WHAT HAS INFORMATION SCIENCE CONTRIBUTED TO THE WORLD? A CONTINUING DISCUSSION

The article below is the initiation of a discussion on the contributions that Information Science has made to the world, particularly the world of science. Trudi Bellardo Hahn has asked me to create a "forum" for continuation of the discussion. This page, and regular updates to it, will be the forum (until we find a better venue). The discussion begins with Trudi's article, reproduced in its entirety below (with a link to the original source) and continues with the most recent contributions I have received from others about the topic, which are reproduced with their permission. Please join in the discussion by e-mailing me at bobwill@sc.edu After brief review of your comments I will then ask for your permission to reproduce them on the Web page.

2 *Bulletin of the American Society for Information Science and Technology —April/May 2003* *(reproduced by permission of ASIS&T)*

What Has Information Science Contributed to the World?

By Trudi Bellardo Hahn, President ASIS&T, 2002-2003

The Council of Scientific Society Presidents recently asked me to respond to a survey question: "What were the most important seminal five to seven discoveries in the field represented by your professional society in the 20th century?" Such a question raises several complex issues, such as what are the most remarkable achievements unique to the field of information science in the past 100 years? Who are the individuals who were responsible for each one? Just what constitutes our field as separate from other fields such as computer science, librarianship, chemistry, engineering, medicine, management, law or education? How do our research methods differ from those of the social sciences, operations research, linguistics and others from which we have obviously borrowed?
Since I could not answer the survey question off the top of my head, I consulted ASIST members who research and write the history of information science. Michael Buckland, Eugene Garfield, Julian Warner and Robert Williams replied. It appeared that "developments" is more apt to describe information science activities than "discoveries."
However, their responses appeared to have discouragingly little consensus or overlap.
By merging their responses into larger categories and consulting some information science textbooks and historical papers, I drafted a list of five major categories of accomplishment that I believe can be attributed directly and solely (well, nearly) to IS researchers and developers.

1. Information science researchers measured the information explosion. They created the field of bibliometrics – the study of published literature and its usage. Bibliometrics has many aspects, including studies of impact, diffusion of innovation, bibliographic coupling, citation and co-citation patterns and other statistical regularities in scientific and scholarly productivity and communication.

2. Information science developers contained the information explosion. Information scientists pioneered innovations in indexing systems that were very different from traditional subject cataloging in libraries – automatic indexing and abstracting, KWIC and KWOC indexing, citation indexing, keyword indexing and postcoordination, text analysis and natural language

searching systems. They also developed thesauri or controlled vocabularies for thousands of disciplines and specialties.

3. Information science developers applied computers to manipulating documents and document records in information storage and retrieval systems. This began almost as soon as computers became available in the 1950s, but really took off with third-generation computers in the 1960s. The development of online database systems was accompanied by related telecommunications and networking technologies and specialized search functionalities, as well as large machine-readable databases. The application of formal logic (Boolean operators) to database searching was a major component of these developments.

4. Information science researchers studied users' information seeking, needs and preferences, as well as related areas such as relevance and utility assessment. The sociologists got us started, but we quickly developed our own body of research in the second half of the last century.

5. Information science leaders in government and industry contributed to formulating national information policies related to issues of privacy, security, regulating dissemination and access, intellectual property, acceptable use and others. They contributed to developing standards for the processing and communication of information, as well as the monitoring of the national information infrastructure (human, technological, materials and financial) to ensure that information systems and services related to the public interest were maintained.

ASIST members are invited to debate the content of this list, to suggest additions or items that should have high priority, to identify the pioneers and to date seminal discoveries, developments or inventions. We know we are multidisciplinary and cross-disciplinary, but I believe there is a core of knowledge and developments that is uniquely ours – if we can but define it.
I have asked Robert Williams, University of South Carolina, to work with members of the Special Interest Group on History and Foundations of Information Science to refine and expand this list. He has already started the process by compiling a draft of a detailed chronology of information science and technology available at www.libsci.sc.edu/bob/istchron/ISCNET/Ischron.htm . Please help by sending your thoughts and suggestions to Bob (bobwill@sc.edu).

Our goal is to publish an authoritative list of accomplishments on the ASIST website. In addition to the existing "About ASIST" page and the mission and vision statements, it will show ASIST

members and potential members what this field is about, what it values and where the greatest potential for future discoveries and contributions lies.

President's Page

CONTRIBUTIONS TO THE DISCUSSION

From: Gafar Ibrahim (2/05)

Librarian & Information Officer GHD Global Lty Ltd

I have read the introductory President's Page of Ms Trudi Hahn on the ASIST Bulletin, April/May 2003,p.2 concerning the question of 'What has Information Science Contributed to the World'. I agree with her and add that earlier tools of information science applied for taming first waves of the information explosion phenomenon, such as automatic indexing and abstracting, KWIC and KWOC indexing, text analysis and natural language search systems have led and contributed to
the development of the indexing and the search engines of both the Internet and the Web. Still there is a need for more research and development of them in order to prevent the coming information society generations from the devastation of the digital tsunami as well as loss of global digital memory.

Moreover, terms like: document or doc., web page, home page, bookmark, databases, program library, ebook, ejournal and hyperlinks that applied as 'see' and 'see also' references are inspirations from what earlier information scientists have developed and dealt with. To what extent do we need to document the role of the information science in building the current Information Society? Let's discuss...

From: Lawrence W. McCrank (8/03)

Trudi Bellardo Hahn's statement of contribitions of Information Science (IS) as seminal discoveries in this century is written to be as ecumenical as possible. Still, there is always the exclusionary delimitation of one's professional society, i.e., ASIS&T, when so much of informaiton science lays outside its purview as defined largely by practitioners in library science qua information science, and so many contributers who would not see themselves as information scientists... lexicographers and linguists, historians pioneering in methodology and especially quantitifaction, those specializing in imagery, and whole coteries of information scientists within other disciplines. Consider, for example, the journal *Le medieviste et l'ordinateur*, a review published by the Institut de Recherche et d'Histoire des Textes in Paris. Its 42nd vol. focused just on the special theme of Diplomatics and computing, ie. form analysis in communications and documentation ... never considered Information Science as such by "the" Information Scientists of ASIS&T. Vol. 41 treats the cognitive aspects of medieval documentation at the very point of information science's origin... far flung from our modernist notion and presentist mentalities. Or consider the explosion of work in archival science that is seldom integrated into Information Science, and which goes on unfortunately without the cross-fertilization with IS that would be a benefit for all.

Much of my own work lies outside the invisible parameters of ASIS&T in such forums as Computers and History, largely a European circle; archival science and humanities computing; and such contributions as the series Data Bases in the Social Sciences and Humanities where genuinely pioneering work was reported, not from the ASIS&T inner circle, but from humanists and social scientists working within their individual disciplines. The cross over to IS per se has been negligible. In my last book -- dedicated to Eric Boehm, an information scientist and entrepreneur who should have been included in ASIS&T's "greats" for his early pioneering of automated indexing and bibliographic control over the literature of History, founding of ABC-Clio and the Institute of Information Management -- I attempted to provide a synthesis on the interplay between History and Information Science, a hybrid called Historical Information Science, since the advent of personal computing in 1984. Its 6000 citation bibliography may beof interest to those interested in the history of information science. And for the issue of History becoming history with the onslaught of digital media and rampant interpolation everywhere, resulting in a destablization of how we know anything from documentation, one can turn to the recent discussion in the *American Historical Review* [Vol. 103, Issue 5, (Dec., 1998)] forum by Roy Rozenzweig -- again outside the pale of IS as defined by ASIS&T.

The question [by Trudi B. Hahn] posed to ASIS&T was to identify if important accomplishments over the past century to establish its professional history in the historical tradition of great deeds... ignoring its failed aspirations, fractured professional association, and disunified research agenda. In this sense Trudi Bellardo Hahn's answer may be appropriate and her attempt at synthesis intriquing... but IS is still without its own history well documented or elaborated in historical analysis and secondary literature, and it remains virtually beyond the pale of professional History. Is it any wonder then that IS has not bothered much about History? In this vein, it is important to remember that the critical question is not what IS has contributed in the past, but what ASIS&T and information scientists still do for the world, and what they can do in the coming years so

that future generations have a history.

References:

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From: W. Val. Metanomski (5/03)

I have read with interest a statement on "What Has Information Science Contributed to the World" by Trudi Bellardo Hahn in the April/May 2003 issue of the ASIST Bulletin. Since I have worked on some aspects of the history of
scientific and technological information science, I am taking the liberty of contributing some comments.

I could not agree more with all the succinctly stated five points delineating progress in the research, development and application of information science. But I think that some important aspects have not been sufficiently highlighted with respect, for instance, to information science in chemistry, and in science and technology in general. There has been a real revolution in scientific pathways between the producer of chemical information and the consumer of chemical information, who more often than not is also a producer of information. There is some hint of it in Item 3 with reference to "the development of online database systems accompanied by related telecommunications and networking technologies", but that brings to mind improved telecommunications such as better equipment, faster switching systems, new satellites, and the like, and it does not highlight a modern scientist-to-scientist interaction.

In the old days, the producer of information had to publish it somewhere, this was then abstracted and indexed, and eventually through laborious manual searches the user found it and applied thus gained knowledge to his own research or application. The electronic searches of databases improved the searching tremendously, but originally it had to be mediated by information professionals. The advent of electronic terminals or personal computers on almost everybody's desk has allowed not
only finding the needed information, often through ingenious front end software, but also the various links (once called "hyperlinks") which provide an instant access to the original full-text documents, be it the primary journals, chemical dictionaries, inventories of chemical compounds, listings of properties, etc. All of this occurs at the speed of light while the chemist sits at his desk and simply pushes a few appropriate keys. Actually some of this is hinted in the topics for the ASIST 2003 Annual Meeting "Humanizing Information Technology; from Ideas to Bits and Back".

I understand the need for brief statements on the major accomplishments, but I still think that another **major category** should be: "Information science developers revolutionized pathways between the producers and users of information, allowing almost instantaneous retrieval of needed complete information, as well as instantaneous direct personal contact between the concerned individuals." This category is needed to do justice to that aspect of information science. Obviously, I am alluding above to the e-mail and World Wide Web as well.

From: Barbara Flood: (5/03)

These are the contributions that come immediately to mind: Information storage, dissemination, retrieval, use, and evaluation.

Starting with microforms (including aspect cards, microcards, both tape and cassette microfilm, and fiche in various reduction rations) and applied reprography (contributed to standardization with various ANSI committees).

Storage: use of various 'newer' methodologies for information (e.g., variable length string structures) to punched paper tape, punch cards (both Rem-Rand & IBM) as well as Termatrex (Jonkers), Zator edge notched (Calvin Mooers) cards with or without specialized coding. Also abstracting including 'slanted' abstracts, extracts, automatic. Various indexing technologies. Indexing formats included inverted (Taube at Doc Inc) Termatrex, coordinate, KWC KWOC, SWOC, etc, Permuterm, citation, automatic.

Dissemination: e.g., Watson in 1939 with scientific material on fiche, ISI with Current Contents in 1960's, SDI in late 1960's and early 1970's, IEG's (Information Exchange Groups), OATS = Original Article Tear Sheets from ISI.

Systems approach i.e., many products off same database with CAS,BIOSIS, INSPECT, Engineering INdex, various government including NTIS, ASTIA, etc.

Search: Boolean (of coordinate indexing), of edge-notched cards, weighted term (Salton, Marronb) Info theoretic, various linguistic methods using term frequencies, citation.

See also Joe Becker, The First Book of Information Science (Washington, DC: US Energy Research and Development Administration, Office of Public Affairs, 1973.)

Use: array of user studies in late 60's e.g., analysis of networks of scholars by Crawford and also Garvey & Griffith

Evaluation: recall and relevance starting with the Cranfield studies, later impact factor. Usual management techniques.

Also pioneered the application of so-called information technologies in the social sciences and humanities as well as in various community applications (urban, rural) in addition to the sciences

Translation, Technical writing and Editing, Information Analysis Centers.

From: Julian Warner (5/03)

I have read the chronology carefully and was very impressed by it and fascinated by some of the images.

In my view, more could be made of technology influencing consciousness (consider the personal computer and information society speculations). Shannon's work (http://cm.bell-labs.com/cm/ms/what/shannonday/work.html) would be a starting point. The public conception of the information revolution might have more to do with Shannon and associated ideas than information and libraries.

Some notes made while reading the chronology follow.

Growing specialisation since the 17th century.
Early association with chemistry.
Early 19th century development of review articles / annual reviews.
Early interest in nomenclature.
Message transmission systems preceded analytical systems in their full public development.
Discontinuity with Avagadro.
Technologies giving greater control of complexity: and recurrent concern with nomenclature.

From: Albert Henderson (5/03)

I would add items which go beyond your number 5: ... formulating national policies related to issues of privacy, security .... One describes the productivity of information. Fritz Machlup summarized "'Productivity of R&D' thus comes to refer to the ultimate output increments (or input economies) in the areas in which the new knowledge, the direct output of R&D, is applied." He continued, "...R&D expenditures are investment, and the incremental outputs (or economies) attributable to the application of the R&D findings are return." (1) In other words, savings come with improved outputs rather than as reduced inputs.

Another is the observation that human beings lack the capacity to cope with the rising tide of discovery. William D. Garvey described the scientists' problem concisely: "Even if they had perfect retrieval systems they would be presented with so many items that they could not assimilate and process them." (2) The recommendations of the 1963 President's Science Advisory Committee responded: 1. The technical community must recognize that handling of technical information is a worthy and integral part of science.... We shall cope with the information explosion, in the long run, only if some scientists are prepared to commit themselves deeply to the job of sifting, reviewing, and synthesizing information; i.e., to handling information with sophistication and meaning, not merely mechanically. Such scientists must create new science, not just shuffle documents: their activities of reviewing, writing books, criticizing, and synthesizing are as much a part of science as is traditional research." It also said, "The ideas and data that are the substance of science and technology are embodied in the literature; only if the literature remains a unity can science itself be unified and viable. Yet, because of the tremendous growth of the literature, there is danger of science fragmenting into a mass of repetitious findings, or worse, into conflicting specialties that are not recognized as being mutually inconsistent. This is the essence of the "crisis" in scientific and technical information." (3) I feel this is worth repeating because the science policy establishment turned away from information science as soon as the United States landed a man on the Moon. The mandate of the Science Policy Act of 1976 (4) to include an expert in dissemination on the panel advising the President on matters of science and technology was instantly abandoned. The National Science Foundation ended its interest in research into science communications. In spite of libraries being recognized as research overhead by Office of Management and Budget Circular A-21, science agencies and universities treat libraries as if they had no

role in the preparation of research proposals, authorship, and peer review. Nonetheless, the pair of important seminal discoveries are on the books, should anyone ever again care.

1. Machlup, Fritz. The Production and Distribution of Knowledge in the United States. Princeton: University Press. 1962.
2. Garvey, William D. 1979. Communication: The Essence of Science. Oxford: Pergamon Press. 1979.
3. President's Science Advisory Committee [PSAC]. Science, Government, and Information. The Responsibilities of the Technical Community and the Government in the Transfer of Information. Washington DC: Gov't Print. Off. 1963.
4. Public Law 94-282; 42 USC 6601+
