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A Long Search for Information

By

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A Long Search for Information
Brian Vickery

The service professions such as medicine and teaching have proud and age-old traditions. Only relatively recently have we realised that serving people's information needs can be as socially valuable as looking after their health and educational needs. I have been very happy to be a member of the information profession for nearly sixty years. Perhaps these notes on my experiences will explain why.

WORLD WAR II

"We do not encourage initiative," said the factory manager. "What you must do is to learn to work to the safety rules." It was my first day in my first job, as a plant chemist in an explosives factory, located in the English countryside, in July 1941. Happily, he was quite wrong. We were not making some old, tried and tested explosive like nitroglycerine or TNT. It was the first large-scale production of a brand-new chemical, code-named RDX—Research Department eXplosive—developed by a government military research department. The factory staff consisted of young graduates and foremen, and operatives drawn from Somerset towns and villages. Few of us had ever been in a chemical works before, let alone one making explosives. We had everything to learn, both about the job and about the vagaries of this new chemical.

I came to the factory fresh from an Oxford degree course in chemistry. I had not got high marks—there were far too many other interesting things to do at university, distracting me from studying chemistry: the new poets (Auden and his friends); Shaw, Ibsen and O'Neill at the Playhouse; reading history and philosophy; socialist politics. The outbreak of war half-way through my studies did nothing to help my concentration. My choice of chemistry to study had been influenced by a schoolmaster, though the most exciting reading I did at school was *The Science of Life*, by H.G. Wells and Julian Huxley (chosen by myself as a prize), and I have always continued to read biology for pleasure. My most treasured chemical memory of Oxford is a guest lecture on "the nature of the chemical bond" by Linus Pauling, double Nobel Prize winner—a vivid, elfin personality, who almost persuaded us that we understood quantum chemistry. University was for me a new social and intellectual world, a vivid life experience. Can distance learning—via email or snailmail—replace it?

My first encounter with the concept of "information service" came with the reading of *The Social Function of Science* by Desmond Bernal, first published in 1939—a work that stimulated a whole generation of young scientists to think about the role of science in society, its organisation, its future (reprint, Bernal, 1965). In it, he wrote that in every laboratory "there should be someone deputed to watch the whole of current literature for items which might be relevant to the work of the laboratory, and to be able to indicate without loss of time where such items are likely to be found." Such a person "would have to be chosen partly for his comprehensive scientific interests, which need to be much greater than those of the other laboratory workers, and partly for his inclination to systematic thinking." Already I felt that I might be suited to such a role.

But chemical graduates with poor marks had no choice of career in wartime, so I was drafted to the explosives factory. After leaving the factory manager's office, I went to the RDX plant. I was put in overalls, given a spanner [wrench], and told to take to pieces an industrial pump, so as to understand how it worked. RDX was a white powder and a very safe chemical—you could hammer it, even burn it on an open fire without risk, and it had no known untoward physiological effects. It was made by nitrating hexamine with concentrated nitric acid, and it was the acid and its fumes that posed the biggest hazard in production. From RDX were made two explosive products. Heating an RDX-TNT mixture produced a toffee-like substance that could be remelted and poured into bombs (this was done at another factory). Mixing RDX with an oil produced something like plasticine—a plastic explosive, now notorious as Semtex.

The manufacture of this plastic explosive gives an interesting picture of the realities of chemical production at that time. The oil was made from three materials: "mineral jelly" (a petroleum byproduct), chunky sheets of crepe rubber, and slabs of beeswax (the product, we were told, of large African bees). The rubber and beeswax were chopped into small pieces and heated together in a vat with the jelly and a little lecithin (a vegetable protein). They were rendered down into an oil, and heating was continued until the oil was "the right viscosity." Viscosity was tested by taking a small sample of the oil on a dipstick, and touching a plate with this to see if it seemed "sticky enough." A batch of freshly made RDX was stirred into a large container with water, and heated. A dose of oil was poured in. If you were lucky, granules of RDX coated with the oil were formed, and these could be filtered off through a tap at the bottom of the container. If you were out of luck, the oil and RDX formed a single glutinous mass that had to be dug out. The oily granules were next loaded into water-jacketed vessels, heated and stirred. The vessels were in fact dough-mixers used in bread-making. Then the "dough" was forced through heavy rollers. This was continued until the plastic was "the right plasticity." Plasticity was measured by taking a sample, cooling it, rolling it into a small sausage, and trying to stretch the sausage to see how quickly it broke. Unusable plastic was too crumbly, and broke too quickly.

At one time, we were getting too many unusable batches of plastic. For each batch of RDX, the factory laboratory routinely made an analysis of the distribution of particle sizes. We had the idea that particle size might affect plasticity, and I looked back over our production records to seek some correlation. At first, no success, but then I speculated that the very large particles in a batch of RDX might be aggregates of small particles, which would break down during plastic production. Therefore, in the analysis we should add them to the count of small particles. This was successful: poor plasticity seemed to be correlated with an excess of small particles as now counted. We set a threshold, and in future used for plastic explosive only RDX batches with the amended small-particle content below that threshold (other batches went into RDX-TNT toffee). Thereafter most batches of plastic proved to be usable.

Among my regular duties was to carry out a periodic "yield test." This involved making an estimate, over a period of 24 hours, of the amounts of hexamine and nitric acid fed into the production process, and of the amount of RDX produced. The hexamine was introduced, in weighed quantities, into "hoppers" that delivered a succession of small quantities to the nitration vessels; the nitric acid delivery was regulated by calibrated

flow meters. Thus, estimates of these inputs were not difficult. But the RDX was scattered at various stages of the subsequent processing: from its first washing and filtration into trolleys, from there into the vessels to make toffee or plastic, then into stores of completed explosive. In addition, there were always spillages of RDX, which accumulated in a large sump. All this had to be weighed or estimated over the 24 hours.

The factory had an extensive research laboratory, headed by Kenneth Denbigh, a professor of chemistry from Southampton University. RDX was a new variety of chemical, and it was the focus of a lot of academic research interest. British and American chemists came to conferences at the site. The laboratory produced a string of project reports and progress reports. I was sent for a training course in statistical analysis, and eventually transferred to the laboratory as librarian, to look after books, journals and reports. Denbigh also used me to help on some pet projects of his own. These involved identifying and collecting published data on the properties of various groups of chemicals, and carrying out statistical analysis on these values (Vickery, 1947a, 1947b).

The funniest job I had to do was to consult every foreman in the factory to find out who he was responsible for, because the records of the Personnel Department were in a muddle. When the war in Europe ended, my first task each Friday was to duplicate the job advertisements in *Nature* and circulate them to all chemists in the factory. So, quite unexpectedly, I had begun an information service.

Editorial Interlude

A well-established London journal, *The Industrial Chemist*, was looking for an assistant editor at this time, and the RDX factory manager (a new one— old "no-initiative" had not lasted long) recommended me for the post. I worked there for over a year. The most interesting part of the job was to visit factories (with a photographer) and write up an illustrated account of their procedures, for example (Vickery, 1946a, 1946b). I also had an enlightening experience of what could be found in the scientific literature. I had at home a longish run of the *Annual Reports on the Progress of Chemistry* (evidently my interest in chemistry had not evaporated). When the first atom bomb was used at Hiroshima, the UK government published a fairly brief information statement, but I was able to dig out of the *Annual Reports* a circumstantial account of relevant nuclear research from 1921 onwards, and wrote up quite a respectable article on the subject for my journal (Vickery, 1945).

Another task was to visit the Patent Office in London to prepare abstracts of recent chemical patents. Of course, I used these occasions also to browse around its library, and on one visit came across a book strangely entitled *Colon Classification*, by S.R. Ranganathan. I was intrigued and impressed by his mode of conceptual analysis.

Industrial Librarian

In 1946 there came an invitation from my war-time colleague Denbigh. He had joined a "fundamental research" laboratory established by the chemical firm ICI (Imperial Chemical Industries) at Welwyn, Hertfordshire, and suggested that I apply for the librarian post. The Akers Laboratories were situated in and around an old country house, and included departments of microbiology, organic chemistry, physical chemistry, physics, toxicology, instrumentation and control. They were indeed working in fundamental as well as applied research—three heads of department subsequently became Fellows of the Royal Society. It was an ideal environment to encourage wide scientific interests.

The administrative director of the laboratories was very interested in the possibilities of microphotographing documents at a high degree of reduction—stimulated no doubt by war-time stories of "microdots"—and I was hired on the understanding that I would pursue this interest. So one long-continued activity (which never in fact resulted in any useful product) was to engage a photographer to carry out experiments in this field. In the course of this work, our experimenter did, however, develop micrographic skills that proved very useful to the microbiologists.

When I arrived, there was already a foundation library stock—the private library of a well-off chemistry professor. In its original glass-fronted wooden bookcases, it reposed in a palatial conservatory, which became the first site of the library—until the roof leaked, and we had to move hurriedly to another room. Eventually, it was decided to provide separate library accommodation. The task of producing a design was entrusted to the architects at ICI headquarters. Their design proved to be wholly non-functional—for example, they had allocated no space for library staff. In the end, one of the large wooden huts on the site was fitted out to my design and proved to be very suitable accommodation. (I remember in later years showing the library to a delightful visitor, Elin Törnudd from Finland, and discussing whether the weighty volumes of abstracts journals should be housed near other reference books or near the journals they abstracted. "I think," she said, "they should be near a table.")

The work of the librarian (for whom a graduate assistant was soon provided) can be imagined: building up the stock of books, current journals and back runs, cataloguing and classifying the stock, circulating current journal issues (and getting them back!), lending, photocopying articles (using some ghastly diazo process that gave a copy in rather pale blue, but just about readable), doing literature searches, indexing the growing collection of our own reports and publications, translating foreign papers when we could, or getting translations made, and making ourselves familiar with the work of the laboratories.

All this had to be learnt on the job. I was aided in three ways. First, ICI was a corporate member of Aslib (then the Association of Special Libraries and Information Bureaux), and I attended conferences and courses where I could learn much. Second, I worked my way through the proceedings of the Aslib annual conferences from 1928 on, to get a picture of the development, problems and procedures of the information profession. Third, our laboratories were but a small part of the far-flung activities of ICI, whose librarians and information officers came together in regular meetings.

At this time, ICI comprised a series of subject divisions, scattered around the UK—pharmaceuticals, plastics, paints, metals, explosives and so on— together with several research laboratories, e.g. for agricultural chemicals. Each division or laboratory had its own library and information service, responsible for books, journals, reports and sometimes correspondence files. The division would also have a patents section, responsible both for preparing patents and searching patent literature. In addition, at headquarters there was a wide-ranging library, a correspondence registry, a technical index section, and a business intelligence section. From the colleagues who managed these services I learnt much. Some of the libraries had been long in existence, for example, that at the explosives division in Scotland. J. Kaiser, a librarian there, had published a book about an innovative indexing system that he had developed (Kaiser, 1911).

One lesson that I learnt was the great importance to industry of their depositories of reports (and indeed of laboratory notebooks) that embodied the technical knowledge of the firm. At one time a scheme was mooted to duplicate and circulate within the firm a collective monthly bulletin of all reports produced that month; a trial issue was duplicated, but immediately quashed by top management as too revealing of ICI interests if it were leaked. (It will be remembered how avidly the Allies, at the end of World War II, collected report material from German and Japanese industry.) Most ICI divisions also undertook the production of ab-

stracts bulletins of current published literature in their fields, cumulating
the entries into card indexes.

An important library activity not yet mentioned was interlending. The ICI
libraries produced a union list of their periodicals holdings, and we bor-
rowed extensively from each other. In addition we made good use of the
Science Museum Library (SML) loan facilities. The SML was originally set
up in the nineteenth century to serve the needs of the scholars who were
building up the museum collections. By the 1940s it had the largest col-
lection of scientific books and journals in the UK—perhaps in Europe. It
also served as a reference library for the adjacent Imperial College of Sci-
ence and Technology. It became, in effect, Britain's national science li-
brary. In 1926, the Keeper of the Library, S.C. Bradford, decided to start a
postal loan and Photostat service to industrial and research libraries. By
1946 it was lending to 1,000 institutional borrowers.

Beyond this, there was available the *World List of Scientific Periodicals,* re-
cording holdings in many UK academic and society libraries, who were
often kind enough to lend items to industry. When I started work, the
current edition of this was out of print, and I was lucky to persuade the
Aslib library to let me have an old proof copy that they had in store. As a
last resort, there was the National Central Library. This had been set up in
1916 as a "central library for students." Its main resource was the union
catalogues of the holdings of the public libraries of the country, together
with those of a number of special libraries, and its service was to locate
and arrange for the loan of requested items.

It was interlending that led to my first published paper on information
(Vickery, 1948). One of Bradford's tasks in the SML had been to prepare
bibliographies, as comprehensive as possible, on topics requested by us-
ers. Looking over some of these in 1934, he noted the obvious fact that
some journals would yield more references to a topic than others. If he
ranked the journals according to yield, and plotted the cumulative num-
ber of journal titles against the cumulative number of references obtained,
a typical curve resulted, which he described verbally and for which he
then proffered a mathematical formula. From idle curiosity, I did the same
plot with my interloan records, and obtained a similar curve. Then I noted
that his formula did not in fact match his verbal description, and with the
help of a mathematical colleague showed that the latter, when formulated
mathematically, gave a better match for the curve.

I look back at this publication with some amusement. Although I have
published a few more papers looking quantitatively at "the literature," I

by no means deserve to be called a "bibliometrician." But it seems that this is what I am often cited for, as the co-citation analysis of White and McCain (1998) has made clear.

Royal Society Scientific Information Conference (RSSIC)

In 1948, the Royal Society decided to hold a conference on scientific information. ICI librarians situated in or near London were privileged to take an active part in the conference, for the head of ICI's technical index section, John Holmstrom, was appointed as editor of Section III of the conference, on indexing and other library services. No doubt at his suggestion, a number of ICI library staff were asked to act as section secretaries or as "leaders and recorders" of working parties. My particular topic was "guides to information," which covered guides to information centres, the afore-mentioned *World List*, data tables, handbooks to scientific literature, and an index of scientists.

The other three sections of the conference were on publication and distribution of papers (Editor, Professor Desmond Bernal), abstracting services (Editor, Sir David Chadwick), and reviews and annual reports (Editor, Professor Munro Fox). The many information workers who participated—including Ralph Shaw, later of the US Department of Agriculture Library; and Donald Urquhart, later Director of the UK National Lending Library for Science and Technology—felt that this opportunity to discuss the problems of scientific communication with some of our most eminent scientists was an event of major importance in our professional lives. Whether the practical results of the conference were epoch-making is to be doubted (what conference results ever are?), but it remains a professional landmark (Vickery, 1998).

The proposals mooted (and then withdrawn) by Bernal, for the reorganisation of the publication system for scientific papers, have been sufficiently aired in recent years. The Internet is pushing us well on the way to realising them. As a teenager in Ireland during World War I, Bernal had a wild dream of using science to "liberate his country." He soon outgrew his nationalism and became international in outlook, but he remained a visionary. His ideas on what science could do, what science could be, and what man could be, were always looking to the far future, ahead of their time (Swann, 1999). And so it was with his plans for scientific publication. Incidentally, Bernal carried out in preparation for the conference what he believed to be the first ever survey of scientists about their use of information.

What about automation? An Aslib committee on "the mechanized distribution of information" contributed a paper that made mention of "electronic sorting devices," but this was not further elucidated. Holmstrom noted that there was in America "a machine called the Univac. Its ultimate possibilities seem to be very great, but it seems unlikely that in the foreseeable future it will be economical to set up such machines at more than one or two central points in each country." He also quoted from Vannevar Bush's "As We May Think," and Ralph Shaw spoke of the Bush Rapid Selector (Royal Society Scientific Information Conference, 1948).

For my own part, in preparing for the conference, I was stimulated to produce a lengthy review of information problems, *The Dissemination of Scientific Information Among Scientists* (unpublished), which contributed considerably to my own education. The conference itself enabled me to have first contact with Bernal, and to meet with a man who would later become a close colleague, Donald Urquhart. Urquhart had a doctorate in metallurgy, but had found employment difficult to get in the 1930s. In 1937 he applied for a job at the SML because it offered him free time to continue his scientific studies. During the war he worked as an administrator in the Admiralty, returning to the SML in 1945, but transferring to the Department of Scientific and Industrial Research (DSIR) in 1948. DSIR had been set up by the UK government in 1915 to stimulate cooperative research in industry, and included an Intelligence Division. It was as a member of that division that Urquhart attended RSSIC.

Classification

After my first encounter with *Colon Classification* in the Patent Office, and subsequent use of the Universal Decimal Classification (UDC) for the Akers library, I became increasingly interested in problems of information organisation for retrieval. My first paper in the field was "The Structure of a Connective Index" (Vickery, 1950). I looked at it recently, perhaps for the first time in half a century. It argued that a subject index had two jobs: (a) to permit easy and unequivocal location of every topic indexed (as an alphabetical arrangement does); and (b) to reveal relations among topics, so that the searcher can navigate from one to another. The paper went on to consider the extent to which various then-current types of index (alphabetical and classified) achieved these aims. Well, the problems of subject search on the Internet are no different in principle: search engines may permit easy location of verbally expressed topics, but we still seek to improve our methods of navigation. In this first paper, I cited contributions by Holmstrom to the RSSIC, books by Ranganathan, Cutter's *Rules for a Dictionary Catalog* (1904), writings by Bradford (who was a great

supporter of the UDC), Kaiser's book, and Julia Pettee's *Subject Headings* (1946).

One outcome of the RSSIC was that the Royal Society expressed an interest in the classification of scientific literature, and a study group of scientists led by Bernal started to consider this. After a while, they decided that information professionals were better placed to carry the subject forward, and as a result, in 1952 a Classification Research Group (CRG) was formed, which has been meeting regularly in London from that day to this (2004)— quite a history! All its members have been actively involved in constructing, using, or teaching about classifications, and its basic mode of working was to take up specific, concrete problems encountered on the job, to discuss and generalise them, and so to build up a corpus of concepts and principles that could be embodied in further work. During the 1950s, the CRG concentrated mainly on the structure of specialised classifications. I acted as secretary to the group until I moved out of London in 1960, and by the end of that period had written a booklet (aided by much collective comment from the group) that represented our general conclusions at that time (Vickery, 1960). My own developing views were published more extensively in *Classification and Indexing in Science* (editions 1958, 1959, 1975). Let me give a brief account of some of the people who participated in our discussions during the 1950s.

Not present in person, but influencing many of our discussions, was Ranganathan. After education and teaching as a mathematician, "Ranga" had been asked in 1924, at the age of 32, to organise the first library of the University of Madras. He came to England to attend courses at the School of Librarianship in University College London (UCL), and visited about 100 libraries. This almost immediately led him to develop a novel library classification, described in *Colon Classification*. Its principle was to group the subject terms encountered in each main class (e.g. literature) into a series of categories or facets (such as language, form, author and work), to arrange the terms within each category, often hierarchically, and to form subjects by linking a term from each relevant category by colons (e.g. English: drama: Shakespeare: Hamlet). He argued that this provided a more flexible classificatory tool and better reflected the structure of knowledge. The technique became known as "facet analysis," and Colon Classification underwent many developments over the years. Ranganathan's main theoretical work was *Prolegomena to Library Classification* (editions 1937, 1957, 1967). He was a man of wide knowledge, much charm, and intense concentration and dedication to work. There are many anecdotes about Ranga. Once he visited me at my ICI library; he was talking enthusiastically about some subject as we went to his departing taxi,

and he leant out of the window trying to complete a sentence; I met him in London a week later and his first words were "As I was saying..." Quite apart from classification, Ranganathan made a vast contribution to the development of librarianship in India.

Douglas Foskett in the 1950s was librarian at the Metal Box Company, a large canning firm. Already familiar with Ranga's work, he was devising a faceted classification for his special field. Widely knowledgeable, talkative, humorous, Douglas later wrote a book on *Classification in the Social Sciences*, and became librarian, first of the University of London Institute of Education, then of the central (Senate House) library of the University.

Jack Mills in the 1950s—and indeed for long after—was teaching at a polytechnic school of librarianship. Ever cheerful (it seems that life and work held some secret source of happiness for him), in later years he has been associated with the reconstruction, along faceted lines, and publication in parts of a third edition of the Bliss bibliographic classification. There may be readers of this paper who do not remember the eminent US librarian, Henry Evelyn Bliss, who worked at the College of the City of New York, and wrote, in about 1930, two valuable surveys of the organization of knowledge before launching himself into constructing a new general classification.

Eric Coates was working as a cataloguer and classifier at the then recently established *British National Bibliography*. Earnest, sometimes a little severe, transparently sincere and humane, Eric later became the first editor of the *British Technology Index* and wrote a book, *Subject Catalogues: Headings and Structure*, much influenced by facet ideas. He has also played a major part in constructing and testing the *Broad System of Ordering*, a high-level classification system.

Jason Farradane, of Polish origin, worked for the sugar manufacturers Tate and Lyle. He also was both earnest and sincere, very independent in his views, and very persistent in wishing to separate information work from conventional library work. This led eventually to his founding in 1968 the UK Institute of Information Scientists, which after many years of fruitful work has recently merged back with the UK Library Association. A sign of the times?

Lastly I must mention Robert Fairthorne, a true original. He had been neither librarian nor information scientist, but mathematician at the Royal Aircraft Establishment, responsible also for setting up punched card systems to process data. Interested and knowledgeable about everything, he

had quite early connections with bibliographical activities. Robert's chief contribution to our group was to educate us, in a highly entertaining way, on all sorts of topics that became relevant to our discussions—lattice algebra, information theory, the 2x2 retrieved/relevant matrix, how far we could go in using ritual instead of understanding, and so endlessly on. He dated his final change-over from aeronautical mathematics to information science to a visit to the US in 1950, where he met Calvin Mooers and "began a new journey" (Vickery, 2000).

We were all well aware of "mechanised" information in the shape of Hollerith punched cards, "peephole" cards and so on. By 1958, a second edition had been published of the collective work edited by R.S. Casey, *Punched Cards.* A slow realisation of the coming importance of the computer was beginning (Robertson, 1994). Fairthorne, of course, was much more aware of this than the rest of us.

The CRG decided to have a conference, and with the help of Aslib and the School of Librarianship at University College London in May 1957 held a four-day International Study Conference on Classification for Information Retrieval. The main framework of presentations was very firmly laid down by the CRG itself, but papers by other attendees were interspersed with these. The guided direction of the presentations, the copious time available for discussion, and the fact that we were living together in a comfortable isolated English country house, all led to a very rich and intensive interchange of views. Most of the three dozen attendees felt that the conference was a great success. Overseas participants included Ranganathan; Eric de Grolier (a renowned French expert on classification); Jesse Shera (from the School of Library Science at Western Reserve University); Eugene Garfield (who gave us a first introduction to citation indexes); and Helen Brownson (of the US National Science Foundation, who presented a valuable review of relevant current US research, and introduced us to the concept of a "thesaurus"). Quite carried away by the occasion, de Grolier made a concluding survey in which he raised a glass "to the future classificationist who will be master of the world!"

A few years earlier, I had met Cyril Cleverdon, who was librarian at the Cranfield College of Aeronautics. Aeronautical librarians in those days had ready access to funds, and held regular conferences. I attended one of these with Farradane, where we expounded faceted classification. Cyril was skeptical, so Jason and I (with huge bravado) offered to run up a faceted classification of aeronautics for him. He accepted the offer, so we were stuck with the job, and eventually did provide one.

Meanwhile Cleverdon, stimulated by discussions with Fairthorne, was lay-
ing plans for a comparative test of the retrieval performances of a series of
indexing languages, and decided to use our "facet for aero" as one guinea
pig. This test started in 1957. My only involvement with what became known
as "Cranfield I" was a lengthy interchange with Cyril and his colleagues to
iron out the many bugs in "facet for aero." Anyone who wants to see the
problems of constructing a faceted classification in a complex domain
might care to look at the record of these discussions (Classification Re-
search Group, 1959).

Though it has nothing to do with classification, there is no other conve-
nient place to mention an event that occurred in 1955. There was a con-
ference of the Library Association, and, for reasons that escape me, I was
asked, or perhaps offered, to make a presentation on language problems
in science. The paper discussed the current diversity of languages in which
science was published, and how translation tried to cope with this. It in-
cluded a couple of pages on major episodes of scientific translation in the
past—Greek science into Arabic, Arabic into Latin, Latin and Greek into
European vernaculars. For some reason, the paper hit a public interest: it
was reprinted in the *Linguists' Review*; summarised in the *Bookseller*; given
a half-column in *The Times*; and was the subject of a two-page editorial in
Nature. There's glory for you. Nothing substantial that I ever wrote aroused
that kind of attention!

International Conference on Scientific Information (ICSI)

In November 1958, I was one of two civilian passengers in a US military
transport plane taking US soldiers and their families home from a stint in
Europe. The flight was made available by the US government, as part of
their action to assist overseas participation in an international informa-
tion conference. The other civilian was Cyril Cleverdon. One of the GIs
on the plane asked, how come we were on board? I explained that it was
due to US generosity. "Gee, we're a great people," he said. Yes, great, though
faulty like the rest of us.

ICSI was organised in 1958 by the US National Science Foundation, the
National Academy of Sciences, and the American Documentation Institute.
It covered seven areas: (1) literature and reference needs of scientists; (2)
function and effectiveness of abstracting and indexing services; (3) effec-
tiveness of monographs, compendia, specialized centres; (4) comparative
characteristics of information systems; (5) intellectual and equipment con-
siderations in design of new systems; (6) possibility of a general theory of
information storage and retrieval; (7) administrative responsibilities for

information provision. The attendance was truly international, and 75 papers were presented. Like RSSIC, ICSI was a landmark in the lives of many who attended.

This is not the place to attempt a review, but it is fascinating to browse through the proceedings, to see how many of our eminent professionals contributed, and how many hares were started that we are still chasing today. Some of the paper titles hint at this: "How Scientists Actually Learn of Work Important to Them," "Planned and Unplanned Scientific Communication," "The Relation between Completeness and Effectiveness of a Subject Catalogue," "Lost Information," "Linguistic Transformations for Information Retrieval," "Interlingual Communication," and "Creation of an International Center of Scientific Information."

No formal paper was presented by Hans Peter Luhn, organizer of Area 5. Luhn was a very inventive IBM engineer. At ICSI, he distributed a sample of a permuted or KWIC index produced by computer. The following year he published on computer-based selective dissemination of information (SDI). A real pioneer. You can read all about him (and by him) in (Schultz, 1968).

The immediate impact of ICSI on myself was to broaden my interests. In 1959, I contributed to a conference in Cleveland, where I met, among many others, the team from Western Reserve University (James Perry and Allen Kent), Robert Hayes, and John O'Connor. By 1960, I had put together a new book *On Retrieval System Theory* (editions 1961, 1965), trying to present (somewhat presumptuously) some kind of unified theoretical treatment of the various approaches to information retrieval. Chapter 8 of this book was a "thought experiment": I tried to visualise all the stages of the information storage and retrieval process, and then to discuss the possibilities of automating each—speculating, in Fairthorne's words, as to "how far ritual could replace understanding." The same kind of thought experiment was carried out again many years later, when Alina Vickery and I explored what stages of the online search process could be automated. It is a procedure I recommend.

In 1960, on the carefully chosen date of April 1, *American Documentation* published a paper on the MARLIS, a Multi-Aspect Relevance-Linkage Information System. In it I described a mechanism I named HOMO, "so-called because it is almost human," with optical and sonic input-output devices, as well as a capacity for digital manipulation. I described how HOMO carried out all the functions of a librarian, and that there was need to develop a more special-purpose device, SUBHOMO, to take over

some of these functions. I was delighted with some of the responses. An IBM branch in Germany wrote asking where they might purchase HOMO. The noted linguist, Yehoshua Bar-Hillel, queried me on one point, but said "he did not fully understand English humour." Gerry Jahoda wrote to say that some of his students led him to fear that SUBHOMO had already arrived.

National Lending Library for Science and Technology (NLL)

By this time I had changed jobs. At the ICSI conference, Donald Urquhart had said to me: "I am planning a new UK national science library, and the deputy's job is to be advertised. Would you like to apply?" What could I say? Yes, please!

In November 1956 Urquhart's bosses in DSIR had asked him to drop all other duties and start to plan a national science lending library. The background to this is set out in his autobiography (Urquhart, 1990). Traditionally, national libraries had been visualised as reference libraries. As at the British Museum Library, scholars had to sit in its reading room to have access to its treasures, which were too valuable to risk out of the building. Ever since the importance of the SML service to industry had been recognised, a campaign (in which Urquhart himself had played a considerable part) had been going on for a national lending library, and at last permission and funds had been provided. During 1957, a "Lending Library Unit" was set up, with premises in four interconnected houses on the edge of Regent's Park, London. Its function was to plan and develop the new library, but of course Urquhart interpreted this to include both collecting literature and lending it.

The deputy's job was in fact not advertised until late in 1959. I applied and—since Donald later wrote "the only man I discovered whom I would welcome as my deputy was Brian"—was successful. Thus began a most fascinating period of my life. Donald had been thinking and working out his plans for some years, and seemed to want to pour the contents of his mind into mine. So our discussions were incessant. Happily, it proved true that we thought along very similar lines, though Urquhart was much more the pragmatic engineer than my theorist self. (For example, he had not the slightest interest in classification.)

Urquhart believed that a library using the postal service to deliver loans ought to be in the middle of Great Britain, to equalise delivery times over the country. He had set about looking for cheap existing accommodation, and had picked on a disused Royal ordnance-filling factory site near

Boston Spa, Yorkshire, where there were some large brick-built storage buildings. Bombs had been filled with RDX-TNT toffee there during World War II. As Urquhart wrote, "the buildings did not look like any library we had ever seen," and he was not surprised when orthodox librarians howled in protest at the idea. One advantage was that there would be available one of the largest library sites in the world—65 acres—so room for expansion would be no problem.

We moved into Boston Spa accommodation during 1961. There was by then a lot of stock to move—not only all that had been collected at Regent's Park, but also many runs of periodicals that were transferred from the SML—about 600 tons in all. The volumes were packed into special boxes and loaded into railway wagons (4 tons at a time), which delivered to Boston Spa four times a week. The destined shelf position for each journal run had been planned in advance. Throughout this period, the library continued lending—issuing items from London for return to Boston Spa, with telex messages between the two every evening to transfer loan records.

The whole rich story of the Boston Spa library up to 1973 is told by Urquhart (1990). At that time he was the *bête noir* of the library profession, and no wonder. He had only one professional librarian on his staff; he did not catalogue the books—just put them on the shelf in title order; he bound popular journals issue by issue (to make them more available for loan); he put in an industrial conveyor system to carry books round the library; he had inmates from the local open prison doing low-level clerical jobs—whatever next! Despite my own lack of library education, I was regarded by the profession as "sound." When I gave a talk about the NLL at a local conference, the conference report was headlined "Light Dawns in Yorkshire." The county librarian said to me, "Urquhart must be furious that you were appointed as his deputy." (Not so many years after that, Urquhart became president of the UK Library Association).

Apart from the innumerable diverse jobs that a deputy undertakes, I had various special tasks. First, I became responsible for book selection over the whole range of science, technology and medicine, so my exposure to a wide area of science at Akers Laboratories proved invaluable. Second, I had to dive into the cataloguing of serials, for our periodicals were to be arranged by title, and complex corporate names presented many problems. Third, the library was managing a programme for cover-to-cover translation of Soviet science and technology journals, and I had to handle all the detailed liaison with their society publishers. Fourth, I was involved in the development of courses on scientific literature to be attended by post-graduate research students and by interested university librarians.

Fifth, I carried out some internal surveys of our stock and the use made of it, and various statistical investigations. Sixth, I often had to show round "distinguished visitors," including some from the Chinese Academy of Sciences and from VINITI, the information service of the USSR Academy of Sciences.

After leaving the NLL, I continued to have intermittent contact with Urquhart. For example, we were both on the editorial board of the *Journal of Documentation*; I became a member of the NLL Consultative Committee; Urquhart was a member of the Research Committee of the Research Department of Aslib, where I worked from 1966 on. He remained a good friend and an inspiration to me. I was both sad and happy to be asked to write an obituary notice in 1994.

In 1962, Cyril Cleverdon began a second evaluation project, Cranfield II (Keen, 1998). Instead of constructing several indexes, each with a different strategy for search reformulation, he aimed to construct a single index with a structure that allowed for the use of many such strategies, and to test these "retrieval devices." Karen Sparck Jones and I were asked to form an advisory team, to meet periodically with Cyril and discuss problems. Karen has spent much of her working life at the Computer Laboratory at the University of Cambridge, where she is now a professor, and has had a considerable influence on the development of retrieval research in the UK and more widely.

During 1964-66, I was librarian at the University of Manchester Institute of Science and Technology (UMIST), but this period is more memorable for me as the time when my personal and professional life became intertwined with that of Alina Gralewska. Of Polish origin, she was then Chief Librarian at the Israeli Atomic Energy Commission. We met, and after much trauma decided to be together. In London in 1966, she was fortunate to be appointed to a new post, as information officer to the Rock Mechanics Section of the Imperial College of Science and Technology. While there, she built an ingenious hybrid automated information system, making use of both computer and punched tape processing to produce index cards, a printed KWIC index, and an abstracts bulletin. I had little to do with this, but in later years we increasingly collaborated on projects.

Aslib Research and Consultancy

In 1966 I was invited to become head of the Research and Consultancy Department at Aslib. This association was set up in 1928 to bring together

the libraries of industry, industrial research associations and other special
institutions, together with a sprinkling of interested government, univer-
sity, and public libraries. It had expanded over the years, and had its own
library and information service. After the war, it was much occupied giv-
ing advice to the many new special libraries being formed, and in 1959
created a research and consultancy department. I knew some of the staff
there, and had known and respected the first head of research, Chris
Hanson, for over a decade. The department was initially funded entirely
by Aslib, but from 1965 onwards it received a research grant from the UK
Office for Scientific and Technical Information. This grant was later taken
in hand by the British Library Research and Development Department
(BLRDD). These two organisations played a most important role in infor-
mation research and development in the UK. Their history from 1965 to
1993 is well surveyed in (Meadows, 1994).

At its peak, the Aslib Research and Consultancy Department had fifteen
researchers and five consultants. Its work was guided by a Research Com-
mittee that at first included Bernal as well as Urquhart. A few years ago,
three former members of the department gave a brief account of the
department's work (Gilchrist, 1999), from which I quote. "Over the three
decades of its existence, the department carried out a wide-ranging
programme of applied research...Its three main areas of work were usually
identified   as   operational   studies,   user   needs,   and
'mechanisation'...Operational studies included task analysis of library
operations...cost-effectiveness of information systems, and evaluation of sec-
ondary services. Many user studies were conducted...Perhaps the largest single
IT-related project was an investigation of the potential use of Prestel as a
medium for providing community information" (this one was after my time).
The consultancy section of the department was formed in 1966, and at first
"was mainly engaged in the setting up of special libraries, information ser-
vices or specific systems, but as its experience and confidence grew, it took
on increasingly ambitious projects for large organisations, including
UNESCO, OECD, UNIDO and the European Commission."

As it happens, this account does not mention some of the projects that I
found most interesting during my time there. When I arrived, we were
completing a feasibility study for the Institution of Electrical Engineers,
which led to the creation of INSPEC. We followed this up by a similar
study for the Commonwealth Agricultural Bureaux, leading to the setting
up of their database: this project was led by Harry East, my own part being
a study of the terminology and thesaurus problems involved. Next we set
out on a year-long project to explore the possibility of a computer-based
information service for the House of Commons Library (HCL), led by me

but with the active participation of Harry East and Jane Wainwright. When an implementation decision was eventually approved—for the POLIS system—Jane transferred to the HCL to head up its development.

This project was full of interest. We had fascinating interviews with a sample of Members of Parliament about their information needs and habits; exploration of the many "visible indexes" whereby references to current material were displayed by the library to users; a visit to the country cottage where the daily report of Parliamentary proceedings (Hansard) was indexed; study of the problems of generating a standardised thesaurus for indexing; and collaboration with the library of the Culham (atomic energy) Laboratory, where the only in-house online information system in the UK was operating at that time (1970). Culham provided an experimental computer-printed library bulletin for trial use by Members of Parliament, then with the cumulated machine-readable material set up an experimental online facility for the library to try out.

When I joined Aslib, commercial online search was just beginning in the US, but it took some time to become available in the UK. We recommended it for eventual use at the HCL, but much UK effort was then still going into the use of information tapes for selective dissemination of current information. Aslib surveyed the scene in 1972 and listed over 100 institutions (mostly in the US) that were then making (mainly bibliographic) monthly tapes commercially available for such use. We noted that the volume of information in machine-readable form was bound to grow. In the future "much more important from the quantitative point of view will be files of full text and of data." How right we were.

We produced two reports on scientific data. One, a survey of the importance and production of evaluated data, including studies of a number of specialised data centres in the UK; and the other, an interview survey of chemists to assess their use of data and the sources they employed. Again, a desk survey was carried out on citations within a random sample of UK science, technology and social science publications (books and periodicals) over the period of a year. This enabled us to explore citation interrelations between different subjects. Towards the end of my stay at Aslib, I compiled a book, *Information Systems* (1973), trying to sum up what I thought we had learned about information at that time.

As well as Harry and Jane, mentioned above, others who at various times worked in the department include: F. Wilfred Lancaster, later to evaluate Medlars and go on to head up the Graduate School of Library and Information Science at the University of Illinois at Urbana-Champaign; Stephen

Robertson, who went on to be Professor at London's City University Department of Information Science, and who now works for Microsoft Research at Cambridge, England; Alan Gilchrist, author of books on thesauri, editor of the *Journal of Information Science,* and well known now in Europe as an information consultant; and Blaise Cronin, presently at Indiana University.

University life

In 1973 I received a new invitation—to apply for the post of Professor of Librarianship at the University of London, which was associated with the directorship of the University College School of Library, Archive and Information Studies. The School (at first, only of Librarianship) had been established in 1919, and was then the only such school in the UK. (Archives was added in 1947, Information in 1970.) The students were postgraduate, pursuing either a diploma or a master's degree.

There was a small full-time staff of seven, supplemented by part-time teachers. I arrived to find a very confused situation. The archives teacher (who was himself primarily interested in medieval and Renaissance manuscripts rather than archives), the information teacher, and the senior librarianship teacher, were at loggerheads, and had all recently publicly criticised each other in a College bulletin. So my first act was to give the staff a good stiff lecture on loyalty and cooperation. I knew nothing about archives, and had much to learn about universities, despite a couple of years at UMIST. I never learnt to play the game of academic politics, which can be pretty rough at times.

The problems just recounted may suggest why someone with no library qualification was asked to head up a library school. The first head of the school had been a professor of English, and the school had just suffered several years of inadequate leadership by another such professor. I think that UCL was desperate to bring in some fresh blood. In their hearts, the grandees of UCL at that time did not have a high opinion of the academic value of these vocational studies, or of library qualifications. So they simply looked for someone in the field who had published quite a bit and seemed to have some reputation internationally.

The school staff were frankly nervous at my appointment. I seemed to be an "information" man. What would be my attitude to historical bibliography, conventional cataloguing, archives? I had two main jobs to do: to weld the staff together by letting each group see that it had my full support, and that no one need feel threatened; and to develop information

studies. During my ten years' tenure as director, I believe that I achieved these objectives. The information teacher was Bertie (i.e. B.C.) Brookes (a statistician turned information scientist, particularly keen on bibliometrics), an admirable man, but mainly interested in looking after his doctoral students. These included Stephen Robertson (come from Aslib), Nicholas Belkin (an American who went on to Rutgers), and José-Marie Griffiths (now at the University of Pittsburgh). I left him free to teach them and a small group of master's students in information science, while I developed the information content of the main diploma and master's courses.

The staff presented me with another little shock. An integral part of the library diploma at that time was a term's lecture series on the history of the subject, and "the professor always does that." The first year I dragooned the staff to share the lectures with me, though in the second and succeeding years I did in fact take over the course.

Soon after I was appointed, the University of London advertised a new post: that of Senior Information Systems Officer at the main university library, with the task of exploring the possible use of computer information sources. Alina Vickery, as she now was, decided to apply. The opposition was stiff, including the knowledgeable and experienced Harry East from Aslib. But Alina's enthusiasm persuaded her interviewers to give her the job. At the time, even the forward-looking librarians at the university (like Douglas Foskett) were still thinking in terms of running information tapes for SDI, and indeed the University computer centre was giving an experimental service from INSPEC tapes.

But Alina was afire with the idea of using online search. She developed a Central Information Service, offering online search to scientific staff and post-graduates (free during a long experimental period). More than this, she and her colleagues started a "travelling workshop," in which they set up equipment in each college and institute of the University in turn (120 visits in all), to provide a local sample of online search. Records of all searches were kept, and a substantial evaluation report was produced. Crunch time came in 1977, when a conference was held on the future role of computerised information services in the University of London, attended by many academics and librarians. Debate was intense, but the final recommendations were that online search should form the basis of a service, and that the central service should be continued to "monitor, teach and provide services for those without local facilities."

For our institutions, both Alina and I purchased Commodore PET microcomputers as soon as they became available in the UK (32 kilobytes of

RAM, external storage on an audiotape recorder: what a joy when a disk drive was eventually provided). Mine was of course immediately used in demonstrating online search and in teaching the elements of BASIC programming. Getting money for further equipment always remained a severe problem at the UCL school. Alina and her team developed some BASIC programs simulating DIALOG and MEDLINE searching, and I did one simulating the search for MARC records on BLAISE. Alina also began to offer courses to train academic librarians in online search procedures. This is not the place to outline the difficulties and opposition Alina encountered in introducing the University's librarians to computer searching.

Later, Alina taught courses, in which I participated, in simple BASIC and PASCAL programming, and in the elements of expert systems. We even put together a special course for the information staff of UNESCO. One member of her staff, Stephen Walker, a highly ingenious programmer, wrote an information retrieval program for microcomputer, Mirabilis, which for a period was quite successful in the market, and to which modules for library cataloguing, acquisition handling and circulation control were added. Walker later joined Steve Robertson at City University, and has now accompanied him to Microsoft.

After my initial problems, UCL courses settled down and improved year by year, and we continued to turn out diplomates and masters and doctorates, one of whom, Lynne Brindley, is now Chief Executive of the British Library. My most valuable teacher colleagues during this time were Ia and John McIlwaine, both of whom eventually became professors at the University of London. What I want to do is to describe some of the other activities in which I participated during my stay at UCL.

One long-continuing research project, funded by BLRDD, was concerned with the use of modelling techniques to increase understanding of the dynamics of library and information systems. In the course of this, I had come across the simulation technique of system dynamics, developed by J.W. Forrester at MIT. We planned to mount his software DYNAMO on the UCL computer, but meanwhile we needed a tool for learning and demonstration. I was able to write a BASIC program that successfully "simulated the simulator" on our PET computer. Our overall project conclusions eventually resulted in a paper on interactive information networks and UK libraries (Vickery and Heseltine, 1984).

Bertie Brookes and I shared a common view that, beyond the practical activities of information provision, there could be discerned a more gen-

eral science of information. He tended towards a mathematical formulation of this; I was more interested in its social aspects. In 1975, with financial support from BLRDD, we organised an "international research forum" on the theoretical basis of information science. Amongst the participants were William Cooper (University of California, Berkeley), William Goffman (Case Western Reserve University), Belver Griffith (Drexel University), Manfred Kochen (University of Michigan), Ferdinand Leimkuhler (Purdue University), some European professionals, and from the UK, Karen Sparck Jones, Robert Fairthorne, Alan Gilchrist, Michael Lynch (University of Sheffield) (Willett, 1998), and Bertie's Ph.D. students, mentioned above.

Varied views were, inevitably, put forward as to the content and priorities of information science, though there was general agreement that its central topics should be information organisation, dissemination and retrieval. The final conclusion was that "theoretical research in information science is still marked by a tendency to 'play safe'...it is still marked by timidity. It could now afford to be more boldly speculative, intellectually exciting and therefore more attractive to intelligent and ambitious students." Have things changed?

Three years later, at my proposal, BLRDD held a workshop on basic information research. Once again, it was well attended, though more oriented to the British scene. US participants included Manfred Kochen, Michael Buckland (University of California, Berkeley) and Tefko Saracevic (then Case Western Reserve University). UK participants included Keith van Rijsbergen (then University of Cambridge), Cyril Cleverdon, Robert Fairthorne, Jack Meadows (then University of Leicester), Steve Robertson and Karen Sparck Jones. The conference was intended to stimulate and give some direction to UK basic research in the information field. It divided into five discussion groups on memory structures, data representation, interactive systems, information requirements, and systems modelling. One hopes that it influenced our main funders—the BLRDD.

In the late seventies, the then Shah of Iran decided to plan a great national institution: national library, national bibliographic centre, science information service, archive centre, school of library and information studies—you name it. He assembled, at considerable expense, a team of 40 or 50 information professionals, mostly from the US. From the UK came Urquhart, Foskett, Alina and I, and others. The US contingent included Martha Williams, Herbert White, and Richard De Gennaro. We were divided into teams— I worked on the library and information school team, Alina on science information services. For several weeks, we were closed in an office building

in Teheran from 9 to 5 each day, and told to plan the functions and struc-
ture of whatever section of the project we were involved with. Any infor-
mation about Iran that we needed was provided if available. We paid visits
to existing institutions. A nurse and rest room stood ready to cope with
the stomach upsets to which all of us eventually succumbed. We produced
an enormous report; I only ever saw a bit of it. It was a crazy project, typi-
cal of the Shah, but a great experience for all who took part. On our free
days we toured Teheran, Shiraz and other places, and the wonderful ruins
of Persepolis. We came home with a Persian carpet and ornaments and
photos and a warm feeling for the people of Iran. Of course, the plan was
never implemented, as political events overtook the Shah.

In 1980, the Education, Science and Arts Committee of the House of Com-
mons decided to investigate the subject of information storage and retrieval
in the UK. This is a cross-party committee of Members of Parliament. Such
a committee has an administrative secretary, and appoints an adviser to aid
its deliberations, who prepares working papers and drafts a final report.
The committee takes written and oral evidence from all interested persons
and institutions, it can summon people to answer questions, and it draws up
conclusions and recommendations. I was very happy to be asked to be the
visiting adviser. It was an opportunity to review all the varied activity going
on at the time (particularly, of course, in relation to electronic technology),
to identify gaps, and to discuss futures. The recommendations were fairly
bland and general in tone, and whether the committee report had any in-
fluence on the government of the day is another matter.

I came to the end of my UCL tenure in 1983 but continued to occupy a
small office there. Meanwhile, Alina had started another project: to build
a "demonstrator" expert system for referral (inevitably, with BLRDD fund-
ing). The system (PLEXUS) housed a database that recorded reference
books and organisations concerned with gardening and related subjects,
and could be accessed by inputting natural language queries, which would
be "interpreted" by the system, clarified if necessary by interaction with
the enquirer, and searched; responses were then presented in a user-
friendly way. The system used artificial intelligence techniques such as if-
then production rules and frames with slots. The detailed system design
was by Helen Brooks, and the programming by Bruce Robinson. My main
involvement was to construct the gardening dictionary, classification and
categorisation used. In two phases covering three years in all, a working
prototype was developed, tested and evaluated.

When not occupied with PLEXUS, I sat in my office and started to write a
book, *Information Science in Theory and Practice* (editions 1987, 1992, 2004).

As each section was drafted, I discussed it in detail with Alina, and material from her papers was incorporated, so the book justly bears our joint authorship. My publications up to 1987 are (mostly) listed in a Festschrift (*Essays*, 1988), but I have managed a dozen or more since then, that are included in the references below.

Reflections

I have been very fortunate to have been able to participate in three aspects of professional work—practice, research and education. My main practical jobs (at ICI and NLL) were both in a strong research environment, and I was encouraged to pursue research interests. My research job at Aslib had a large practical consultancy content. And at UCL, funding by the BLRDD made it possible to carry out research as well as teaching.

Much research in our field is applied research, or even innovative product development. Think of the many user studies carried out in institutions in the hope of getting clues to better service; the novel classifications for application in a special library; the operations studies aiming to streamline the performance of a system; the new search mechanisms. Even retrieval evaluation is essentially the testing of prototypes (or of operational systems). In addition to all this useful work, there has been some more basic research. Looking back, I ask myself why so little of the basic research has had an impact on professional practice.

The paradigm of scientific research and development is: make a basic investigation to identify regularities in the way some aspect of the world behaves; then design a product or process to manipulate that aspect of the world—taking into account the knowledge of how it behaves. Our profession is concerned with three "aspects of the world." First, how people behave when they feel a need for information; second, characteristics of documentary information that constrain how we can manipulate it; and third, characteristics of the physical media that carry the information, whether they be static books or dynamic electronic networks.

With the third of these, we are in the field of physical science and engineering technology; we can reach fairly reliable answers as to how physical media behave, and based on that knowledge build devices, like computers and computer systems, that mostly do exactly what we tell them to do. The characteristics of documentary information, such as are studied by bibliometrics or "domain analysis," do display some regularities, and we can make limited use of these in technical development. But people are another matter. Many information professionals (including myself)

have drawn elaborate "models" suggesting that the information behaviour of an individual is affected by his/her work or life situation, subject field, current purpose, existing knowledge, personal psychology, information environment, time pressure, and what have you. But with so many variable influences, it is so rarely possible to hold any of them constant. It is so difficult to pick out those that are significant, and even more difficult to identify reliable quantifiable "indicators" for these variables. Thus, the generalisations we achieve are often of little help in practice, and we are forced to treat each information enquiry as an individual case. Perhaps the best that "user research" can give us is a better "feel" for how to handle these cases.

It is probably true that the researchers who produce the most successful work—or that which gets the most acclaim—are those who stick to one theme over a number of years, exploring it in some depth. Just as in any other discipline, however, this can lead to a narrowing of focus that is in the end stultifying. (I think of a biological researcher who spent his whole career studying the excretory system of one particular species of earthworm). I sometimes wonder whether the vast efforts that have been put into the TREC retrieval tests have also suffered this fate (Sparck Jones, 2000).

Documentary information search starts with a problem arising in some activity (practical or intellectual) upon which we are engaged. Using whatever understanding we have of the problem situation, we formulate our information want into a search request. This must then be converted into a formal query that can be handled by whatever retrieval system we interrogate. This formalism will depend on the model of the subject domain that is adopted by the system. The model may be a classification of knowledge, a structured thesaurus, an ontology, or it may be as formless as a set of words extracted from Web pages. The formal query is matched against document representations to give a search output, whose relevance to our information want we must judge. The true measure of success in information search is whether the information we retrieve and assimilate can be successfully applied to solve the original problem. But the measure of success used in retrieval testing is a subjective estimate of search output relevance. In TREC testing, it is not even the opinion of the enquirer—it is an estimate made by "subject experts." In either case, it bears an uncertain relation to the true measure of success noted above.

TREC testing over the last decade appears to indicate that the use of structured knowledge models (e.g. classifications and thesauri) to aid search offers no advantage over the use of purely statistical approaches using counts of search term frequency in documents. This is a strangely counter-

intuitive conclusion. Knowledge itself, embodied in documents, exhibits more and more complex and intricate structure, yet we are asked to believe that understanding of this structure does not aid retrieval. Is it possible that the problem is that the bibliographic structures we use are too simple, too rigid, too constraining, so that they distort and obscure the intricate relationships within knowledge, and pure word statistics at least avoids this distortion? Should we not aim to build models of subject domains that better reflect the structure of knowledge? Is the construction of complex ontologies moving in this direction?

One type of contribution to information science noted by White and McCain (1998) is the importation of ideas from other disciplines such as computer science, social science, artificial intelligence. There is no denying the value of some of these importations, and an awareness of what is going on in neighbouring fields is a necessary attribute of the researcher. But there does seem to be among some members of our profession a rather desperate search for a "fundamental theory of information," which leads them to attempt to derive our practice from disciplines such as epistemology, or hermeneutics, or discourse analysis, or semiotics, or even "cybersemiotics." Their derivations rarely make adequate contact with the realities of information practice (Vickery, 1997). The theory of a science should spring from deep immersion in its practice.

Let me turn to education. In most education with a vocational aspect, there is probably a tension between teaching skills that will be immediately appreciated by a prospective employer (often called "training"), and teaching knowledge that will be of value in a continuing career. My own commitment has always been to the latter. Only in a very static profession can one be trained to slot in immediately to an available job, and our profession is far from static. It is more beneficial for the students to give them a generalised grounding in a wide range of professional activities and concerns, so that they will have some background knowledge for no matter what job is first available. For those who seek it, our subject also has its cultural value, which can contribute to a general education. And it is up to the professional to go on learning lifelong, widening and deepening his/her knowledge and skill, not becoming an "earthworm man."

There are two types of "width of knowledge." One is knowing as much as possible of what is going on now. The other is knowing how we got to where we are—what is the heritage of ideas and practice on which we may draw. I suspect that teaching the history of our subject is less frequent in our institutions than it was. We are getting short-sighted both in looking forward and in looking backward, to our detriment. I rejoice when I find

a sophisticated modern text on "knowledge representation" opening with a historical reference: "Like Socrates, knowledge engineers and systems analysts play the role of midwife in bringing knowledge forth and making it explicit" (Sowa, 2000). I hope that our own new "knowledge managers" will show equal awareness that handling knowledge has a long history.

What does all this say about the qualifications of the teacher? Ideally, of course, he/she should have had both practical and research experience in the information field, and if possible be still contributing to research. Teaching illustrated by examples of practical situations or of problem solving that have arisen from the teacher's own experience is always more enlivening for the student. But a staff of ideal teachers does not exist, so it is important to draw into teaching, as part-timers or visiting lecturers, those who can contribute their practical or research experience in the information field. It is not always helpful to import specialists in other fields such as computer science. In a way, the more deeply they are immersed in their own field, the less they can contribute to ours: the mind-sets may be so different. Those outsiders we invite must also be wide-ranging in their interests, if possible with experience of applying their knowledge to a problem in our field.

Would I have benefited from getting an information qualification when I was younger? I find this very hard to answer. How much of the *particular* knowledge learnt on a course is of later use? One gets a general grasp of the nature of the subject, of the way it tackles its problems, plus the invaluable experience of interaction with one's peers and, if one is lucky, with a gifted teacher. I think that in later school years and at university I had managed to learn how to learn by individual study (and indeed cannot break myself of the habit). But for the profession as a whole, it is necessary that our hard-won understanding of our discipline be handed on to the next generation in a formal way.

A Kind of Retirement

Alina retired from her University job in 1985. Before then, she had been approached by two young men who had come across PLEXUS, and believed its methods had commercial possibilities. They wanted to form a small company to develop the idea. One of them was a system analyst, the other had inherited a good deal of money and was looking for some interesting project in which to invest. Alina, ever ready for something new, jumped at the proposal; I was doubtful of the technical and managerial abilities of the sponsors, and said I would be consultant. Each of us agreed to work for only a nominal fee. So Tome Associates was formed, and the

programmer Bruce Robinson was its first employee. Alina argued that if PLEXUS techniques could be used to access a local database, why not a remote one? Could we build an intelligent, user-friendly online search assistant? She set about drafting a system design.

After many trials and tribulations, a prototype Tome Searcher was constructed. It was designed to search in the field of electrical engineering, and once again my main role was to develop the dictionary, classification and categorisation. Though not many units were sold, and its performance left much to be desired, the product achieved a certain notoriety in the UK information field, and Alina was happy in 1989 to accept, on behalf of the firm, an Aslib/ISI award for innovation.

As a result of this, Tome was in 1989 invited to join a consortium of European institutions, to put forward a proposal to the European Commission for the construction of a more ambitious multilingual online search aid. The leader of the consortium would be CRI, a Danish firm, and the other participants included Softex GmbH, associated with the University of Saarbrücken; and the Gesellschaft für Mathematik und Datenverarbeitungen, Darmstadt. A proposal was formulated and accepted, and then—for whatever reason—our leader organisation pulled out. How to save the project? Tome was asked to take over the leadership, and I, its "visiting professor," was asked to be project director.

We all worked hard on the project for eighteen months, but then came disaster: Tome's other activities were commercially unsuccessful, and the firm became insolvent. Apart from financial problems, our contribution to the project had grave defects. First, our programming was falling behind schedule, primarily because our Technical Director recruited cheap but inexperienced programmers, who were given inadequate leadership and training. Second, though I was quite successful in developing a good, cooperative team spirit among the European partners, I was totally inexperienced in the technical problems of integrating into one whole a set of diverse programming contributions, and we were not paying enough attention to the required interfaces between program modules. In short, I had taken on more than I could manage. Alina and I salvaged something from all this by writing a long review paper, *Online Search Interface Design*, which was also published as a separate paper by Aslib (1993).

The coming of the Internet and World Wide Web, with its "browser" interface, made many of the specific solutions offered by online search interfaces inapplicable. But there is now developing interest in the use of intelligent software on the Internet—"intelligent information agents"

and the "semantic web"—that is directed at some of the same problems tackled by the old search interfaces. The analyses made and the types of solution devised in earlier times are still relevant today.

The main practical information activity I subsequently undertook was a consultancy for Nirex, the UK agency for disposal of radioactive waste. They had contracted a firm to set up and operate a database concerning waste held in depositories throughout the UK, and my job was to design the database, which was mounted in BASIS, the Battelle relational system. Meanwhile I settled down to complete a work for which I had been collecting material for decades, *Scientific Communication in History*, which was published by Scarecrow Press in 2000. Nowadays I am a regular user of the Internet, still searching for information.

> From the first writings onward a new sort of tradition, an enduring and immortal tradition, began in the minds of men. Life, through mankind, grew thereafter more and more distinctly conscious of itself and its world. It is a thin streak of intellectual growth we trace in history, at first in a world of tumultuous ignorance and forgetfulness. It is like a mere line of light coming through the chink of an opening door into a darkened room; but slowly it widens, it grows. At last came a time in the history of Europe when the door, at the push of the printer, began to open more rapidly. Knowledge flared up, and as it flared it ceased to be the privilege of a favoured minority. For us now that door swings wider, and the light behind grows brighter. Misty it is still, glowing through clouds of dust and reek. The door is not half open. Our world today is only in the beginning of knowledge.
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> H.G. Wells on history, 1930

Oxford
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