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THE IMPACT OF COMPUTERS ON KNOWLEDGE INDUSTRIES: PART II*

Charles A. Myers

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**Comments are welcome on this first draft of Part II.

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Section 4

Medical and Hospital Services

As in the other areas examined in the preceding sections, the application of computers to medical and hospital services is moving rapidly. Keeping up to date on developments in this field is often as difficult as it is in the other "knowledge industries." An editorial in the special 1966 issue of the Journal of the American Medical Association on computer applications posed the question:

> "What is the present status of the computer in medicine? The honest answer to that question is, of course, that we do not know. In common with publications in all fields of human knowledge, medical literature is old the day it appears in print."[1]

In attempting to assess what has happened, it is important to remember the caveat suggested by Dr. G. Octo Barnett, Director of the Laboratory of Computer Science at the Massachusetts General Hospital in Boston:

> "I am concerned with the scientific integrity of the approach that allows a broad statement that the computer can do tasks X, Y, and Z when even a superficial investigation would reveal that X can be done only on a limited demonstration basis in an artificial environment, Y is being seriously considered as an area to be programmed three years hence when system '...' is fully functioning, and task Z looks like a challenging problem in information processing and wouldn't it be nice if we could get a National Institute of Health grant to carry out a research project. The failure to discriminate between present reality and

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[1] JAMA, vol. 196, no. 11, June 13, 1966, p. 1014.

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future speculations has been one of the major causes of frustration and misunderstanding in the medical applications of computer science.[1]

The Needs

A review of the literature on computer applications in medical and hospital services indicates the following needs which have called forth these efforts:

1. The information explosion represented by increased records for present and past patients means that professional hospital personnel may spend a third (or more) of their time on information processing. Much of this is routine clerical work with manual methods which have been used for many years.[2] The consequences of the record-keeping explosion are dramatically shown in the experience of the Massachusetts General Hospital:

> "The Medical Records Department now stores 1,350,000 records dating from 1937. During an average day, 150 new patient records are issued and over 4,000 demands for existing records are made. ... The various laboratories perform 1,000,000 procedures per year... Each time a patient is admitted, pertinent information is sent to some 30 different areas. It is estimated that on an average day, some 5,000 doctor's orders are written and the nursing service administers over 30,000 drugs and treatments. It is probable that at least 50,000 separate items of information are entered into patient records each day, or almost 20,000,000 separate items each year. The problems created by the large bulk of information processing are greatly magnified by the

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[1] In Report to the Computer Research Study Section, Research Grants Review Branch, Division of Research Grants, National Institutes of Health, on Computer Applications in Medical Communication and Information Retrieval Systems as Related to the Improvement of Patient Care and the Medical Record, September 1966. (Also contains an annotated bibliography.) (The underlining added above.)

[2] "It is probably true that many of the record keeping methods we use (in hospitals) are somewhat archaic and represent the carry-over of practices developed 30 to 50 years ago." Jordan Baruch and G. Octo Barnett, quoted in Datamation, December 1965, p. 30.

> complexity of the data flow. For example, there are 24 different laboratories in the MGH which perform over 300 different laboratory tests involved in routine patient care. ... The manual transformation from the patient domain (the doctor's order book) to the time domain requires many hours of clerical work on the part of the nursing staff. For example, a nurse in each care unit may spend 4 hours each day on bookkeeping activities concerned with the ordering, administering and recording of medications."[1]

2. There is a chronic shortage of all kinds of medical and hospital personnel, and this has recently been accentuated with the advent of Medicare. One estimate is that "with our continuing population growth, 333,000 physicians will be needed by 1975."[2] Perhaps even more serious is the shortage of nurses, medical technologists and other types of paramedical personnel.[3] To some extent the lower salaries, long hours, night shifts and other conditions of employment which are less favorable than those available in other skilled occupations may account for the "shortages." Whatever the reasons, the existence of unfilled vacancies in hospitals and medical centers continues. Research studies of the health manpower field are proceeding in a number of places, and "action programs" are proposed at federal and state levels. New medical schools are being established. But present shortages are not likely to be alleviated within the foreseeable future.

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[1] G. Octo Barnett, The MGH Report, Hospital Computer Project, February 1966, pp. 14-17.

[2] Evon C. Greanias, "The Computer in Medicare," Datamation, vol. 11, no. 12, December 1965, p. 25. However, another projection concludes that there will be 362,000 physicians by 1975 - hence no shortage. cf. Rashie Fein, The Doctor Shortage, Brookings Institution, Washington, D. C., 1968.

[3] Technology and Manpower in the Health Service Industry, 1965-75, Manpower Research Bulletin No. 14, U. S. Department of Labor, May 1967, especially pp. 18-24.

3. While the practice of medicine has required more sophisticated information in greater quantities, professional medical personnel have less time to process it because of the shortages mentioned above. Thus, the possibility of human error is probably increased. One hospital reported that there were 5 per cent errors in all of the manual processing of the administration of medication through the hospital pharmacy. It has been claimed that even the doctor's memory needs an "electronic crutch" through computerized medical information retrieval or through computer-aided diagnosis, discussed below. The information explosion has swamped the medical profession, sometimes with serious consequences.[1] The workload of lab technicians in hospitals is increasing each year, but they must spend as much as 2 hours daily on clerical work, with possible errors in transcription. Thus, the opportunity for computer-based information processing is present, although the task of developing a computerized system is never easy.[2] Also, with the present more-powerful drugs, mistakes can be more costly. Using the wrong drug or the wrong amount is more likely to be fatal than formerly.

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[1] According to a New York Times editorial, "Many people die needlessly of Hodgkins Disease, a cancer of the lymphatic system, because their doctors are ignorant of the major advances in treatment made during recent years. ... Presumably there are many other diseases in which the gap between the most effective treatment known and that actually received by many patients is very wide indeed. One reason is that even physicians who seek to keep up with the advances in medicine are swamped by conflicting demands of an overly busy practice and the information explosion in their field." New York Times, February 19, 1969.

[2] Two doctors reported in 1965 that one such computerized system was discontinued because of errors in input, excessive time requirements on the medical residency staff, unacceptable time lags, and, above all, a cost much greater than originally estimated. H. W. Baird and J. M. Garfinkel, "Electronic Data Processing of Medical Records," New England Journal of Medicine, vol. 272, 1965, pp. 1211-1215.

4. Finally, the process of diagnosis itself is time-consuming. Patients may not immediately be referred to the right specialist, with consequent loss of time to doctor and patient. Then the actual diagnosis may take much longer, if tests are spaced out and if a number of specialists have to be consulted. The administrator of the Bellevue Hospital in New York City is quoted as saying: "If you're acutely ill, we can handle you. But if you've got diagnostic problems, it can take six weeks to get a diagnosis."[1]

First Steps

The first computer-applications reported in the literature cover medical records, hospital administration, electrocardiagram analysis, and medical research. All of these are continuing, so that distinctions between first steps and recent applications are somewhat hazy.

1. Medical records. By 1965 about 200 large hospitals had either installed computers systems or had computers on order for storing some medical records and for other administrative purposes.[2] Some of these were probably "experimental," and research-oriented, as was one of the most publicized: the Massachusetts General Hospital project under the direction

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[1] Dr. R. A. Wyman, quoted by Dr. John F. Davis, "Computers and Medicine," International Science and Technology, December 1966, p. 46.

[2] Technology and Manpower in the Health Service Industry, 1965-75, p. 46. For an account of conversational computer interviewing of medical patients to obtain medical histories, see Werner V. Slack, G. P. Hicks, C. E. Reed and L. J. Van Cura, "A Computer-Based Medical History System," New England Journal of Medicine, January 27, 1966. Dr. Slack is Professor of Computer Science and Medicine at the University of Wisconsin. The system is now reported to be in operation, using a cathode-ray tube for showing questions to the patient, who responds by pressing certain buttons.

of Dr. G. Octo Barnett. It began in 1962 with the assistance of Bolt, Beranak and Newman, a Cambridge consulting firm. The purposes of this project initially were to (1) "increase the rapidity and accuracy of collecting, recording, transmitting, retrieving and summarizing patient care information," (2) "decrease the amount of routine paper work required of the nursing staff," (3) "arrange and consolidate information for more effective and efficient utilization by the medical staff, and (4) "store large amounts of complex medical information and contribute to clinical research by facilitating rapid and easy retrieval and analysis of stored information."[1]

The first MGH "developmental-experimental project was the use of a small time-shared computer to process drug orders in the hospital's pharmacy. The computer program included correct formulae, dosages and other directions, so that orders transmitted by doctors or nurses were checked for accuracy before being filled. Doctors or nurses could override the dosage limits, but only on notification by their names. However,

the former non-computerized system continued in parallel with the new system, with the result that the staff withheld "full support and utilization of the experimental system in favor of the old-fashioned, time-tested one."[2]

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[1] MGH Project Status Report, February 1, 1966, p. 1.

[2] MGH Project Status Report, February 1, 1966, pp.24-25. The total staff of the original project numbered 71, 34 of whom were from the hospital and 37 from the consulting firm. It was financed by grants from the National Institutes of Health, the American Hospital Association, and the American Heart Association. This pharmacy application is now running successfully at Monmouth Hospital, Monmouth, New Jersey.

The computer project at the Tulane University School of Medicine, directed by Dr. James W. Sweeney, began pilot studies in 1961 looking toward electronic storage and retrieval of patients' medical records. These included records for patients in cardiac surgery, cancer detection, obstetrics, gynecology, orthopedics, pediatric cardiology, and psychiatry. By 1966 there were more than 40,000 individual case histories in Tulane's computer data bank. Information was submitted by physicians on self-encoding worksheets for each patient. To make subsequent information retrieval for the physician easier, a natural language (Meditran) was developed to permit the physician to use words to specify what information he wanted.[1]

2. Hospital administration. Accounting, payrolls, and dietary administration have been natural computer applications in hospitals and medical centers. The Minnesota Hospital Service Association provides a computerized service to 180 hospitals for all of these purposes, and eventually for medical records.[2] Other groups of hospitals in New Jersey, and in Peoria, Falls Church, and Wilmington, among others, are sharing computers for accounting purposes. Patient billing has also been speeded up by computerized systems. The Abbott Hospital in Minneapolis, for example, draws on the central file mentioned above for patients' records, and gives the patient his bill "in a matter of seconds, whereas formerly it took considerable time for the office staff to look up all the individual charges."[3]

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[1] "Packaging Patient Information," Hospital Physician, September 1966, pp. 45-46.

[2] "Hospitals Share Computer Through Communications," Systems, February 1967, pp. 12-14. Hospital administration is apparently still the major application of computers, despite the interest in more recent experimental applications. See J. Peter Singer, "Computer-Based Hospital Information Systems," Datamation, May 1969, pp. 38-45. This is an up-to-date survey of recent developments.

[3] Ibid., p. 14

3. Electrocardiagram analysis - George Washington University Hospital in Washington, D. C., began in 1963 to develop a computer program for analyzing abnormalities and deviant patterns in electrocardiagrams. The Veterans' Administration began a similar effort before 1965. The Mt. Sinai Hospital in New York programmed a computer to recognize and interpret rhythm changes in the heart's beat, before 1966.[1]

4. Research. As in other types of scientific research, the computer's facility for rapid data processing has relieved medical research workers of much of the drudgery in their work and has speeded "critically important experiments."[2] As noted earlier, a number of the early computer applications in medical and hospital services could also be termed "research."

Recent Applications

Some of the initial projects have continued; these and additional computer applications will be summarized under the following headings: diagnosis and treatment, information retrieval systems, planning and managing complex medical and surgical procedures, hospital administration, and medical education.

1. Diagnosis and treatment. In an early summary of computerized medical diagnosis, four general areas were listed as relevant: (a) "the communication of information about the patient to the physician, (b) comparison of patient information with available medical information,

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[1] As reported variously in Datamation, December 1965; Technology and Manpower in the Health Services Industry, 1965-75, p. 40; and New York Times, March 3, 1966.

[2] Business Week, July 9, 1966, p. 142. This article has a summary of early use of computers in medical research laboratories.

(c) diagnostic decision making, and (4) treatment of the patient."[1] A more visionary and optimistic view of the future was outlined by Evon C. Greanias of IBM:

> "Diagnostic assistance by computers is an attractive potential application. ...In a typical exchange with the computer, a physician might type in a few symptoms, and the computer would respond by printing out a list of possible diseases. The physician might then ask why a particular disease appears on the list, and the computer would supply a number of possible cause-and-effect relationships. The physician could then ask for more information about a particular causal path, examine the logic, and agree or disagree with the computer's response. Searching in this way, the doctor could make a logical examination of all the reference possibilities stored in the machine."[2]

Despite this optimistic view, a 1966 report concluded that "there has been little operational success in the area and most of the work has been either theoretical, developmental or sharply limited."[3]

Among the more recent attempts to develop computerized systems for medical diagnosis are the following:

- Preliminary diagnosis has been used in periodic medical exams for preventative medicine. The Kaiser Foundation Health Plan in the San Francisco area gives the patient a self-administered questionnaire of 266 questions; answers and routine test results are then fed into the computer. This information can then be

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[1] Lee B. Lusted, "Computer Techniques in Medical Diagnosis," Ch. 12 in Ralph W. Stacy and Bruce D. Waxman, Computers in Biomedical Research, vol. I, Academic Press, New York, 1965, p. 321.

[2] Datamation, December 1965, p. 27.

[3] Dr. G. Octo Barnett in his MGH Project Report, September 1966, Appendix, p. 25. The one exception to this generalization was, he noted, "the automatic classification of electrocariographic abnormalities" by computers.

used by the physician in his subsequent examination of the patient.[1] This experience seems to be the prototype of the concept of "automated multi-phasic health screening (AHMS)" which is claimed to streamline the "time-consuming, office bound physical examination" by reading, processing and interpreting past medical records, analyzing other tests, and producing a printed report for the company or family doctor.[2]

The Mayo Clinic has used a computer analysis of the results of the Minnesota Multiphasic Personality Inventory, to provide the doctor who is not a trained psychiatrist or clinical psychologist with a clinical evaluation of the test results on a particular patient.[3] The computer center at the Rockland State Mental Hospital in New York "enables psychiatrists to maintain accurate, standardized medical histories; someday they may also help the diagnosis." The system includes pencil notations on forms that describe a patient's behavior and the computer then stores this information to provide the psychiatrist later on on call with a full patient history in straight sentences.[4] The Lahey Clinic in Boston is also using this system.

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[1] As reported by Paul Armer in Appendix Vol. 1, p. 225, Report of the National Commission on Technology, Automation, and Economic Growth, Washington, D. C., 1966.

[2] "Electronic First-Aid for the Busy Doctor," Business Week, October 5, 1968, pp. 156-158.

[3] Lusted, op.cit., p. 322. Also see, Howard P. Rome, M.D., William C. Menninger Memorial Lecture, "Psychiatry: Circa 1919-1969-2019," American College of Physicians, Spring Meeting, Chicago, April 25, 1969.

[4] Thomas Fleming, "The Computer and the Psychiatrist," New York Times Magazine, Sunday, April 6, 1969, p. 47.

Computerized collections of medical histories are being developed at the Lahey Clinic and the Massachusetts General Hospital in Boston for preliminary diagnosis and patient assignment to physicians. Professor John F. Rockart of the M.I.T. Sloan School of Management has been working with the Lahey Clinic on the development of a "symptom questionnaire" sent to patients prior to their visit, to determine which specialists they should see, thus saving valuable time during consultations.[1] A computerized system is in the "pilot plant" stage of being used to schedule patients more efficiently through the multi-specialist clinic. Cost effectiveness and attitudinal studies are being made of these experimental programs.[2] The MGH is also working on an automated collection of medical histories of patients in the ambulatory clinic, including automatic ordering of particular laboratory gests, and minimal automatic differential diagnosis of those histories specifically oriented toward a complaint, such as a chest pain, a headache, etc.

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[1] John F. Rockart, Philip I. Hershberg, Jerome Grossman and Richard Harrison, "A Symptom-Scoring Technique for Scheduling Patients in a Group Practice," M.I.T Sloan School of Management Working Paper 385-69, to be published in the Proceedings of the Institute of Electrical and Electronic Engineers.

[2] Report of the Activities of the Laboratory of Computer Science, Department of Medicine, Massachusetts General Hospital, 1968. Bolt, Beranak and Newman is no longer involved with this project, which has developed into a series of several smaller, better-focused research studies. Dr. Barnett observes: "We have abandoned the 'total systems' approach to the development of a hospital information system in favor of a modular evolutionary activity, wherein we proceed in a type of hill-climbing fashion, developing and implementing relatively separate sub-systems. We feel that this is a much more productive approach and that integration of the sub-systems will be relatively simple compared to the task of the development of each sub-system." p.1

A different approach to computer-aided diagnosis is being developed at the Massachusetts General Hospital by Professor G. Anthony Gorry of the Sloan School of Management in collaboration with Dr. G. Octo Barnett, Director of the Laboratory of Computer Science at the hospital.[1] Their approach is known as "sequential diagnosis" to correspond to the sequence of steps a doctor uses in diagnosis, as opposed to present computer diagnostic systems which start out with all the relevant data, including tests which may be unnecessary and costly. The sequential system involves three parts: (1) the information structure constituting the medical experience available to the program, including probabilities of certain diseases occurring with certain symptoms, and costs of various tests and misdiagnoses; (2) the inference function which uses Bayes rules to update a probability distribution for the disease in question, as the sequential interaction of the doctor with the computer in English conversation proceeds in real time; and (3) the test selection function, which selects one of several decision alternatives corresponding to each potentially useful test and one corresponding to the cessation of testing. This step takes into account the current view of the problem (as seen from the inference function), the cost of the test, and

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[1] G. Anthony Gorry and G. Octo Barnett, "Sequential Diagnosis by Computer," Journal of the American Medical Association, vol. 205, September 16, 1968, pp. 849-854; and G. Anthony Gorry, "Modelling the Diagnostic Process," M.I.T. Sloan School of Management, Working Paper 370-69, February 1969. A brief account of this approach was also reported in The Technology Review, April 1968, p. 51.

possible test results. The test selection function determines the best test to perform at a particular stage in the diagnosis, as contrasted with other computer-aided diagnostic programs which begin with a number of possibly-helpful and often costly tests.

This sequential diagnostic program has been employed in the diagnosis of bone tumors, congenital heart disease (35 different types), and recently, acute renal failure. These programs have been developed on M.I.T.'s pioneer time-sharing computer, Project MAC. Preliminary experience supports the superior value of sequential-decision making in computer-aided diagnosis, although the researchers state that more extensive evaluation will be necessary.[1] One additional value of the system may be that para-medical personnel such as nurses could query the program and know when a patient should be referred to a specialist on the disease.

Professor Gorry is also working with the New England Medical Center of Tufts University in developing similar computer-aided sequential diagnostic programs in collaboration with doctors who help revise and test the programs. These may later be available to doctors throughout the region to assist diagnosis of certain diseases.

• Computer-aided electrocardiographic analysis of heart patients is being extended over wider geographic areas. Early in 1969, a computer at Mt. Sinai Medical Center in New York City

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[1] Gorry and Barnett, op. cit., p. 854. Professor Gorry is extending the renal failure study to deal with the assessment of therapeutic strategies when significant risk is involved.

was available to doctors in West Virginia through a project carried out jointly by Mt. Sinai, the West Virginia State Health Department and the Cro-Med Bionics Corporation. The program is still experimental, since the EKG readings transmitted to the New York computer by special modulated signals over the telephone are being checked by mailed magnetic tapes and by independent EKG analysis. In the past, West Virginia hospitals have waited two weeks for an analysis by distant cardiologists, and the computer-aided system promises two-minute results by telephone to the waiting doctors.[1]

- A computer has been teamed with a device called a scintiscanner by doctors at Long Island Jewish Hospital to find thyroid and brain tumors directly in patients, and to pinpoint the location and size of the growth. The computer analyzes the x-rays, by a technique derived from military uses to examine aerial photographs for enemy troop concentrations. The computer can detect shades of gray in the x-ray, indicating tumors which visual examinations may miss.[2]

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1 "Computer to Aid Heart Diagnoses," New York Times, December 8, 1968, p. 59.

2 "Computer Helps to Detect Tumors," Boston Sunday Herald, March 2, 1969, Section 4, p. 3.

On-line computer monitoring of heart and lung conditions of patients in intensive care units has been developed at the Pacific Medical Center in San Francisco, as a joint project with IBM. It is claimed to be more than automated record-keeping, because it "is aimed at spotting potentially dangerous conditions early enough in their development cycle to correct hem easily and minimize their medical effect on the patient."[1] The system, which first went into operation several years ago, also provides for the rapid access to data needed by medical personnel to take the corrective action. Skin temperatures and blood pressure are also monitored by the system.

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1 James O. Beaumont, "On-Line Patient Monitoring System," Datamation, May 1969, pp. 50-55.

- A matrix-type diagnostic computer has recently been patented in the United States by the Nippon Electric Company Ltd. of Tokyo. According to a published account, a similar computer has been used for some time in the Tokyo University Hospital and 50 other Japanese hospitals.[1] Symptoms are linked with diseases in the computer's memory, and weight is given to the degree of certainty associated with symptoms for a particular disease. When buttons are pressed on the matrix, "an ammeter indicates the most likely disease."

- Medical diagnosis is also claimed to be aided by a Clinical Decision Support System developed before 1967 by Evon C. Greanias (an engineer) and Dr. Frederick J. Moore of IBM.[2] A more recent advertisement by IBM stated that Dr. Moore was experimenting with the system which would make available to doctors' offices and even hospital rooms "the latest information about ailments and their remedies... Using a portable terminal no bigger than a briefcase with a keyboard and display screen, the doctor could get the information he wanted by simply plugging into the circuit.

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[1] "Japanese Company Promotes Diagnosis by Computer," New York Times, August 31, 1968, p. 42. The computer has circuits for 40 diseases and 40 symptoms. It is obviously quite different from the "sequential diagnosis" developed by Gorry and Barnett, especially since the Times report further states: "The company says its operation does not require professional knowledge of medicine or electricity; the patient himself could push the buttons."

[2] New York Times, September 25, 1967; see also Datamation, December 1965, p. 28.

With the latest in medicine at the doctor's fingertips, combined with his judgment and experience, he could make his diagnosis in the shortest possible time."

This approach, which involves "information retrieval" as an aid to diagnosis, would apparently not be interactive, and is simply designed to help the "already overworked M.D." overcome the medical information explosion.

2. Information gathering and retrieval systems. Early efforts to gather medical records and other medical information for computer storage and retrieval have been mentioned earlier, and some have been reviewed in the preceding section. Among the more recent developments are the following:

- The laboratory test reporting system, which is the largest on-going research project of the Laboratory of Computer Science at Massachusetts General Hospital, and is claimed to be the largest of its kind in any hospital in this country.[1] The project began with the Chemistry Laboratory, with direct reporting of test results to the emergency ward and intensive care units. A later stage of the project will provide for direct connection to the automated instrumentation in the Chemistry Laboratory, and eventually extension of the computer-aided reporting system to the other 32 laboratories in the hospital. Later on, the system can be transferred to other medical centers for use in their laboratories.

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[1] Report of Activities of Laboratory of Computer Science, 1968, pp. 1-2.

• A medical information network for hospitals is the objective of Medinet, a General Electric subsidiary centered in the Boston area. By early 1969, this system was being tested in a number of hospitals in New England, and was actually in use in one hospital.

• The National Library of Medicine in Bethesda, Maryland, has been perfecting its MEDLARS (Medical Literature Analysis and Retrieval System), developed initially in 1963. Its intention was to produce a monthly computerized list of some 14,000 articles in the bio-medical field, but delays were reported by physicians in utilizing it effectively.[1]

• A computer-based Medical Audit Program (MAP) and Professional Activity Study (PAS) are both available to hospitals through the Commission on Professional and Hospital Activities, Ann Arbor, Michigan. By the end of 1967, approximately 1,140 hospitals were involved in the PAS system, which covered primarily hospital administration and research. Promotional literature described the systems as "computer-based medical records information systems," and the non-profit sponsoring organization was described as a "computer utility" service for hospitals.[2]

• Some writers have envisioned a medical information system similar to the "total management information system" in industry (which does not yet exist). One notes that this is further in

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[1] Hospital Physician, September 1966, p. 48. See also New York Times, February 6, 1966, and Guide to Melars Services, National Library of Medicine, Section F, p. 1, U. S. Department of Health, Education and Welfare, November 1966.

[2] Correspondence and enclosures from Berhnard J. Henehan, December 13, 1967.

the future,[1] and another and another has abandoned the effort in his own hospital in favor of a subsystem by subsystem approach.[2] A proposed national computer-based medical record system has been discussed in Great Britain, which has a national health service[3]; and the Food and Drug Administration in the United States claims to have put a major computer system in operation to give all its experts in field offices better access to the agency's technical data. It would provide instant data on new drugs under investigation, and would monitor abuses of narcotics and psychedelic drug compounds.[4]

3. Planning and managing complex medical and surgical procedures. Using Critical Path and PERT methods taken from computer applications in industry, a team of doctors have planned and carried out kidney transplant operations through a number of computer runs.[5] Simulation of procedures in advance of the actual operation would seem to be a logical application of computer-based systems, but published reports on further applications are lacking.

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[1] Evon C. Greanias in Datamation, September 1965, pp. 27-28.

[2] G. Octo Barnett, 1968 Report as cited, p. 1.

[3] "U.K. Council Proposes Medical Data Bank," Datamation, September 1967, p. 105.

[4] "Drug Computer to Expand Data," New York Times, August 12, 1967, p. 11; also Business Week, August 19, 1967, p. 60.

[5] "Planning and Managing Complex Medical and Surgical Procedures," in special issue on computers, Journal of the American Medical Association, vol. 196, no. 11, June 13, 1966.

4. Hospital administration. In addition to accounting, payrolls, patient billing, dietary administration and menu planning (all noted earlier), some recent applications have involved various forms of "inventory control" such as:

- Assuring full bed occupancy, by careful patient scheduling as has been done at the Massachusetts Eye & Ear Infirmary.
- Control of blood bank supplies, to assure use in right order to prevent spoilage and losses.[1]

5. Medical education. As computer experiments and applications in medical and hospital services are spreading, it is natural that they should be introduced in medical eduation. Some examples are the following:

- Fourth-year medical students at the University of California at Los Angeles are given computer presentations of hypothetical patient medical histories and texts which they then diagnose and recommend treatment. The computer program checks the validity of their work. This is claimed to be superior to clinical experience, in which the student finds diagnosis and treatment developed by the staff, with little opportunity for his own separate diagnosis.[2]
- A computer-controlled patient simulator has been developed at the Medical School of the University of Southern California to train resident physicians in anesthesiology.[3]

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[1] This was Lockheed Aircraft's first venture into computerized hospital systems. Fortune, January 1967, p. 186. Lockheed was also developing a computer center or utility for 58 San Francisco Bay hospitals.

[2] New York Times, February 2, 1968.

[3] Datamation, May 1967, p. 77.

• The Laboratory of Computer Science of the Department of Medicine at the Massachusetts General Hospital has engaged in a number of teaching efforts, including a "medical student medical record," which uses a medical summary completed by each student on his cases in the clinics, to report both to the students and the faculty a summary "so that they can have a better understanding of the type and character of the treatment they give."[1] A lecture-laboratory course in computer science is also offered to clinical and research fellows of the hospital. Some Harvard Medical School students are employed part-time in the Laboratory of Computer Science.

Some Long-Run Implications of Computer Applications in Medical and Hospital Servic

1. There will be further reduction of routine, time-consuming work by professionals and sub-professionals. If it is remotely true, as one computer specialist has claimed, that 90 per cent of the physician's time is spent in information gathering for patient diagnosis and treatment, then this "is the kind of task that can be programmed into a computer."[2] As the Surgeon General of the U. S. Public Health Service has put it: "The challenge to the physician is to use computers to help do the burdensome part of the medical workup, so that he may give his full attention to the creative, human part."[3]

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[1] G. Octo Barnett, 1968 Report, as cited, pp. 7-8.

[2] Evon C. Greanias (IBM), "The Computer and Medicine," Datamation, vol. 11, no. 1, January 1968, p. 57.

[3] Dr. William H. Stewart, in Datamation, vol. 14, no. 1, January 1968, p. 57.

2. The shortage of professional and sub-professionals in this field should be somewhat relieved by computer programs which handle the routine tasks reviewed in the preceding sections. Furthermore, with the expanding demand for medical and hospital care, it seems unlikely that there will be any actual displacement of personnel. Their professional talents will certainly be better utilized, and some expansion of services should be possible with a higher ratio of patients to physicians. Computerization of patients' medical histories, preliminary assignments to specialists, preliminary diagnosis, and easy access to medical records from the data bank should be a boon, rather than a threat, to busy physicians.[1]

However, this means that some present work of physicians will be taken over by computers. Those who now fail to keep up to date on recent developments may be able to do so with information-retrieval systems similar to Medlars. Computers may, therefore, even help some to become better physicians.

3. The view that physicians will not be displaced, even though the nature of their work may be changed, is challenged by a prediction that the computer and other highly specialized equipment will be operated by an army of technicians, who will routinely hook up the patients and maintain the equipment.[2] The large number of physicians, as we know them, will dwfndle into a small cadre of medical scholars. The authors also point out that no matter how many physicians and related personnel are trained, "we cannot keep up with the demand for health services. Technologists,

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[1] M. S. Blumberg, "Computers Will Augment Physician's Role, Modern Hospital, vol. 106, no. 48, 1966.

[2] Edmund J. McTernan (Dean of Health Sciences at Northeastern University) and Dr. Dean Crocker (of Children's Hospital), writing in the Hospital Physician, and quoted in "The Computerized Hospital of the Future Is Visualized," The Boston Herald, March 23, 1969.

technicians and aides in the patient-care spectrum are means to extend the productivity of the physician--the human computer." They add that the human computer has certain weaknesses - failing hearing and vision, as well as personal worries which distort perception - while the computer itself is "always available."

The official American Medical Association view is clearly at variance with the above prediction:

> "If one general conclusion is possible, it is the statement that no computer will attain an MD degree, nor replace a single physician. The computer can be an extraordinarily useful aid, and we should become better acquainted with the potentialities and limitations of these electronic devices. But despite the theories of certain enthusiasts, the computer cannot offset any present or future shortage of physicians. A current relevant quip states: 'Any doctor who can be replaced by a machine, deserves to be replaced by a machine.'"[1]

4. The future possibilities of man-machine interaction in medical and hospital services are impressive. The sequential diagnosis experiment being developed by Professor Gorry and Dr. Barnett at the Massachusetts General Hospital, as reviewed earlier, is an illustration of an interactive system between the doctor and the computer, designed eventually to assist the doctor in his diagnosis in real time. So is the electrocardiagraphic analysis provided by the Mt. Sinai Medical Center in New York City for physicians in West Virginia hospitals. The availability of patients' medical records from a computer data bank is less interactive, as is any other form of information retrieval from stored sources. But all of these are computer-aids to decision making, and represent a true man-machine partnership, as a 1966 article in the Hospital Physician noted:

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[1] Editorial in Journal of the American Medical Association (special issue on computers), June 13, 1966, p. 1015.

> "For most M.D.'s in computer projects the supreme goal is to help the physician in his management of patients. They don't want or expect the computer to tell the doctor what to do, but they believe it can mark out guidelines and perform specific services that will directly aid his decision making."[1]

The same observations may be made about interactive computer systems which can assist nurses, technicians, dieticians, and office staff in hospitals, as they make decisions and perform their assigned tasks.

5. Some centralization of organization structures in hospitals is likely to occur as computer/service centers in large hospitals or computer centers serving groups of hospitals replace some of the clerical functions which each participating hospital previously performed. Examples are accounting, billing, payrolls, and medical records. Possibly the remaining hospital clerical staffs will perform somewhat different functions: providing computer inputs and analyzing computer outputs, rather than keeping and retrieving records directly. Area-wide or regional medical records will require better inter-hospital cooperation. Centralization of computer services will make available certain specialized functions more widely (such as computer analysis of electrocardiagrams), and in one sense, may strengthen decentralized units in the hospital system of the country.

6. All of these developments may herald "The Coming Revolution in Medicine," to borrow the title of a recent book by Dr. David D. Rutstein, Head of the Department of Preventitive Medicine at the Harvard Medical School. Arguing for a complete reorganization of the delivery of medical care, Dr. Rutstein believes that computers will act as information clearing

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[1] Lead paragraph in "The Computer and Its Effect on Hospital Physicians--Guiding Diagnosis and Treatment," Hospital Physician, September 1966, p. 47.

houses in the diagnosis of disease as well as administrators of a vast and unified medical network — including feedback mechanisms to control blood pressure and other physiological functions, perform laboratory tests, and assist in medical research. He also forsees a reallocation of physician's duties, some delegated to trained technicians, some performed by machines - leaving the physician to spend his time on problems that demand his special education, training, and talents.[1]

Resistances to be Met and Overcome

The exciting possibilities of computer applications to meet some of the needs outlined at the beginning of this Section will not be widely realized until doctors, sub-professionals and others in hospital and medical care understand how these can help them in their work. The conservatism of the medical profession is well known, and as one doctor active in computer programs has noted, this is "another factor which has limited the initiative of hospitals in the dynamic application of computer techniques to the area of patient care."[2]

If the lessons from both unsuccessful and successful computer applications can be summarized, they suggest the following steps are necessary for forward progress:

1. Initial commitment on the part of the hospital administration that experimentation and eventual implementation are necessary.

2. Direct involvement of the medical and nursing staff, as well as other specialized groups, in developing, testing, and implementing

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[1] David D. Rutstein, The Coming Revolution in Medicine, The M.I.T. Press, Cambridge, Massachusetts, 1968.

[2] Report to the Computer Research Study Section, ...National Institutes of Health, op. cit., p. 33.

subsystems in particular parts or functions of the hospital. Some of these should be encouraged by hospital management to volunteer for (or to be assigned to) these projects.

3. Avoidance of what someone has called "a priesthood of programmers," through which all changes in information handling must go, is imperative. The same comment could be made about systems designers who fail to consult practicing physicians. One physician reported participating in "a simple compilation regarding one disease," for which over 10,000 questionnaires covering about 20 questions were gathered and turned over to trained programmers who were not, however, physicians. The results were useless and the study had to be reprogrammed after physicians had rephrased the questions and methods of approach.[1] The full facts in this case are not reported, so it is possible that until the error occurred, physicians may have abrogated their responsibility to become involved in the program from its inception.

4. Continuing involvement of hospital or medical center management is vital in selecting objectives, determining priorities in areas for study of computer applications, and subsequent support and help as problems are encountered.

5. Finally, an evolutionary approach is desirable, because the profession changes slowly and successful applications depend on full understanding and appreciation of the ways in which computer-based systems can aid doctors and hospital staffs, rather than threaten them.

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[1] Dr. Irving S. Wright, Professor of Medicine at Cornell Medical College, in his presidential address before the American College of Physicians, San Francisco, April 10, 1967, as reported in the New York Times, April 11, 1967.

Section 5

National and Centralized Data Banks

The uses and potential abuses of national and centralized data banks for statistical and analytical purposes have a recent but full history. The dialogue has involved high-level committees, two Congressional hearings, and numerous supporters and critics. At this writing, there is no comprehensive National Data Center, despite the committees' recommendations. But there are several partial national data banks in a number of Federal agencies in the Departments of Agriculture, Labor, Interior, Commerce, Treasury, and Health, Education and Welfare, as well as in the Board of Governors of the Federal Reserve System.[1] And there are several centralized data banks in cities and counties, primarily for administrative purposes. Since many of these contain information about individuals, as would the proposed National Data Center, the issue of privacy of information has been injected into discussions with some heat.

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1 As noted in the Report of the Committee on the Preservation and Use of Economic Data, to the Social Science Research Council, Washington, D. C., April 1965. This is known as the Ruggles Report, after the name of its Chairman, Professor Richard Ruggles of the Department of Economics at Yale University.

The Needs as Developed in the Proposal

The need for a National Data Center was developed in two outstanding committees, supported by a report of the Joint Economic Committee of the Congress, and subsequently by a committee of the Division of Behavioral Sciences of the National Research Council.[1] The needs that such a center would fulfill may be summarized in the following points:

1. The present organization of Federal statistical information, much of it on machine-readable tapes, does not lend itself to optimal use of these vast amounts of data for economic research and analysis. (The Ruggles Report)

2. There is need for a "large scale systematic demographic, economic and social statistics file" the purpose of which is "the assembly of statistical frequency distributions of the many characteristics which groups of individuals (or households, business enterprises or other reporting units) share." (Testimony of Professor Carl Kaysen at Senate Subcommittee Hearings; Kaysen was chairman of a Task Force on the Storage of and Access to Government Statistics, reporting to the Director of the Bureau of the Budget.)

3. "The data center would supply to all users, inside and outside the Government, frequency distributions, summaries, analyses, but never

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[1]This section draws material from Robert L. Chartrand, "The Federal Data Center: Proposals and Reactions," Legislative Reference Servi Library of Congress, Washington, D. C., June 14, 1965; and from testimony and appendices in the hearings on "Computers and Invasion of Privacy," before the Special Subcommittee on Invasion of Privacy, of the House Committee on Government Operations, July 26, 27, 28, 1966 and "Computer Privacy," Hearings before the Subcommittee on Administrative Practice and Procedure of the Senate Committee on the Judiciary, March 14 and 15, 1967, and February 8, 1968.

data on individuals or other single reporting units. The technology of machine storage and processing would make it possible for these outputs to be tailored closely to the needs of individual users without great expense and without disclosure of individual data. This is just what is not possible under our decentralized system." (Kaysen testimony.)

4. The center would include existing bodies of data already collected by such Federal agencies as the Census, the Bureau of Labor Statistics, the National Center for Health Statistics, the Office of Education, the Department of Agriculture, and the Department of Commerce. Additional data generated as a result of the administration of the federal income tax and the federal social security systems would be included. But the Kaysen Committee specifically excluded police dossiers from the FBI, Civil Service personnel records, personnel data on the armed services, or any other personal information. While no one could find out an individual's income or tax paid through the Center, knowledge of aggregates of income, by sources, would be useful to the Congress and to the Executive Branch in generating tax policy.

5. "The central problem of data use is one of associating numerical records and the greatest efficiency of the existing Federal statistical system is its failure to provide access to data in a way that permits the association of the elements of data sets in order to identify and measure the interrelationship among interdependent or related observations. This is true at virtually all levels of use and for all purposes from academic

model builders to business market researchers." (Edgar S. Dunn, Jr., of Resources for the Future, Inc., in his evaluation report of the Ruggles Report, made at the request of the Bureau of the Budget, November 1, 1965.)[1]

6. Better coordination and integration of separate government statistical programs is essential, and it was the view of the Joint Economic Committee that the current statistical information is "toally inadequate to meet the changing policy needs of our times."[2]

7. The information explosion requires that behavioral and social scientists develop computerized information systems before the flow of research data rises "to blood heights." This was the view expressed in a committee report of the Division of Behavioral Sciences of the National Research Council, which is the operating agency of the National Academy of Sciences.[3] The report recommended a decentralized national network of data banks containing statistical information, and a Federal data center to coordinate the Government's statistical output.

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[1] This report, as well as the full Ruggles Report, is found in the Appendix to the House Subcommittee Hearings on "The Computer and the Invasion of Privacy." The Dunn quotation is on p. 255.

[2] The Coordination and Integration of Government Statistical Programs, Subcommittee on Economic Statistics, Joint Economic Committee, U. S. Congress, Washington, U. S. Government Printing Office, 1967, p. 4.

[3] Communication Systems and Resources in the Behavioral Sciences, summarized in New York Times, January 14, 1967.

The Problem of Privacy

Will a proposed National Data Center expose individuals to loss of privacy and maybe blackmail by those who gain access to an individual's records? This concern has monopolized the two Congressional hearings, and even the experts are divided on the issue. The same problem applies to the limited national computerized data banks in present federal agencies, as well as to the county and city data banks, which will be discussed later.

The Critics

An editorial in the New York Times in 1966 put the fears of a National Data Center in these words:

> "Can personal privacy survive the ceaseless advances of the technological juggernaut? ....The Orwellian nightmare would be brought very close indeed if Congress permits the proposed computer National Data Center to come into being. We already live with the fact that from birth to grave Federal agencies keep tabs on each of us, recording our individual puny existence, monitoring our incomes and claimed deductions, noting when we are employed or jobless, and--through the F.B.I. and similar agencies--keeping all too close watch on what we say, what we read and what organizations we belong to.... What is now proposed is the amalgamation of these files, and the creation of a situation in which the push of a button would promptly dredge up all that is known about anyone. Understandably, this idea has brought vigorous protest, in which we join. Aside from the opportunities for blackmail and from the likelihood that the record of any single past transgression might damage one for life, this proposed device would approach the effective end of privacy...."[1]

Vance Packard, the best-seller author who has written on the erosion of privacy in his book, The Naked Society, has testified before the Gallagher Subcommittee of the House of Representatives in the same

[1] New York Times, August 9, 1966. It is clear that the editorial writer was not aware of the more limited proposals summarized in the preceding section.

vein, and has criticized the proposed National Data Center for four reasons: (1) it "threatens to encourage a depersonalization of the American way of life," (2) it "is likely to increase the distrust of citizens in their own government and alienate them from it," (3) "a central file can absorb large batches of data about people but it is ill-equipped to correct errors, allow for extenuating circumstances, or bring facts up to date," and (4) it would place "so much power in the hands of the people in a position of power to push computer buttons." He adds:

> "When the details of our lives are fed into a central computer or other vast file-keeping system, we all fall under the control of the machine's managers to some extent ....My own hunch that Big Brother, if he comes to the United States, will turn out to be not a greedy power-seeker but a relentless bureaucrat obsessed with efficient (who) could lead us to that ultimate of horrors, a humanity in chains of plastic tape." [1]

The public statements of Representative Gallagher and Senator Long, during or following the hearings they conducted, are not dissimilar from these views. Indeed, Packard quotes extensively from Representative Gallagher.

The critics from the universities are mostly law professors, prominent among whom is Alan F. Westin, Professor of Public Law at Columbia University and author of a book, Privacy and Freedom (1967). In his testimony before the Long subcommittee in the Senate, Westin expressed

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[1] Vance Packard, "Don't Tell It to the Computer," New York Times Magazine, January 8, 1967, pp. 44-45ff. The last quotation is on pp. 90-92.

the view that the proposed National Data Center "would clearly lack the careful development, the system safeguards, the administrative procedures, and certainly the type of legal framework that would be necessary to protect individuals and groups if information from many Federal agencies were to be collected, stored, and used in unspecified ways, thus raising the very problems of the incorporation of data collections that you mentioned in your opening statement."[1] Senator Long had expressed fear that the proposed National Data "Bank" is "designed to store names and information on citizens so that the simple push of a button will spread a citizen's life history on the computer readout."[2]

In a more recent statement, Professor Westin has suggested that proper safeguards in computerized data banks should include the following: (1) privacy - whether certain kinds of information should be collected at all in these systems, the extent to which one piece of information within a data bank ought to be associated with another, and what information should be disclosed and circulated and to whom? (2) due process -- giving an individual the opportunity to know what is in his data file, to challenge its accuracy, and to contest interpretations based on the facts, and

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1 Long subcommittee hearings, Senate, p. 282.

2 "Opening Statement of Senator Long," p. 276. I leave it to the reader's recollection whether this is what the supporters of the Center proposed.

(3) public audit and review, in the form of watchdog or ombudsman-type agencies, or legislative agencies, or public review boards, etc. Westin believes that "public concern over the issue is forcing public and private organizations to become more self-conscious about the role of privacy and the role of information in our society; and this exercise could—if properly nurtured and protected—lead us to give more protection to individual rights than we provided in the pre-computer era."[1]

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1 Alan F. Westin, "Computers and the Protection of Privacy," The Technology Review, vol. 7, no. 6, April 1969, pp. 32-37. Westin's views are apparently shared by Professor Robert M. Fano, who was the first director of Project MAC at M.I.T. In a recent unpublished paper he noted that the Compatible Time Sharing System at M.I.T. "is far from adequate in its protection of privacy." Although every user has his own password, he can give this to other users "or to everybody." Furthermore, "system programmers are fallible, and mistakes in the control programs of the system may remain undetected for a long time. As a matter of fact, they may be discovered by users inclined to exploit them for their own advantage or for other malicious purposes. Our experience at M.I.T. indicates that these dangers are very real and that no community can be assumed to be immune from them....There is no simple answer to the problem of protecting a computer system against intruders." ....The right to privacy must be defined and protected by suitable legislation, and also appropriate regulations must be enacted to protect the users of public computer systems." R. M. Fano, "Implications of Computers for Society," paper presented at the Joint Summer Conference on "The Computer in the University," Technical University of Berlin and Massachusetts Institute of Technology, Berlin, Federal Republic of Germany, July 22-August 2, 1968, p. 8.

The Defenders and Their Proposals for Protecting Privacy

Most of those who favored the National Data Center for statistical purposes argued that individual economic and social data should not be revealed, and that the data bank would not contain detailed personal dossiers about individuals and life histories. Many of these explanations were offered at the Congressional hearings, frequently in answer to queries from the subcommittee chairmen or their staffs. However persuasive they might be to an objective reader of the testimony, they did not convince the Congressional subcommittees.

After denying that the proposed center would contain any individual dossier with personal data of any kind, Kaysen subsequently tried to suggest the following safeguard on revealing other individual data (such as incomes, job experience, mobility, etc.):

> "Everytime anyone calls out a file or a group of files out of the Data Center, he has to make a record entry that says, 'I am so and so, I have called out files number so and so, and so and so, and I have called them out pursuant to such and such a job order.' Thus, he leaves a trail, and the machine, and the programs which operate it, can be so organized that nobody can operate the machine without leaving a trail, unless he tries to eradicate both the trail and the data in the machine and thus shows to his supervisors that something has gone wrong."[1]

Kaysen has also pointed out that the distinction between a personal dossier and the assembly of statistical frequency distributions based on individual economic and social data is not self-applying, and

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1 Long subcommittee hearings, p. 9. Despite this, Senator Long at a later point, questioning another witness, said "If we did go on this cradle-to-the-grave deal, everything in regard to that individual would be collected and by pushing a button you could get all of the information (on the individual) if it was put in a machine like that." (p. 116)

"administrators and bureaucrats, checked and overseen by politicians, have to apply it. But so it is ever."[1]

The same point was made at the Long subcommittee hearings by Emmanual R. Piore, Chief Scientist of IBM, who after describing the Project MAC system of protection of access at M.I.T., and in company management information systems, concluded:

> "...preservation of privacy rests not with machines but with men. The effectiveness of all protective measures, however sophisticated they may become, will still depend upon people: operators, service personnel, supervising officers, and all those who decide what information to put into a computer and how to use it....Machines have no morals, no ethics: men have ethics and morals."[2]

The present confidentiality of individual data in Census reports, protected by law and by administrative action, has been cited as a good example of the protection of privacy which could equally well be applied to the proposed National Data Center. As Kaysen has pointed out:

> "The present law and practice governing the Census Bureau offer a model for this purpose. The law provides that information contained in an individual Census return may not be disclosed either to the general public or to other agencies of the government, nor may such information be used for law-enforcement, regulatory, or tax-collection activity in respect to any individual respondent. This statutory restriction has been effectively enforced, and the Census Bureau has maintained for years the confidence of respondents in its will and ability to protect the information they give to it. The same statutory restraints could and should be extended to the data center, and the same results could be expected of it."[3]

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[1] Carl Kaysen, "Data Banks and Dossiers," The Public Interest, Spring 1967, (reproduced in Long subcommittee hearings, pp. 265-269).

[2] Long subcommittee hearings, pp. 122-123.

[3] Kaysen, op. cit., (p. 268 in Long subcommittee hearings).

Despite the answers of the proponents, those who feared the advent of an Orwellian 1984 "Big Brother" in the form of a computer whose "button could be pushed" to print out revealing and damaging information about an individual carried the day. The proposal for a National Data Center is in limbo, even though there are a number of national subsystems in different federal agencies. The benefits that might derive from statistical analysis of aggregates based on individual economic and social data are casualties of the fear that individual privacy might be eroded. Even the sensible proposals of Alan Westin, reviewed earlier, have not received serious discussion in the Congressional subcommittees which killed the national data bank proposal.

Regional and Local Data Banks

As Westin pointed out in his Congressional testimony, there seems to have been little concern about the privacy question in the efforts to develop data banks in such cities as New Haven and Detroit, or in Alameda County, California. A brief review of each of these will indicate their purposes, recent status, and relation to the privacy issue.

1. The City of New Haven, with the help of IBM's Advanced Systems Development Division, began in 1967 to "put the city's files on computers to obtain a statistical profile of everyone in town....The knowledge, for example, that a man was crippled could be stored away for possible use by the Fire Department. His application for welfare assistance could be automatically checked to see if he owned a car.... The police chief could have instant access to all the information about a suspect, (and)

the computer system could also determine if a fire broke out near a convicted arsonist's home."[1] This type of data bank, unlike the proposed national one, does have individual dossiers, with cross referencing.

2. Detroit has been developing two data banks, one containing physical data and the other social data. "The physical data bank contains such information as the condition of the city's residential, commercial, and industrial housing, obsolescent structures, crime rates, and much more" to help plan urban renewal projects. The social data bank "includes statistics on crime rates, welfare, births and deaths, school truancy and drop out rates, the occurrence of venereal diseases and tuberculosis, and other information." Printouts of social data are made quarterly, and can be retrieved by census tracts when needed. Apparently, social data are used in urban planning, also, for the statement is made that "we cannot improve a neighborhood's social vitality if we do not know what the neighborhood's social problems are and how its people live." Also, "in time we may even be able to devise an 'early warning system,' which could alert us to a neighborhood drifting into instability or social decline."[2] There is no mention of the possibility that individual data may be revealed.

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[1] "New Haven Plans a Computer Pool," New York Times, March 29, 1967.

[2] Harold Black and Edward Shaw, "Detroit's Data Banks," Datamation, vol. 13, no. 3, March 1967, pp. 26-27. The authors are staff members of the city's Community Renewal Program.

3. The Alameda County "People Information System" includes the City of Oakland, California and surrounding area with a population of over 1,000,000. The system consists of two parallel but separate real-time subsystems: (1) a central index for social services "to better coordinate the line activities of the social service agencies like welfare, hospitals, health, and probation," and (2) a police information network. Both subsystems have data on individuals, since the first can "identify people, locate their records, and thus respond to the thousands of inquiries pouring in each day by telephone, by letter, and by walk-ins." The second real-time subsystem, known as PIN, contains warrants of arrest "to serve the 93 law enforcement agencies in the Greater San Francisco Bay Area." The benefits claimed are "more efficient government" (particularly in preparing reports to different State departments) and "increased service" in better law enforcement, better future planning, and in "helping welfare, health and probation social workers spot and control potential trouble areas before—not after—the fact." The privacy question is skirted with the note that "most information handled by counties is of a nonconfidential nature and security requirements are not involved." But for files that are confidential, "access is carefully controlled by permitting only authorized terminals, and where necessary authorized persons—by means of secret codes—to inquire into such files. Future plans also call for monitoring techniques to determine what terminals are accessing any given file."

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[1] Gordon Milliman, "Alameda County's 'People Information System'," Datamation, vol. 13, no. 3, March 1967, pp. 28-31.

Some Implications of Centralized Data Banks

Some implications drawn from the preceding discussion may be summarized in the following points:

1. The proposal for a National Data Center was designed primarily to permit large-scale statistical analysis of the characteristics of groups of individuals, households, or business establishments. The purpose was to aid in policy planning at the national level. In contrast, the local and regional data banks have been designed and used primarily for administrative purposes.

2. Despite the limited objectives of the National Data Center proposal, the issue of "privacy" of individual data or "dossiers" was raised by Congressional committees and a number of critics of the proposal. The objectives of the proposal were distorted by some of these critics, who suggested that a "1984-Big Brother" type of surveillance of all that any individual ever did in his lifetime would be available in a computer printout "at the touch of a button." These distortions, along with some more moderate criticism, resulted in the indefinite postponement of any national data bank.

3. The issue of privacy of computer-based information is, nonetheless, a real one. A number of useful suggestions have been made to protect access to data on individuals, and these would require both legislative and administrative controls. Presumably, these could be made effective, in order that the legitimate research objectives of a national data bank could be realized.

4. In contrast, the issue of privacy has not been raised about the local and regional data banks, which admittedly do contain detailed information about individuals. Sate and municipal governments have apparently been less concerned about possible misuse of such data than was the Congress about a national data bank.

5. Unlike the other "knowledge industries" reviewed earlier in this paper, there do not seem to be important organizational implications about these data banks. The proposed national center would not lead to more centralization of government as such, but to more centralization of final statistical collection and analysis. There is no published evidence that the few local and regional centralized data banks have led to greater centralization of governmental administration.

6. Implementation of centralized data banks has not threatened the jobs of existing governmental personnel; nor has it drastically changed the nature of their jobs. The main obstacle in implementing the National Data Center has been the privacy question. Quite possibly, greater attention to ways of protecting individual privacy in the earlier special committee reports which recommended such a center would have forestalled some of the opposition. But in retrospect it is not at all certain that any such recommendations would have prevented the raising of a politically-attractive and often emotional issue. Perhaps only time and patience will overcome this obstacle.

BASEMENT

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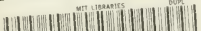
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