GEOLOGICAL INFORMATION — PAST, PRESENT AND FUTURE

by

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Originally a keynote address to the 2nd International Conference on Geological Information in May 1982, this paper is a general overview of scientific and geological information and its communication with an emphasis on Europe. It looks at the scientific and in particular the geological community, the dissemination of information with special attention on the role of publishing and publishers, and the retrieval of information through the medium of the secondary services - those devoted to abstracting and indexing the literature and their on-line databases - and finally the role of libraries.

Historical Background

At the end of the 18th century geology - like science itself - was in its infancy. There were no professionals, relatively few publications and the main channel of communication was the handwritten letter. This era lasted until the first decades of the 19th century, however, geology remained in the hands of amateurs, gifted though many of them might have been.

The end of this first phase came with the establishment of specialized societies - the first of these being the Geological Society of London - which had as one of its several aims the publication of the results of members' research. Such societies provided vital focal points for the development of geology. Despite the difficulties often encountered in actually undertaking investigations, and the sometimes greater problem of getting it published, the corpus of published information then began to develop. Many authors, of course, paid for their own works to be printed or invited subscribers. Even so, the great Charles Lyell could lament the amount of information he had to cope with - proving that nothing is new!

One-third of the way through the 19th century the pace of science development began to quicken, as the population of the western world increased to provide a larger base of potential personnel. University education improved, and governments became involved with geology. One example was the establishment of the Geological Survey of Great Britain. These developments caused geology to move away from an amateur-based science to a professional one. This led in turn to a fairly rapid increase in all types of publications. Libraries too began to move from the private to a more "public" domain.

It should be noted that all these developments increased on a global, as opposed to just a European, scale. The foundations for the scientific communication system laid down in the 19th century were adequate to last until the second half of the 20th century. Certainly new societies were formed (as some older ones died), new periodicals came into being, and the scientific community continued to grow as did further education and the availability of professional employment. But there was relatively little further fragmentation of geology from those major divisions established in Victorian times.

The last 20 years correspond to the beginning of the third phase in the evolution of scientific communication - the beginning of the electronic era. The 1960s, in particular, saw a rapid increase in the number of individuals involved in science and geology was no exception to this trend. Educational establishments flourished, new literature gushed forth and library budgets seemed to keep pace.

The growth of the geological profession, coupled with the seemingly crazy "publish or perish" syndrome - those trying to cope with the increasing information flow might say publish and perish - could only lead in one direction, to a

growth and perhaps more importantly to a fragmentation in the literature. The professional societies long dominant as publishers could not keep their grip. Their financial resources were inadequate to capitalize on all the new developments and on the new sales markets; hence the rise of the commercial giants.

Recent Developments

The publishing of scientific information in the period 1960-1980 could be adequately summarized by a paragraph from a recent article in *The Sunday Times* (April 4, 1982, p. 57) on the man who founded Pergamon, Robert Maxwell: "Pergamon is based on Maxwell's brilliant idea of creating monopolies in abstruse academic journals which universities find they have to buy to keep up with the subject. Pergamon can charge over 2 000 pounds a year for a subscription, while its contributors tend to be professors who are content to accept little payment for the honour of having their articles published before their deadly rival half-way round the world."

One interesting development has been the substantial rise in the number of geological (and in particular palaeontological) newsletters. These often represent the visible portion of an invisible college but perhaps also show through their informality a certain frustration with the more formal world of publishing - both primary and secondary. For those groups that have access to computers, this type of publication would be ideally suited to the electronic medium.

Perhaps the greatest changes in the past three decades have been in the abstracting and indexing services. The rise in the amount of literature conveniently occurred at the same time as the rapid development of computer technology (for some recent developments, see box below). Of course the use of computers in the printing industry has also moved forward

One important recent development is the setting up of a joint indexing service combining the two major international computer databases in geology, GEOREF and PASCAL-GEODE. Geological surveys in eight European countries (France, Germany, Spain, Czechoslovakia, Finland, Hungary, Poland and Romania) share bibliographic documentation through the French PASCAL-GEODE database and its printed equivalent "Bulletin Signalétique - Bibliographie des Sciences de la Terre". Last year the group reached an agreement with the American Geological Institute, responsible for GEOREF, and the "Bibliography and Index of Geology", to implement a joint service which will continue both PASCAL-GEODE and GEOREF. Thus the duties of indexing the 1981 and later literature from North and Central America, Australia, New Zealand and half the U.S.S.R. now fall to GEOREF, the rest is being handled by PASCAL-GEODE. Global coverage is still available through both systems.

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but the economies here are not as high as were hoped for initially. The base created, however, may form the foundation on which to build in the future.

Libraries and librarians appear to have changed very little. Libraries have become larger, and now require a greater percentage of the parent institutions' funds and space than ever before, but basically they remain much as they were in the 19th century. Computer technology has largely been hidden from users by being concerned with housekeeping routines. However, the two areas of greatest impact have been in on-line searching and in the development of network cataloguing on either a local or national scale.

To summarize, the present scientific communication system is Victorian in basis. It is now being put under considerable strain and its inefficiencies and inadequacies are becoming increasingly apparent. It is creaking at the seams.

Future Directions

What of the future? It is certain that there will be changes within the system, for several reasons. First, the population of the developed nations is set not only to decline but also to age, thus reducing the potential size of the base of practitioners. Second, the world economy is still basically in recession. Nearly all U.K. libraries report having real cuts of 20 per cent or more, and the same story seems true of the U.S.A. Third, technology continues to develop at what might be regarded as a frightening pace. At a recent editors' meeting in Europe, one speaker quoted the prediction of the chief scientist for a major corporation that in a few years it would be possible to put all the information stored in the Library of Congress in Washington, U.S.A., on about 100 videodiscs!

Just as the secondary services changed in the 1960s and 1970s so will the primary publishing system change in the 1980s. It will do so for one simple reason: publishers are in business to make money and they do not care in what format they work. Changes will occur because of the relative inefficiency of the present system because the cost of its component parts (e.g. paper and mailing) are all increasing while electronic-based system costs, relatively speaking, are falling. Publishers are becoming increasingly alarmed at the extent of photocopying and interlibrary loans. In other words, they want to safeguard their property and make maximum gain out of their investment. What courses are open to them?

With the increasing availability of full text on magnetic tape the trend is likely to follow the path taken by the secondary

Part of the photograph library at the Jet Propulsion Laboratory in California, showing binders storing some 100 000 photographs taken on various space missions (Courtesy of L.J. Pieri, JPL). The inset shows a videodisc similar to the one produced by JPL to hold all these photographs.

services. Indeed, the one major system being developed is headed in that direction. ADONIS is a document delivery system which is due to become operational in 1984. It is based on images of scientific, technical and medical journal article pages, including illustrations, which are stored on optical reading discs. The consortium of publishers involved include Elsevier, Blackwell Scientific, Pergamon, Springer-Verlag, John Wiley and Academic Press. This system is open to others to join and it is estimated that by the time it becomes available more than 3 000 journals will be represented on the discs. A somewhat comparable direction has been taken by McGraw-Hill by placing the full text of 31 technical and business journals on a database.

One area where change will be rapid will be in reference books where, for example, Gale has its Directory of Associations on-line. Many other publishers are now holding the information contained in directories, bibliographies and dictionaries in a form which makes them ideal for on-line searching. There is no doubt that electronic publishing is highly desirable in these areas.

The videodisc/microcomputer unit at Jet Propulsion Laboratory showing one of the 100 000 images stored on a single videodisc. From r-l: Sony LDP-1000 Laser Player with remote control unit, 19-inch Sony Trinitron Colour Monitor, Apple II plus Microcomputer with two disk drives (64K memory), Leedex 12-inch black and white Monitor, Epson Printer, and a custom-made Videodisc Interface Card to operate the Videodisc by the Apple. (Photo courtesy of L.J. Pieri, JPL.)

Within the publishing system itself editors are usually regarded as a conservative group, but even they are already using on-line bibliographic searching to identify possible duplicate submissions, or to discover the track record of a potential author. Authors will need to come to terms with word processors.

On the other hand, it now seems highly unlikely that there will be a microform publishing revolution, or that the synopsis journal will be well received and supported by the geological community. It is only necessary to give the example of the Bulletin of the Geological Society of America. Because of a backlog of papers in January 1979 it began to publish in synopsis form with full text back-up on microfiche. The reaction of potential authors was such that the flow of papers submitted almost ceased and in January 1982 the synopsis idea was abandoned. This was surprising because an analysis of reading habits by scientists would seem to indicate that the synopsis medium would be ideal. Other forces must be at work, and it may be suspected that the root cause of dislike is that it does not help the "publish and be promoted" syndrome.

There is little evidence that major publishers are expecting to go out of business; indeed, they seem to be quietly flourishing. Commissioning editors in major houses still have targets of between 30 and 40 new books in a subject area in addition to perhaps two new journal titles. The journal will be with us for many years, and the demise of the printed book does not seem imminent.

Secondary services will continue to develop as well the trend away from printed copy sales to on-line searching. This in turn will mean higher on-line costs. The reasons for this trend are not hard to discern: Libraries gain access to a wide variety of databases, many of which they could never justify or afford in the hard copy versions; payment is by use; the databases increasingly contain more information than is available in the published service; and individual geoscientists who are often reluctant to use the printed abstracting and indexing services seem to appreciate the flexibility and ease of on-line searching.

Data banks will also continue to develop with greater availability by direct access than ever before. There will be a continuing fragmentation of the retrieval system as smaller units seek to capitalize on any unique information stores they hold by selling them to the community at large. Further, libraries and individual users will be accessing these systems not by "dumb" terminals but through microcomputers, thus allowing a more "friendly" approach to the various systems and providing the ability to store and reformat the information received. These will be important changes leading in many instances to a greater use of such databases by individual geologists rather than just through libraries.

What will be interesting to observe is what effect the development of publisher's databases will have on the secondary services. There is no doubt that the present system of on-line bibliographical database searching can be most frustrating. The citations themselves may take only 15 minutes to retrieve but the actual papers take six weeks or more through conventional libraries and interlibrary loan systems. At the 1st International Conference on Geological Information in 1978 there was a feeling that the secondary services should become increasingly able to retrieve facts as well as citations and that the direction would be toward full text retrieval. Will this particular line of development be taken up by the publishers themselves rather than by the secondary services, or will there be a merging between these publisher/databases and bibliographic data bases? Pergamon certainly seems to have accepted that the future emphasis will be on full text retrieval.

What of libraries in the future? Librarians will be forced to change at least some of their philosophy, for information is going to cost more than it has in the past. Librarians will still need, at least those in charge of large collections of archival material, to conserve and make available books and journals for, of course, many facets of geological research still rely heavily on access to the older literature. More effort will be devoted to conservation, a very expensive operation, and this may well mean transfer from paper to a medium such as videodisc. There will be a change in emphasis from a holding policy (except perhaps in major national libraries) to an access policy, and cooperation and coordination between libraries will be increasingly evident. Because of the fragmenting of communication channels, librarians will retain their important position as intermediaries between information creators and users and the information itself.

Summary

Three factors will be important in determining the speed of change in the main areas outlined above: professional considerations, economics, and technology.

There is little doubt that much of today's publishing is aimed at satisfying the somewhat crazy system which has developed to support academic promotions. In accepting or fighting the new systems, however, the geological profession must decide what it wants, and what it is prepared to accept. Certainly it seems unwilling to accept, at present, synopsis publishing. Because there is an area of potential conflict in accepting the electronic medium, it will be necessary to re-examine the

This Xerox 850 word processor at the Geological Survey of Canada in Ottawa produces EPISODES copy camera-ready for the printers, handles the mailing lists and labels, and is used for routine correspondence.

needs of the creators and users of information and to understand the differences between them. This is necessary as those who demand instant information are less likely to publish, and it is those who do publish who are likely to put up the greatest resistance to change.

What we must strive to ensure is that changes in the primary communication system do not lead to a deterioration in the quality of information. With the introduction of the new technologies also comes a fear for the integrity of the archival copy because of the ease with which it can be altered. Such considerations are particularly important where matters of priority are concerned.

Information will cost more and there will be a shift of costs so that the purveyor of information invests less in the initial product and sells as needed. Publishers and database managers will be looking to earn as much revenue as possible, and certainly publishers will be doing all they can to see a tightening in the laws regarding photocopying and to devise systems of rapid document delivery at a cost - to replace interlibrary loans. Librarians will become more cost conscious and all their systems will be examined in detail, leading to cutbacks in acquisitions, binding and their allotment of building space. In many cases book budgets have already been savagely attacked in order to keep journals coming in. All other library activities will be carefully analyzed for their cost. For example, the cost of an individual library loan has been calculated at \$30.00 and there were 5.3 million of these in the U.S.A. in 1977. Libraries will also seek to capitalize on any unique information they hold.

Cutbacks in institutional funding will affect the introduction of new technology. Where speed of access to information is important the investment will be made; where speed is unimportant investment will not be forthcoming. This will be sure to cause problems within the communication system.

Technologists and particularly those in the computer field commonly promise information creators, users and providers an information utopia. Two recent developments will serve to show a little of what may be in store. Magnetic bubble memories will do wonders for the storage of vast quantities of data; a portable microcomputer capable of storing 15-20 pages of text and displaying it one line at a time is already available. The development of teletext offers the opportunity for standards to be developed. There may well be a real danger that the communication system will become dehumanized, but it is likely that technology will press on rapidly simply because market forces will dominate.

Geology is both an historic and an international science, the different facets of which have different information require-

ments. Of course in many parts of the world it is still cheaper to handset type, while in others it is useless having an electronic device because there is just no power system to plug into. Care must be taken not to injure the whole system by widening the gap between the information "haves" and the information "have nots".

It was Alan Kent (1980) who after a fairly gloomy review of the future wrote: "Perhaps the only possibility for ensuring that my scenario turns out not to suffer the fate of all prophecy is for the major creators, processors and users of information to get together to understand each other's problems and develop together a common strategy for development and advance. We are all in the same boat together. If technology and the opportunity it offers for the future causes us to run before we can walk then none of us may pass the finishing line". Could there be any better reason for aiming at common objectives for geological communication systems and developing the strategy for reaching them?

Acknowledgement

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