

## The Role of Information Scientists

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The development of the age of information is discussed in terms of the economic and social impact of the work of information scientists.

The American Society for Information Science (ASIS) [celebrated] its 50th anniversary in Boston [Oct. 4-8, 1987]. It is an appropriate moment, therefore, to emphasize to the scientific community the strategic and growing role that information scientists play in scientific research, in technological advancement and, in broader terms, in the transformation of society. In fact, information and the transformation of society [was] the theme of the 1987 ASIS conference.

Since 1945 our world has undergone enormous change. Most attribute this global transformation chiefly to the discoveries of scientists and the applications of those discoveries by technologists and engineers. We live in a new age—some would say a golden age—of science and technology. Societies the world over understand the increasing importance of science and technology to economic and social well-being and improvement.

Few recognize, however, how fundamental has been the place of information in these recent scientific and technological developments. Having the right information at the right moment has accelerated scientists' work (see

Glynn Harmon, "Information Retrieval Based on Patterns of Discovery," *The Information Age in Perspective* [Proceedings of the ASIS Annual Meeting, 1978, vol. 15], p. 156). Moreover, an information-rich environment actually contributes to new ideas (see David Bawden, "Information Systems and the Stimulation of Creativity," *Journal of Information Science*, vol. 12, 1986, p. 203-16).

The information drawn upon by scientists over the last four decades did not just appear. It had to be organized and stored, and networks established for its dissemination. The earliest information scientists, then called documentalists, mounted intensive efforts to achieve manual and later automatic storage and retrieval systems. Their successors today are continuing to use the latest technologies to invent new ways in which information can be better exploited by researchers in all fields.

But it would be misleading to give the impression that information scientists serve only as helpmates to scientists and technologists. The work of information scientists—their research into and expertise about the processes of acquiring, manipulating and retrieving in-

formation—has a much broader significance and impact. Their work has ushered in a new age of information, with repercussions in economic, social and political spheres.

U.S. Secretary of State George Shultz, in a speech entitled "The Shape, Scope and Consequences of the Age of Information" delivered in Paris in March 1986, described this new age: "The information revolution promises to change the routine of our planet as decisively as did the industrial revolution of the past century. The industrial age is now ending. In some places it has already passed. The United States and most of the free nations in the developed world are already seeing how the age of information is transforming our economies. A century ago, we moved from an agricultural to an industrial phase in our development. Today, we remain agriculturally and industrially productive; but the basis of our economy is shifting rapidly from industrial production to information-based goods and services."

Indeed, in the economic sphere the strategic and transforming role of information is perhaps most clearly evident. Walter Wriston, former head of Citicorp, has written of the revolution in the financial markets that the telecommunications satellite and instantaneous access to information brought about. He pointed out that with the availability of instant information, currency prices could no longer be determined by political decree or international compact, such as the gold standard or the Bretton Woods Agreement. Now, he added, financial markets operate on the "information standard." This transformation, wrote Wriston, is "something different in kind, and not just a change in degree." ("In Search of a Money Standard," *The Wall Street Journal*, November 12, 1986, p. 28.)

The economic consequences of the information age are plain, as is the increasing value placed on those who specialize in the understanding and expert use of information. It should not be surprising to learn, then, that one focus for ASIS conference participants is the economics of information. The pioneer in information economics was Fritz Machlup, who was the first to attempt a systematic study of the role of knowledge industries in the economy of the United States. As long as we are observing anniversaries, I should mention that

1987 marks the 25th year since the publication of Machlup's seminal work, *The Production and Distribution of Knowledge*, in the United States. (For a recent brief summary of Machlup's impact and successors see: Richard D. Johnson, "Machlup and the Information Age," *Scholarly Publishing*, July 1987, p. 271-6.) In my view, Machlup has had fewer disciples than his ideas or the importance of his subject deserve. The economics of information continues to be an understudied area by information scientists.

Besides contributing importantly to science, technology and economics, information scientists are deeply involved in the social and ethical questions arising from the information age. On the one hand, information is more widely available than ever before. Access to information, being tantamount to education, has brought notable improvements, even in some of the poorest developing countries. Many information scientists are seeking to extend that access through new and more economical information systems. Some of us are involved in bringing into reality H.G. Wells's concept of the "world brain" or Vannevar Bush's "memex," the term he used to describe the ideal information retrieval device. I think we are inexorably moving in the direction of such comprehensive information systems. It is difficult to underestimate what the extension and democratization of information will return in the form of social benefits.

On the other hand, many are uncomfortable with the idea of a centralized information resource center. As we all know, information can be wielded for good or for evil; its misuse is of concern to everyone. Some of the more prominent concerns are over individual privacy and what is seen by many as unnecessary restrictions that governments may seek to place on the dissemination of information, especially of unclassified technical information. In helping government officials and legislators grapple with these and other problems, information scientists will, as they have in the past, provide important counsel on workable and wise policies and practices.

Information scientists are needed in many realms. They are needed for collaborative work with scientists, engineers, economists, sociologists, psychologists, and administrators and policymakers in government. They are

also needed to further the study of information itself—how it is now used and how it can be used to greater effect.

And, ironically, information scientists are increasingly needed because their very industry and efficiency have made information overload a real possibility for researchers. Having achieved a remarkable degree of bibliographic control, albeit incomplete in the ideal sense, we need ever more innovative methods for condensing and retrieving information.

Each new breakthrough contributes to making the library the extension of the laboratory.

I imagine that neither Wells nor Bush thought that it would take 50 years or more to achieve information nirvana. Then again, I did not think 30 years ago that the print media would continue to hold their position alongside electronic publishing. New technologies sometimes parallel, rather than displace, the old ways. And yet we have every reason to believe that our children and their children will be enjoying the fruits of scholarship—thanks to the work of information scientists—under significantly changed and significantly improved conditions. ■

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## Science Needs Critics

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The professions of science writer, science reviewer, and science critic are discussed in terms of serving the professional and the public.

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The professions of science administrator and science writer have become well established in recent years. The first arose in response to the rapid growth of the scientific enterprise and the second in response to its increasing importance to society. And the growth of science has spawned other science-supporting or parascience professions such as the science publicist at research institutes (see "Good Science Needs Good Reporting," *THE SCIENTIST*, December 15, 1986, p. 13). Yet more are in prospect.

About 10 years ago, observing, on the one hand, the high level of unemployment and underemployment of Ph.D. scientists and, on the other, the need for more good literature reviews, I suggested that science reviewing would become a full-time career. Review articles have become increasingly important in the era of Big Science. Nowadays, many research administrators can find time only for reviews and abstracts. Naturally, the professional science review writer requires expert knowledge to control and competently summarize specialists' research. But the science

reviewer also needs knowledge of information science and technology.

In fact, information science can materially aid the writer, and not only in efficiently collecting relevant sources on a particular topic. Techniques such as co-citation analysis, bibliographic coupling, and the making of historiographs and multidimensional scaling maps of research fronts have yielded new understandings of the structure and substance of specialty areas. In the *ISI Atlas of Science*®, we are uniting the strengths of objective, systematic analysis of the scientific literature with the expert judgment and experience of specialists to create a new generation of reviews. Acquaintance with modern information techniques is a must for science researchers today. At the minimum, every research team should designate a qualified information specialist to ensure maximum efficiency.

Another science-related career of the future is proposed by Maurice Goldsmith, director of the International Science Policy Foundation of London. In *The Science Critic* [Methuen, 1987], Goldsmith describes the science critic

as "a public policy generalist alerting us to the growing-pains of future worlds through the day-to-day discoveries of the present." (p. 16) More specifically, the science critic will attempt to see the whole picture of science, examine what its future might be in light of its past, classify the similarities that appear across specialties, monitor the integrity of scientific activity, and convey something of its substance to non-scientists, so they might "understand its poetry and cease to have fear of it." (p. 83) Who will be qualified to serve as a science critic? Goldsmith says, "Clearly not the scientist who prepares an annual review of scientific progress, for he is too narrow. Nor is he the information officer who has a clearly defined task and is mission-oriented. Nor is he the science writer, although he is more likely to emerge from this category of communicator than from the others, mainly because of his imposed breadth of interest." (p. 83)

The science reviewer would serve the professional, whereas the science critic would serve both the public and the professional, to some degree mediating between them.

The growth of science will stimulate new professions along both fronts—some directly related to helping the professional and others to communicating the substance and issues of science to the public. The new professions are inevitable. They are also welcome. None (or very few) of us can do it all anymore. This age of greater and greater specialization has rendered the paradigm of the "two cultures" somewhat obsolete, for even within science itself we find many separate cultures that are little understood by colleagues in other areas. The new parascience professions can be expected to bring together isolated realms within science and involve the public in the debate over the future course of science. ■



*A luncheon honoring UK contributors to the Citation Classics® commentaries that appear in Current Contents® took place in Manchester. Attending were (seated from left) Harry Smith, president of the 14th International Congress of Microbiology; Eugene Garfield, President of the Institute for Scientific Information and Publisher and Editor-in-Chief of THE SCIENTIST®; (standing from left) Stuart Glover, University of Newcastle upon Tyne; E.S. Anderson, former director of the Enteric Reference Laboratory, London; Jack Melling, Centre for Applied Microbiology and Research, Porton Down; Sir Mark Richmond, vice-chancellor of the University of Manchester; Derek Ellwood, University of Durham Industrial Research Laboratories; Sir Andrew Huxley, Master of Trinity College Cambridge and Nobel Laureate. Also in attendance were Sir Cyril Clarke, Liverpool University; John Postgate, University of Sussex; Tim Crow, Northwick Park Hospital, Harrow; Donald S. Robinson, University of Leeds; Gustav Born, King's College, London; Hugh Sinclair, International Nutrition Foundation; Ruth Izhaki, University of Manchester Institute of Science & Technology; Ronald Laskey, Cambridge; Ray Cooper, Burden Neurological Institute, Bristol; and Alec Coppen, West Park Hospital, Epsom.*