mission of error-free information over a given communications system.

Information theory has by now diffused into a collection of theories, but all owe a debt to the original proposition that a quantitative measure can be given to the content of information.

The proprietary familiarity with information theory that seems to be a part of the Bell Labs atmosphere may well add to the impression the visitor is likely to gain there of a widespread assumption that telecommunication is on the edge of a cybernetic revolution, one that will effect a dramatically greater extension of man's senses and reasoning power and work deeply significant changes in human society.

The vista that some scientists and engineers at Bell Labs see before them is sketched in this excerpt from a speech titled "Some social meanings of communications science and technology" by W. O. Baker, vice president for research of Bell Labs, which he gave at Georgetown University earlier this year.

. . . We must remember first of all that telecommunications represents an extension of man's senses, in contrast to his muscle. Much of our industrial and scientific revolution has been concerned with easing man's physical burdens and with multiplying vastly his ability to do mechanical work. Only comparatively recently, and particularly through the discovery of modern communication methods (including especially electrical communications but also involving rapid printing and certain other graphic arts), has it been found that physical science, that is, the behavior of elemental matter (and the energy, often in the form of waves, that is associated with it), can be coupled with the most subtle organic, vital qualities of mankind. These include his speech, hearing, certain of his reasoning processes, such as his ability to do logical, mathematical operations and to remember. Even more recently, indeed, even his senses of heat and cold and to a limited degree that of touch have been approximated by inorganic sensors, like thermistors, strain elements, and piezoelectric devices.

The philosophic imports of these diccoveries, which were really first dramatized by Bell's operation of the telephone, are just now being interpreted by such students as Professor Marshall McLuhan. These men are realizing that the whole concept of man's relation to his universe, even to inanimate nature, is being revolutionized through the extraordinary circumstance that it turns out that electrons and other charged particles (and also neutral atoms and molecules in audio systems) and the electromagnetic waves which permeate all the universe can be adjusted to exquisite fineness and controlled by man-made devices and systems. Most wonderfully, this is in a way which joins directly with his speech and hearing and seeing and sensing, and even certain elements of his thinking. And all at once we see that this strikes at the center of how one is human. The communications and organization and interactions of people and societies are deeply affected by this linking of physical effects with functions of the nervous system. Already it is clear that value scales of this technology diverge considerably (and we are not indicating whether they are up or down), but they are clearly dependent on different judgments and principles from those applied to things which extend to man's muscle, through energy conversion and machines. In the first place, the extension of man's muscle is a vastly more specific process, usually, than communications, or the extension of his senses, especially through telecommunications, where complex communities and groups are inevitably involved. . . .

Intimacy with computer-based research and technology breeds an expectation of things to come which makes many of the most matter-of-fact scientists and engineers talk like visionaries. At the same time, those who know computers best are most emphatic about the inherent limitations of the computer and do not ascribe to it any "humanoid" potential as monster or messiah.

The degree of difference in potential between old and new instruments is so great, however, that initiates, interestingly, do tend to slide into the use of anthropomorphic terms. An example is the feeling inspired by the new central processing equipment for ESS. The processor is really composed of two companion units, paired so that one monitors the other, shares work with it when necessary, and diagnoses ills and prescribes treatment for the other unit. One member of the technical staff concerned with the development of ESS evinced his feeling and turned a neat phrase when he called the processor "a large immortal machine."

—JOHN WALSH

Information Services: A Guide to Federal Offerings

A variety of methods for disseminating scientific and technical information have been developed by organizations concerned with what is referred to as the "information explosion." Information handling services, many of them computer-oriented, are expanding rapidly but are still in a relatively young stage, and the overall system has not yet developed any great degree of rhyme, reason, or clear-cut jurisdiction. Outsiders generally refer to the services as "information retrieval," a casual label that tells only half the story. Information specialists divide the field into two parts: (i) "information retrieval," to designate the raw material, such as statistics, technical measurements, and research data; and (ii) "document retrieval," to refer to reports, articles, books, and other documents. Government agencies and private organizations alike are promoting the development of these services, and federal agencies, in addition to disseminating their own material, are cooperating in many of the nongovernment efforts. The result is an evolving system which, though still in an embryonic stage, can be extremely useful to the researcher who has some idea of where to look. The following is a primer on some of the information and document disseminating services available directly from the various segments of the federal government, what they purport to offer, and how an individual researcher can make use of them. The list is by no means complete, and in addition to these resources, the individual can take advantage of the services of many information centers operated under federal contracts or grants by professional societies, industrial organizations, and colleges and universities across the country.

The information seeker will find

that two serial publications of the National Science Foundation are a useful starting point. The first, *Scientific Information Activities of Federal Agencies* (10 cents), features a different agency in each issue and covers the agency's organization and mission, subjects in which it generates information, where its publications are announced, and ways for individuals to get information on current projects. Each issue has instructions for obtaining the featured agency's documents or services and tells the locations, functions, and policies of the agency's data centers, libraries, and field offices. Copies of most back issues are still available. The second of the serial publications, *Scientific Information Notes* (25 cents single copies, or $1.25 a year in the United States, $1.75 abroad), discusses national and international developments in scientific and technical information dissemination. The journal is mainly for information specialists, but it also reports on new services for the general scientific community. Copies of the 1965 and 1966 back issues are available. (Superintendent of Documents, Government Printing Office, Washington, D.C. 20402)

The major contribution of the National Library of Medicine is the Medical Literature Analysis and Retrieval System (MEDLARS), which offers three services. (i) It compiles several specialized bibliographies in both basic and clinical research fields. Best known of these is the multidisciplinary *Index Medicus*, a subject-author index of articles that have been published in over 2400 U.S. and foreign journals on topics ranging from air pollution to zoology. Copies of *Index Medicus* are available in medical libraries; they also are sold by the Government Printing Office for $3.75 each or $40 a year; GPO sells an annual list of the journals indexed for 75 cents. (ii) MEDLARS compiles lists of citations on specialized topics; these "demand bibliographies" are available free of charge to any researcher. (iii) It offers, also at no charge, a limited number of "recurring bibliographies," compiled at specified intervals for small groups of researchers; some, of broader interest, are also available to the scientific community for a small fee. Applications for these services should be sent to the Chief of the Bibliographic Services Division, National Library of Medicine, Bethesda, Maryland 20014.

A new information resource at the National Bureau of Standards is the

NEWS IN BRIEF

● **FERMI AWARD:** For the first time since its establishment in 1954 the Atomic Energy Commission's Enrico Fermi Award for 1966 will be shared by three foreign nuclear scientists: Otto Hahn, Lise Meitner, and Fritz Strassmann. The three scientists were selected to receive the award (a citation, a gold medal, and a one-third share of the $50,000) because of their combined and individual efforts in discovering nuclear fission and for experimental studies which led to the discovery. Meitner, 87, is the first woman to receive the award. She was born in Vienna, worked for many years in Germany, and now lives in England. Hahn, 87, who now lives in Goettinger, West Germany, and Strassmann, 64, director of the Institute of Inorganic and Nuclear Chemistry, Mainz University at Mainz, West Germany, published on 6 January 1939 the results of experiments revealing that the nucleus of a uranium atom can be split into two parts. About the same time Meitner had also come to the conclusion that atom splitting was possible and had already referred to it as a "fission process." When news of the German research reached this country it sparked the development of the atomic bomb. The award is named in honor of the late Enrico Fermi, leader of the group of scientists who achieved the first self-sustained, controlled nuclear chain reaction on 2 December 1942. The award is made on the recommendation of AEC's General Advisory Committee and is approved by the President.

● **PLANT SCIENCES REPORT:** A 10-year research program in the plant sciences has been outlined by a panel of the National Academy of Sciences in a recently released report, *The Plant Sciences, Now and in the Coming Decade.* (Available from the Printing and Publishing Office, NAS-NRC, 2101 Constitution Ave., NW, Washington, D.C. 20418, $5.) Federal expenditures totaling approximately $1.5 billion—over and above that spent for work done in government laboratories—would go into studies of plant sciences over the decade as a way to prevent food shortages in the future. (The panel compares the proposed figure with approximately $33.4 million per year that the government now spends in support of plant sciences.) Noting that each year the nation loses about a million acres to housing, airports, and shopping centers (much of it first-class farmland) while gaining two to three million consumers of agricultural products, the report states that our present surpluses are based on research developments of 25 to 40 years ago. "How long the nation will have a food reserve," it says, "will probably depend on how many similar discoveries are made by basic research in plant science during the ensuing 40 years." The report, the fifth in a series of studies on the long-range Federal support of science, was issued by the Academy's Committee on Science and Public Policy and was prepared by a panel of scientists under the leadership of Kenneth V. Thimann, formerly of Harvard, now at the University of California, Santa Cruz.

● **BIRTH CONTROL AID:** The Swedish International Development Authority has announced a grant of $300,000 to the International Planned Parenthood Federation in support of IPPF's 1966 budget. SIDA is also making available $86,000 for information, training, and specific projects to be agreed upon by the two groups. Sweden has been a great supporter in the family planning field for several years and currently has basic agreements with the governments of Ceylon, Pakistan, and Tunisia for cooperation in population programs. Half of Sweden's $65-million foreign aid programs this year is administered through multilateral assistance programs of the UN. This represents five to six times more than 5 years ago.

● **WEST COAST HEADQUARTERS:** The Geological Survey is establishing West Coast headquarters for its marine geology and hydrology program at the Survey's Research Center at Menlo Park, California. The office, headed by Parke D. Snavely Jr., will serve as headquarters of geological and geophysical investigations of the continental shelves and slopes—work which has been under way in the Survey for several years. The Interior Department announcement also said that research activities will be conducted at La Jolla in collaboration with the Bureau of Commercial Fisheries and the Scripps Institute of Oceanography.

Technical Information Exchange (TIE), in operation officially only since June. Part of the Center for Scientific and Technical Information, TIE combines the facilities of the center's library and those of the Research Information Center and Advisory Service on Information Processing. TIE is accumulating a library of technical literature and studies on applications of automatic data processing. It plans to eventually have a library of actual data programs or information on where these programs can be obtained.

The Clearinghouse for Federal Scientific and Technical Information (CFSTI), in the NBS Institute for Applied Technology, sells published reports of federally sponsored R&D efforts. CFSTI's own publications include: (i) *Government-Wide Index to Federal Research and Development Reports*, a monthly listing of reports announced in other journals of NBS, the Defense Department, NASA, and AEC; (ii) *U.S. Government Research and Development Reports*, a bibliography of documents available from the Clearinghouse; and (iii) *Technical Translations*, a bimonthly index of translations of foreign reports. The Clearinghouse also provides an industrial referral service for nongovernment researchers who need a source of technical information in their fields in the federal government.

The Bureau's Institute for Basic Research operates the National Standard Reference Data System, which produces and disseminates critically evaluated information on the following topics: nuclear data, atomic and molecular data, solid state data, thermodynamics and transport data, chemical kinetics, nd colloid and surface properties. (TIE and NSRDS: National Bureau of Standards, Washington, D.C., CFSTI: Sills Building, Springfield, Va.)

The Defense Department's offerings cover research in all areas of science and technology, its own and that performed by several other federal agencies. Its information and document dissemination is done primarily through the Defense Documentation Center (DDC) and the DoD Information Analysis Centers; publications of the latter are also available through DDC. The documentation center has about 450,000 usable reports on its own work over the past 15 years. Besides collecting and selling documents, DDC publishes the *Technical Abstracts Bulletin*, and performs demand searches for bibliographies on topics within its scope; the bibliographies are available free to government contractors and federal agencies, and many are sold also by the CFSTI. The Defense Department's information services are available to other agencies, federal contractors and potential contractors, and others with a certified need for them; eligibility is determined on the basis of form "D.D. 1540, DoD Scientific and Technical Information Services" obtainable from DDC. (DDC, Building 5, Cameron Station, Alexandria, Virginia 22314)

The Government Printing Office sells publications and reports on all subjects prepared by the federal agencies and by Congress. The GPO's publications are listed in monthly catalogs, which cost $4.50 a year and in bi-weekly price lists, available free on request. (Superintendent of Documents, GPO, Washington, D.C. 20402)

The National Referral Center for Science and Technology answers, without charge, requests for information on where to find material on a specific topic in any of the sciences or related technical areas. This center refers the inquirer to government information sources as well as to industrial, academic, or professional institutions. It also compiles directories of information resources in selected scientific and technical fields; these are available on a fee basis. Anyone working in science or technology may use the center's services; requests may be by letter, phone, or in person. (National Referral Center for Science and Technology, Library of Congress, Washington, D.C. 20540, Attn: RSS)

The Smithsonian Institution's Science Information Exchange (SIE) can help the information seeker in a quite different way—it can tell him about unpublished research in his field that is planned or under way. SIE covers both basic and applied research in the life, social, physical, and engineering sciences, and keeps track of contracts and grants made by the federal government, nonprofit foundations, industrial organizations, and universities both in the United States and abroad. Any researcher working in a recognized scientific laboratory is eligible to use SIE free of charge. (SIE, Madison Building, 1730 Massachusetts Avenue NW, Washington, D.C.)

Other federal agencies offer a multitude of information and document services, some only to their own personnel, some to the scientific community at large. The National Institutes of Health, for example, has an Office of Research Information, separate information offices in each of its nine institutes and six divisions, and about 50 small computer facilities for information retrieval in specialized subject areas. (NIH, Bethesda, Maryland 20014)

The Food and Drug Administration, which ordinarily restricts its information dissemination services to hospital and laboratory facilities cooperating in its projects, is publishing a drug dictionary, in "microform" negatives, designed to be revised every 3 months. The dictionary is in two parts: the *FDA Drug Name Dictionary* and the *FDA Sign, Symptom, and Disease Dictionary*; it is aimed at helping to standardize the terminology used in collecting and processing data involved in clinical experiences with drugs. Copies are being distributed to selected participants in FDA's drug monitoring system, but arrangements are being worked out with Bell and Howell for wider distribution. (FDA, Washington, D.C.)

Two booklets, sold by the Government Printing Office for 20 cents, are a useful guide to the researcher interested in the information programs at the National Aeronautics and Space Administration. "How to Use NASA's Scientific and Technical Information System" describes the agency's scientific and technical documents, which consist of a number of specialized bibliographies and serial publications on research performed by NASA and by its contractors and grantees. Emphasis is on the semimonthly *Scientific and Technical Aerospace Reports* (*STAR*), which presents abstracts and indexes of both U.S. and foreign research reports; *STAR* is sold by GPO on a single copy basis ($2.25 U.S., $2.50 foreign) or by subscription ($33 and $42 a year) and its cumulative indexes are also available ($30 and $35 a year for subscriptions but individual issues vary in price). The second brochure, "NASA's Technology Utilization Program," discusses the divisions and functions of the space agency's Office of Technology Utilization and describes the specialized technological publications available. Both booklets stress the fact that all NASA reports can be obtained from either GPO or the Clearinghouse for Federal Scientific and Technical Information; both also give the locations of NASA's 13 field installations and offices, the eight regional dissemination centers, and the 11 federal regional technical report centers. (NASA, Washington, D.C. 20546)—MARION ZEIGER