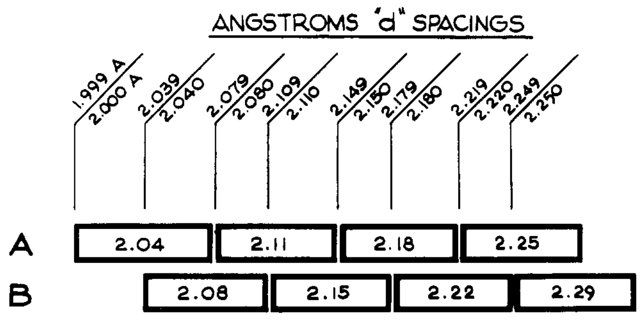
The question of search on either side of the measured d value was effectively answered by use of overlapping descriptors as shown in Fig. 4. The range of values included in each card in the first set A was shifted by half in the second set B so that a descriptor is always available in which values above and below the measured values are included. As shown in Fig. 4, using both the A and B sets, ranges having half the coverage of the original sets are presented.



COORDINATE INDEX CARD GROUPS FOR POWDER DATA

Figure 4.

Using the elements as descriptors for chemical composition can be most helpful in guiding a search by combining chemical information with the numerical data. Similarly negative data, *e.g.*, "there is no calcium or sodium in the unknown" can be applied very effectively using negative cards for the more common elements. Also, negative cards for d values indicating the absence of lines in a given range can be prepared. The chemical composition cards and their negative counterparts are most useful in identifying components of mixtures. Using "random access" colored tabs the refiling of cards is eliminated and the use of the index is thereby greatly facilitated.

Holes in colored transparent sheets are used to record the presence of oxygen (yellow sheets) and hydrogen (blue). When these are superimposed, white spots indicate that both oxygen and hydrogen are present; blue spots indicate oxygen but no hydrogen is present; yellow spots indicate hydrogen but no oxygen; and green spots indicate that neither is present. The green color results from superposition of the yellow and blue transparent sheets.

X-Ray diffraction powder data have proved of particular value in the identification of alloys and of minerals. Hence, cards separating these data have been included. A card for hydrates also has been prepared.

A study of the application of this technique to infrared absorption data is already underway,[2] and a system of this type is now available in Europe.[5]

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Government Services for Technical Information*

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The theme of the following four papers might well be: "Do not ask what you can do for your government. Ask what your government can do for you." Last year the Federal government spent some \$3000 million on scientific information activities concerned with the billions of dollars spent on research and development. Federal agencies are both producers and consumers of scientific information. By definition, at least in the Air Force, anything having to do with basic research is unclassified. The same holds true for almost all of our applied research program. The primary responsibility of any Federal agency is to spend its resources wisely in accomplishment of its mission; certainly a strong secondary responsibility is to ensure that useful information paid for by public funds is available to that selfsame public.

There are certain difficulties in reducing this principle to practice. One of these is certainly the simple effect

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of simple size. I suspect, although I have never tried to prove, that the square-cube law—that the surface increases as a square while the internal volume increases as a cube—that affects all living organisms also applies to information systems. One feels intuitively that the amount of surface area available for radiation—the transfer of information outside the system—increases at a slower rate than the complexities of interactions between the items in the store, and that both of these in turn tend to grow far more rapidly than does the nutrient supply of people and money needed to operate the system.

An interesting consequence of the square-cube law in nature is that it sets an upper limit to the size of organisms. You just don't build a terrestrial animal much larger than the present day elephant. I wonder if it may not also set an upper limit to the size of information systems; if the internal complexities are growing at a much faster rate than the public contact area, the manager inevitably becomes more concerned with the internal management rather than the public service.

It seemed a good idea in planning this symposium to retrieve the managers of four major Federal technical information activities from the midst of their information stores and give them a chance to meet the members of the Division of Chemical Literature. As operators of information systems we are interested in the ways in which their information systems operate; as consumers of the products of these agencies we are concerned with the uses we may make of their information systems.

The Science Information Exchange which Dr. Monroe Freeman heads represents a unique resource, an inventory of current research efforts in the life sciences and, increasingly, the physical sciences. The biological scientists learned to make good use of this agency in its former guise as the Biosciences Information Exchange. It is to be hoped that the physical scientists will make equally good use of it as its stores of information on projects in the physical sciences grow.

In my day to day life everyone I meet seems either to be a Department of Defense contractor or wants to be one. The central agency for secondary distribution of Department of Defense reports is the Armed Services Technical Information Agency of which Colonel James Vann is the Commander.

The Department of Defense has no formal responsibility for disseminating the results of the research it supports to those not in the DOD community. This has become, *inter alia*, one of the many activities of the Office of Technical Services, Department of Commerce, under John Green.

It is seldom that one has an opportunity to start with a clean piece of paper and design a major information system from scratch. The establishment of the National Aeronautics and Space Administration has given Mel Day that opportunity. Perhaps in NASA more than any other agency on today's program, the simple effects of simple size have necessitated many new and ingenious solutions to information problems.

Technical Information for Research Program Management*

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It is axiomatic that intelligent research begins with adequate information about prior experimentation as recorded in the scientific and technical literature. It is equally obvious that the problem of extracting the pertinent information from books, journals, abstracts, and progress reports has *now* become baffling, frustrating, and monstrous. Besides the vast number of records to be examined and their interdisciplinary complexities, there is the faster tempo of modern research. These have contributed critical significance to the pre-publication gap of information on research in progress. This hiatus of uncertainty between the start of experimentation and the time results appear in the literature now seems to average 1–3 years. It is to this one segment of the total technical information problem that these remarks are addressed.

This hiatus was not so critical when research proceeded at a leisurely pace, and when only a few investigators were intimately concerned with any one specific problem. Then, information on current research was fairly well exchanged at annual meetings, at symposia, by correspondence, and by casual meetings among the few principals. This is no longer the case, even in the fields of narrow specialization. No long ago, the Science Information Exchange entertained a visitor whose research specialty was whales. Since not many people specialize in whales, it was a surprise to find records on three whale projects of which the visiting specialist was quite unaware. Another subject brought out 34 records of research in progress at 31 different universities, including three Canadian, one English, and one Italian. These 34 projects were supported by grants from 22 different agencies, of which nine were different government agencies and 13 were

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