the basements (which many houses in Rajasthan have) are twice the ground floor values.

In summary, we can note that in our country, due to the tropical climate and our living habits, we have plenty of ventilation in our houses, which is one of the factors that help in reducing indoor radon levels. Whether one considers the average level over the country, or even the maximum values recorded in the high background areas, the levels are below the ICRP recommended action level of 200 Bqm^{-3}, and hence indoor radon is *not* a significant health risk in our country.

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Electronic databases, networks and information support for scientific research

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Electronic databases and computer networks are bringing forth significant changes in both formal and informal information transfer mechanisms in science. More than 6,000 electronic databases are estimated to be available today, which include a large number of bibliographic and scientific hard databases. While a majority of these can be accessed 'online' using computer-communication networks, they can also be acquired on tapes, diskettes and CD-ROM discs and searched locally. Electronic databases are used predominantly to meet the current and retrospective information needs of scientists. While electronic databases facilitate a researcher in gaining rapid access to published or about-to-be published information, a variety of 'networked information services' have evolved on academic and research networks like BITNET, NSFNET, Internet and JANET. These include electronic discussion forums, data archives, electronic journals, library catalogues and databases. Network information services deliver information to the end-user right at his terminal and have the advantages of convenience, speed and informality. Although researchers in a few institutions in India are beginning to take advantage of these developments, there is need for more widespread awareness of these. This article is an attempt in this direction.

It is now widely acknowledged that the ability to access, transmit, share and disseminate information will make the difference between success and failure in the 21st century. If we have to improve productivity and innovation of our R&D activities and give competitive edge to our technological products, then convenient, economic

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and quick access to results of worldwide scientific and technological research becomes very critical. Given the rapid growth of science, reflected by the growing number of researchers, scientific establishments, scientific fields and research publications, conventional information transfer mechanisms—both formal and informal—are proving to be highly inadequate in achieving this objective.

Solution to this problem has come mainly as the result of a major shift in handling information in its analog and physical form (voice, print, audio visual) to electronic form. The moment information is created in electronic form, it becomes mobile, rather than static. It can then be processed, transmitted, stored, retrieved and presented at enormous speeds and convenience. We are witnessing significant changes in both formal and informal modes of scientific communication due to electronic information handling.

Electronic information, together with computer networks, are making inter-personal communication among researchers more instant, global and interactive. Academic and research networks like BITNET, Internet and JANET, which link universities, laboratories, and research agencies around the world, are enabling more and more information to be distributed in advance of 'normal' publication outlets through electronic conferences and distribution lists (bulletin boards, list servers and news services), info servers, electronic journals and newsletters. We discuss these developments on academic and research networks in a later section of the paper.

But this phenomenon of networked inter-personal communication is a recent one. It is electronic databases which emerged first in the late 1960's offering control over and improved access to the rapidly increasing number of print publications like the journal, conference, patent, report, etc. Information explosion, coupled with literature scatter (dispersion of papers in a field over a large number of journals, including a few 'key' and many peripheral journals) and increasing cost of science publications have rapidly degraded the ability of a scientist to keep well informed of recent developments in one's field.

Electronic databases

Electronic databases (EDB), stated simply, are electronic equivalents of their print counterparts, but as is the case most often, are produced first and then used for producing the print version. They can be categorized into two types—reference and source databases. Reference databases refer or point a user to another source, often a document, for more details. Reference databases can be further sub-categorized into bibliographic (containing primarily citations from published information like journal articles, reports, patents, dissertations, conference proceedings and books) and directory (for e.g. listing of companies, associations or people). Source databases contain complete data or the full text of the original source information. These are categorized further as hard, soft-hard or full-text. Hard databases contain original and/or statistically manipulated numeric representations of data; soft-hard databases contain a mixture of numeric data and related textual information (comments about the data and/or bibliographic references to the original data); full-text databases contain records of the complete text. The number of information items in an EDB may vary from a few thousand to several million items (see the box *Some Key Electronic Databases*).

The information flow in database production is shown in Figure 1. Beginning with the National Library of Medicine, USA, with its MEDLARS database in 1960, the number and size of databases has grown dramatically, from about 20 in 1965 to more than 4200 in 1989. Current estimates indicate more than 6000 publicly available electronic databases in a variety of forms: on storage media like magnetic tapes, CD-ROM (Compact Disc-Read Only Memory) and floppy diskettes, and through online/offline database hosts. While a database producer converts information into electronic form and brings it out on a storage medium, a database host (also called a database vendor) company mounts one or more databases on a computer and offers a variety of services in online or offline mode. While there are a few thousand database producers, there are a few hundred database hosts operating around the world today, resulting in the emergence of an entire industry, called the 'database industry'. DIALOG, BRS, STN Intl, ORBIT, Pergamon Infoline, Questel, ESA/IRS are some of the leading online database hosts today.

While online access has been the most popular mode of database searching so far (about 40 million online searches in 1991!), it is CD-ROM that has captured the current imagination of both database producers and users and appears to be the chief medium of database distribution in the 90's. Thanks to its enormous storage capacity (about 600 megabytes on one five and a quarter inch disc—equivalent of 250,000 pages of printed text!) and its compatibility with microcomputers, it is now possible to access large databases locally using a CD-ROM, without establishing online connection to a big computer system thousands of miles away. CD-ROM databases thus come closest to the concept of *Desk top global information systems*, since the entire set-up, including a PC, a CD-ROM drive, CD-ROM discs and associated software and documentation, can be housed on a single table top!

When compared to library card catalogues and printed sources like directories, indexes and abstracting journals, electronic databases are far more easily amenable for exhaustive and rapid processing of complex queries which are a combination of multiple search terms (for

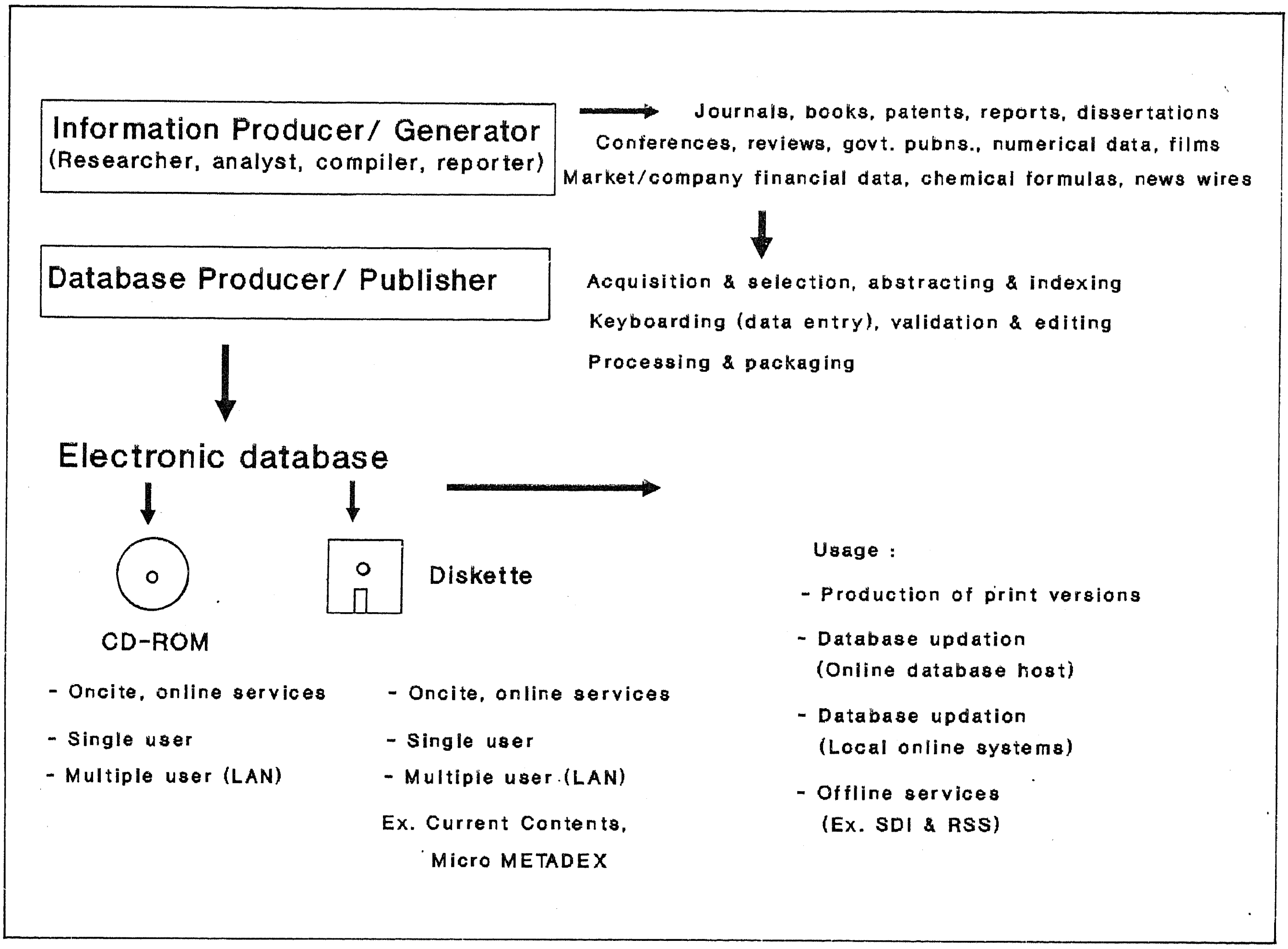

Figure 1. Electronic information path.

ex. papers by FC CODD or CJ DATE on RELATIONAL DATABASES or QUERY LANGUAGES published during 1975–1980), retrieval and display of information in a variety of formats. Electronic databases have thus enabled condensing the time element involved in the creation, storing, retrieval and information dissemination process, thereby making more current information available to users than what comes through printed publications.

Searching electronic databases

How does one search an electronic database? There are primarily two ways of searching a database—online or offline. In online searching a computer terminal is used to access a database residing on a computer situated nearby or in a remote location and the searcher interacts with the database by typing in the search statements (queries) and viewing the results on the terminal screen. Such interactive searching facilitates speed and convenience in modifying the search statements to retrieve all useful information. In offline searching, the user submits his/her query to the database service agency in written form which is converted into a set of search statements and processed on an appropriate database to retrieve all matching records which are then supplied to the user. Offline searching therefore takes longer time and more importantly it does not give scope for taking quick corrective actions. Irrespective of the type of media on which the database is stored and the search mode employed (offline or online), the basic techniques of database searching are the same.

Searching bibliographic databases

Databases on a computer are organized in terms of records. Let us consider searching a bibliographic database like INSPEC, which is the world's leading database covering physics, electrical and electronic engg., computers, control and information technology. A search in a bibliographic database of this type does not result in

SOME KEY S&T ELECTRONIC DATABASES

Following is a brief description of some key electronic databases in science and technology.

A. Bibliographic Databases :

1. CA-SEARCH (Chemistry) : References of more than 9 million chemistry publications, dating from 1967. Produced by Chemical Abstracts Service, USA. Equivalent of the printed Chemical Abstracts.

2. INSPEC (Physics, Electrical & Electronic Engg., Computers, Control and Information Technology) : About 4 million bibliographic records, dating from 1969. Producer : Institution of Electrical Engineers, U.K. Also available in CD-ROM since 1991.

3. BIOSIS Previews (Life Sciences) : More than 7 million bibliographic records, since 1969. Producer : Bioscience Information Services, U.S.A. Also on CD-ROM from 1988.

4. COMPENDEX Plus (Engineering) : Machine readable version of 'Engineering Index'. About 3 million bibliographic records, since 1970. Producer : Engineering Information Inc., U.S.A. Also on CD-ROM from 1986.

5. MATHSCI (Mathematics) : Contains evaluative reviews and abstracts of mathematics literature, since 1959. File size : More than a million records. Producer : American Mathematical Society, U.S.A.

B. Full Text and Image Databases :

I. Full Text Databases : Examples include full text of S&T journals like 'Science', 'Electronic Design', 'Electronics', 'Byte', etc., handbooks and encyclopedias like 'Kirk-Othmer Encyclopedia of Chemical Technology' and 'Beilstein Handbook' (organic chemistry), full text legal databases like LEXIS and news databases like NEXIS, Financial Times, etc. All these include only textual information, without any graphics like diagrams, charts, etc.

II. Image Databases : These databases contain complete images of print publications, captured using optical scanning. Examples include ADONIS CD-ROM discs, produced by ADONIS B.V., Amsterdam, covering about 400 leading biomedical journals and IEEE/IEE Publications Ondisc (IPO), a joint venture product of IEEE, IEE and University Microfilms Intl., providing access to complete page images of about 80 journals, 500 standards and 360 conference proceedings published by IEEE (USA) and IEE (UK).

C. Directory Databases :

Examples include 'Research Centres and Services Directory', by Gale Research Inc., providing detailed information on over 26,000 research organisations worldwide; 'Computer Readabale Databases', by Gale Research Inc., providing description of more than 6,000 publicly available databases; 'D&B Dun's Market Identifiers', by Dun's Marketing Services, providing detailed information on business establishments in USA, Europe, Africa, Asia and other countries.

D. Scientific Numeric Databases :

Examples include 1. CSD - Cambridge Crystallographic Database, produced by University Chemical Laboratory, Cambridge, UK. CSD contains crystallographic, chemical and bibliographic information for organic solids and includes unit cell data, atomic ccordinates, chemical connectivity, and reference information; 2. Metals Datafile, produced by Institute of Metals, UK. Includes mechanical properties like crack propagation, elongation, fatigue life, etc. and physical properties like density, electrical resistivity, etc. of metals and alloys; 3. GENBANK, produced by Intelligenetics Inc., USA. Contains information on nucleotide, DNA and amino acid sequences; 4. Hybridoma Data Bank, produced by American Type-Culture Collections, USA. Contains information on hybridomas and monoclonal bodies.