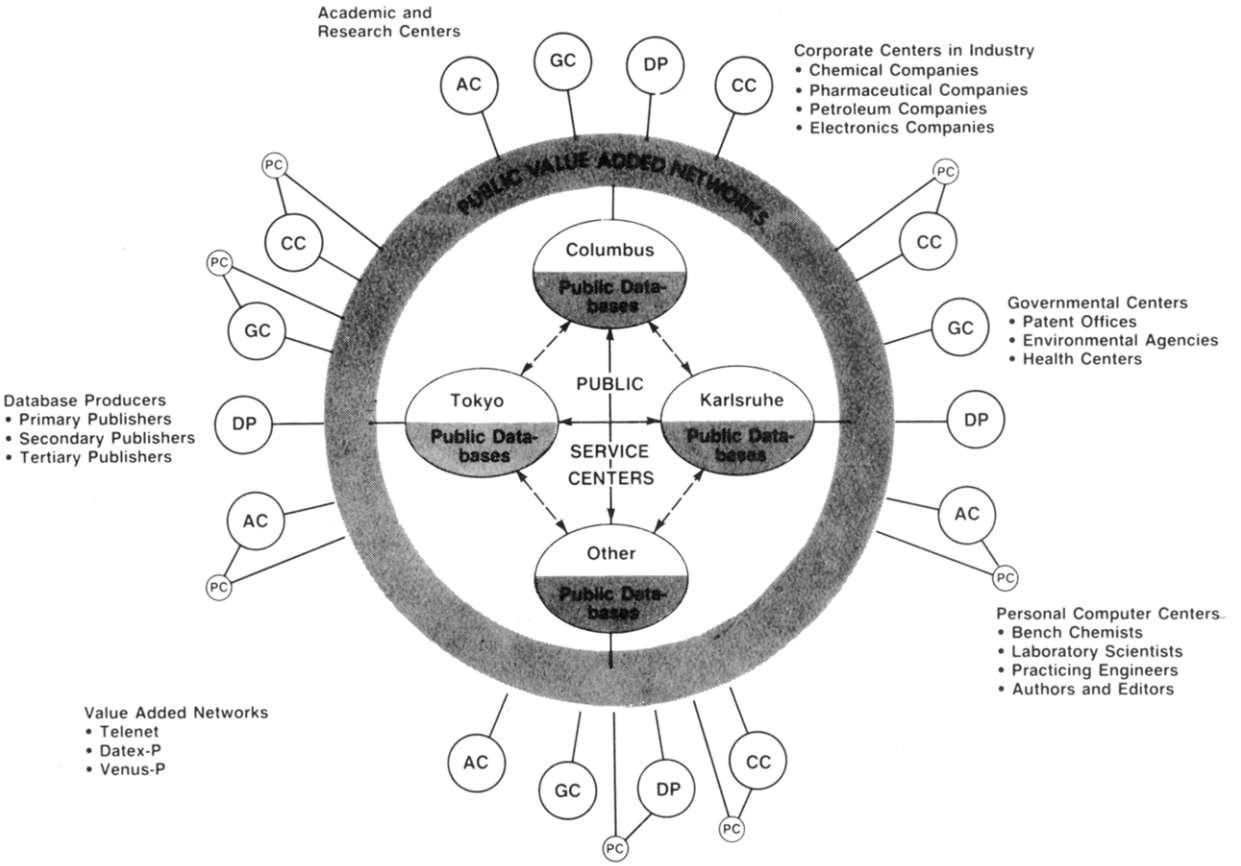
INFORMATION COMMUNITIES

People form information communities. Any two people or a group of people who have a common interest in producing or sharing information can form an information community. Basically, this need for communication and sharing information is what started ACS in 1876. Today the chemical information community has thousands of "shareholders" or "stockholders". These are the parties who are affected by an action or who wish to affect the action to be taken in our planning of the New Chemical Information Order. The stakes are great.

Information scientists and managers have the awesome responsibility to see that all the functions involved in collecting, processing, and delivering chemical information meet the needs of the information creators and users, the other most important shareholders in the system. Some of the questions being asked or to be resolved in our drive toward the New Information Order are

- Are the shareholders receiving the information they have a right to expect in the right manner and at the right time?
- Who owns the information?
- Who has access to it?

Chart II



STN International® A Worldwide Integrated Information Network

- How accurate is it?
- Are the shareholders being treated fairly?
- Are they protected from harm or injury?
- Have their basic, unalienable rights been protected?
- Who pays for information and how much should they pay?

INTERNATIONAL NETWORK OF CHEMICAL INFORMATION

Networks are rapidly emerging as alternatives to bureaucratic, organizational hierarchies as ways to get things done in this complex world. Networks maximize flexibility and minimize vulnerability. With its power distributed polycentrically rather than concentrated monocentrically, a network can survive total destruction of one of its nodes, even a central one.

In December 1983, in London, CAS was one of the parties announcing creation of STN International, a network that functions as a nonprofit, online service bureau for database producers who wish to offer their own files online, under their own control. Joining ACS in the announcement was Fachinformationszentrum Energie, Physik, Mathematik GmbH of Karlsruhe, West Germany (FIZ Karlsruhe). CAS and FIZ Karlsruhe formed the first STN link in 1984. Services are now being provided through this link, and much work and many activities are underway to upgrade and expand the network's functions. Policies and governance structure are being formalized, and the Japan Information Center of Science and Technology recently agreed to join in this collaborative effort. Other national or regional public centers are being considered (Chart II).

Each of the public service centers will load databases of interest to the scientific and technical community. The STN user can in time search the full range of databases in all major areas of science and technology mounted at any of the participating centers. The user will conduct such multiple-database searches in a single session using a single command language.

This global network for scientific and technical information can develop rapidly over the coming years and can be the basic building block for the New International Chemical Information Order. A full complement of the functions and services defined earlier in this paper could readily be available in all nations of the world. This pioneering work on STN will become ACS's and CAS's preeminent gift to the scientific communities. We in the American Chemical Society are clearly committed to share, produce, and deliver chemical information in a collaborative mode for the benefit of all.

Each nation and organization interested in scientific and technical information can become a part of STN. Each can offer something in exchange or barter, rather than trying to create individual islands of independence at great duplication of effort and expense to the community of scientific users. We should strive continuously for information exchange and peace in the years ahead.

SUMMARY AND CONCLUSIONS

I have briefly discussed what constitutes a New International Chemical Information Order, the barriers to the international

chemical information flow, ACS policy on collaboration with other organizations, some new initiatives and approaches to information access, the international border issues, information communities, and international networks. I would hope in our discussions that we could approach a better understanding of what the challenges are for the New International Chemical Information Order and how to resolve the challenges in the future. I recommend that we begin with an in-depth analysis of the problems, including defining scientific and technical information flow. Also, we should continuously seek to assure that government regulations do not further impede this international information flow or create unnecessary barriers. And we should seek through model provisions or model contracts to guarantee continuous access to the databases involved. We should also strongly urge countries to participate in the orderly development of new international laws, standards, rules, values, and just ethical issues for all the shareholders in this chemical information community.

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Factors Involved in Japan's Contribution to International Chemical Information Activities: Present Status and Prospect†

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This paper reviews the current status of information activities in Japan, describes the policies and the projects related to information at the government level, identifies difficulties and problems that hinder the transborder flow of scientific and technical information, and discusses how these difficulties have been or are being solved. A speculative picture is given on the ultimate worldwide information system.

INTRODUCTION

The scope of the present paper will consist of three parts. In the first part, a brief review is given of the present status of Japanese information activities and information policies and projects mainly at the government level. The second part will depict the difficulties and the problems that confronted the Japanese information community during the past two decades. The state may be described as chaotic. As the policies and projects are gradually implemented, we will see that some sort of new order will be emerging out of the present more or less chaotic state. The second part will also describe how the problems have been or will be solved. Finally, some speculation will be made to predict the nature of the ultimate chemical information system that a research chemist will want to use. A proposal will be presented as to how such a system may be constructed and maintained.

Japan is an underdeveloped country in terms of organizing information systems. Like other developing countries, major activities are being conducted by government initiative, although the private sector constitutes the largest user community of international information services. Therefore, the discussion will be confined mainly to the projects and activities at the government level.

There are three major ministries or agencies of the Japanese government that are involved in the scientific and technical information activities.

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The Ministry of Education, Science and Culture (MESC) directly operates the National Center for Scientific Information System (NACSIS), which was established on April 1, 1986, and supervises the administration of the national and private universities and academic societies.

The Science and Technology Agency (STA) directly operates Japn Information Center for Science and Technology (JICST) and has some influence on general national policy on information through the Council of Science and Technology, which is chaired by the prime minister.

The Ministry of International Trade and Industry (MITI) is responsible for all activities related to patents and trademarks and operates through the Japan Patent Office (JPO) and the Japan Patent Information Organization (JAPIO).

The present status, policy, and projects of these ministries will be discussed in turn.

PRESENT STATUS, POLICY, AND PROJECTS AT GOVERNMENT LEVEL

MESC. The Ministry of Education, Science and Culture runs about 100 national universities with numerous research institutes and supervises all private universities and academic societies and associations to which the ministry also gives some financial support. MESC's information plan has three objectives: (1) library automation and online library service through a national computer network; (2) database service, bibliographic and factual, for academia; and (3) promotion of database building at universities, research institutes, and academic societies under MESC's supervision.

To achieve those objectives, MESC has set up the National Center for Scientific Information System (NACSIS) for li-

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