January, 1970

Vol. 19, No. 1

computers and automation

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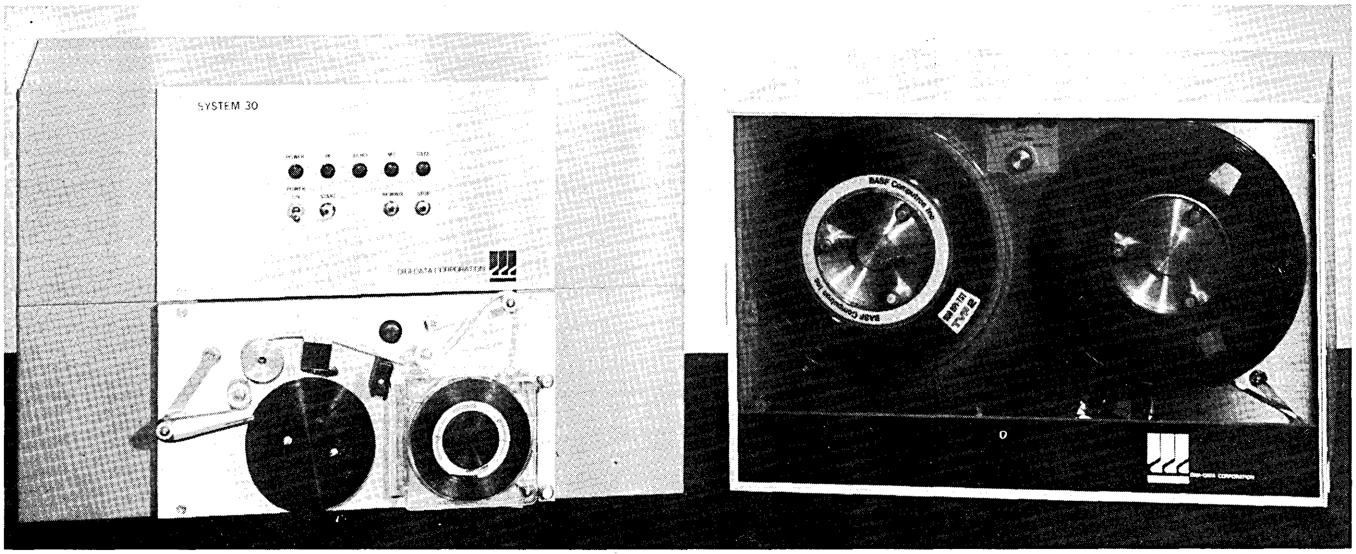

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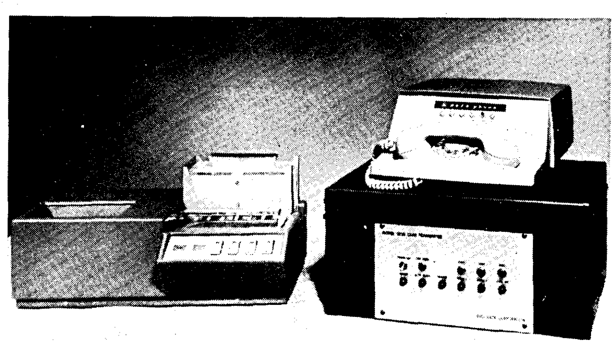

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computers and automation

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PASADENA, CALIF. 91105, Douglas C. Lance
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ELSEWHERE, The Publisher
Berkeley Enterprises, Inc.
815 Washington St., 617-332-5453
Newtonville, Mass. 02160

Editorial Offices
BERKELEY ENTERPRISES, INC.
815 WASHINGTON STREET,
NEWTONVILLE, MASS. 02160

CIRCULATION AUDITED BY
AUDIT BUREAU OF CIRCULATIONS

Computers and Automation is published 13 times a year (12 monthly issues plus an annual directory issue published in June) at 815 Washington St., Newtonville, Mass. 02160, by Berkeley Enterprises, Inc. Printed in U.S.A. Subscription rates: United States, $18.50 for 1 year, $36.00 for 2 years, including annual directory issue — $9.50 for 1 year, $18.00 for two years without annual directory; Canada, add 50¢ a year for postage; Foreign, add $3.50 a year for postage. Address all U.S. subscription mail to: Berkeley Enterprises, Inc., 815 Washington St., Newtonville, Mass. 02160. Second Class Postage paid at Boston, Mass.
Postmaster: Please send all forms 3579 to Berkeley Enterprises, Inc., 815 Washington St., Newtonville, Mass. 02160.
Change of address: If your address changes, please send us both your new address and your old address (as it appears on the magazine address imprint), and allow three weeks for the change to be made.

Letters To The Editor

Computer Art

This is just to inform you that there are other uses for computer art besides hanging it on the wall. A member of the Psychology Department at our University would like to use the drawing "Progress?" [page 14, August 1969 issue] for research study! Subjects would be asked to rate these faces for their meaningfulness, imagery and ease of learning.

I would appreciate it if you could let me know Messrs. Meyfarth's addresses so that I may obtain the original program for use in our research study.

DR. A. A. SHETH, Section Head
Academic Systems and Programming
Scientific Systems
University of Guelph
Guelph, Ontario, Canada

Ed. Note —
Thank you for telling us of this interesting application. The addresses of the artists in the August 1969 issue appear on page 32 of that issue.

The annual publication by *Computers and Automation* of selected examples of computer art is a valuable service to the community. It is interesting to note the rather rapid growth of good material which you publish each year.

I would appreciate your permission to make and use 35mm slides and overhead projector transparencies of this art work. It will be used in a series of lectures to be presented to technically oriented artists.

R. J. KYLE, Scientist
Lockheed-Georgia Co.
Marietta, Ga. 30060

Ed. Note — Thank you for your comments. You are welcome to make and use slides of the computer art if you include in some appropriate place the following credit clause: "Reproduced with permission from **Computers and Automation** for August, 1969, copyright 1969 by and published by Berkeley Enterprises, Inc., 815 Washington Street, Newtonville, Mass. 02160."

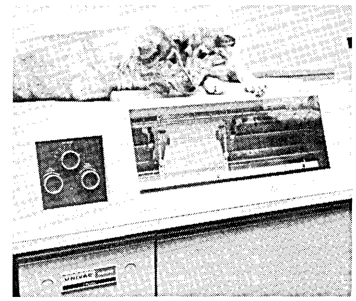
computers and automation

Vol. 19 No. 1 — January, 1970

The magazine of the design, applications, and implications of information processing systems.

Special Feature:

Regular Features



Thousands of dogs have been victims of "dognappers" who sell dogs to laboratories. The computer in the front cover picture has been programmed to reunite identified dogs with their masters, through painless marking of the dog with his owner's social security number and a registration system of the National Pet Registration Center, Gillette, N.J.

NOTICE

Who's Who in Computers and Data Processing is to be typeset by computer. As a result, it should be possible to include new entries (and to modify previous entries) CONTINUOUSLY — especially since **Who's Who** will be published periodically.

Consequently, if you have not yet sent us your up-to-date filled-in **Who's Who** entry form, PLEASE SEND IT TO US QUICKLY — the chance is good that your entry can be promptly included. Use the entry form on page 52 of this issue, or a copy of it.

Departments

The Ocean of Truth

Every now and then some news crosses the Editor's desk which emphasizes again the marvelous possibilities existing in this world. Here is one such news item from the University of Colorado, Boulder, Colo.:

> A University of Colorado faculty member has saved three years and many thousands of dollars by making light provide communication to a computer instead of microwave or telephone.
>
> The problem was to connect the Engineering Research Center on campus with the Computing Center about 3,000 feet away, so that computer terminals in the Engineering Research Center could be linked to the equipment at the center.
>
> The conventional means of achieving the connection would be microwave line-of-sight radio beam or several "voiceband grade" telephone circuits. In this case, obtaining a microwave license probably would have required at least three years, and would have run into complications because of other microwave systems existing in the area.
>
> Also, the telephone company was willing to install a system for $440, but the company, pointing out that the system would consume as much line capacity as 48 regular telephones, figured a monthly charge of $516; so the total first year cost would have been more than $6,500; and if used for four years, the cost would have been over $25,000.
>
> In place of microwave or telephone, Professor Jack R. Baird of the Department of Electrical Engineering and two Electrical Engineering seniors, Larry Potter and Bill Stout, designed and constructed a communications system using infrared light. The system has been in continuous operation for two months, with no maintenance required and very little operating cost. The most expensive components in the communication link are the condensing lenses which are five inches in diameter and cost $40 each. The basic transmitting element is a gallium arsenide infrared light emitter costing approximately $15; the basic receiving element is a $9 photo transistor.
>
> Development and other costs, however, raised the total cost of the installation to somewhat under $5,000.
>
> Atmospheric conditions are nearly no impediment, says Professor Baird, since rain and fog are translucent at the infrared wavelengths used. Heavy snowfall does block transmission, but otherwise the data link has proved so reliable that its downtime has been much less than that of the computer itself.
>
> Because the development work has been done, the link can be duplicated for about $500. Plans are going forward on the campus to install two more infrared links: one between the Joint Institute for Laboratory Astrophysics and the Computing Center; and another between the new Business Building and the center.

What conclusions can we draw from this interesting example of ingenuity and independence?

First, the attitude "there ought to be a better way" plus the refusal to put up with what seem to be unreasonable costs or delays often leads to novel developments.

Second, communication links using infrared light should provide a very good solution to the requirement for communication up to distances of a mile or so—the distance often of an outlying terminal from a central computer, especially on university campuses. And the cost can be a one-time expense instead of a continual monthly rental—over and over again the one-time expense is the big bargain.

Third, many parts of the spectrum of electromagnetic radiation, which includes visible light, microwave, infrared, ultraviolet, radiowaves, all as parts, are still relatively uncultivated and waiting to be used—in fact, waiting to be used even without the contribution of huge organizations and technological laboratories.

Finally, we may well be reminded of that famous remark of Sir Isaac Newton:

> I do not know what I may appear to the world; but to myself I seem to have been only like a boy playing on the seashore and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me.

Almost everywhere we look in the computer field, we find new possibilities, new discoveries, new inventions, new systems, new ideas. The strong tide of discovery and development in the Second Industrial Revolution shows no sign of receding or slowing down.

In January, 1970, we can reasonably assert that we in the computer field have been busy finding pretty pebbles, while a great ocean of truth still lies all undiscovered in front of us.

Edmund C. Berkeley
Editor

MULTI-ACCESS FORUM

COMPUTER RECOMMENDED AS A MEANS FOR HELPING TO CURB ILLICIT DRUG TRAFFIC BETWEEN THE U.S. AND MEXICO

(An excerpt from testimony before the Select Committee on Crime of the U.S. House of Representatives, presented by Donald K. Fletcher, Manager of Distribution Protection, Smith Kline and French Laboratories, 1500 Spring Garden St., Philadelphia, Pa. 19101)

It has been stated authoritatively, and accepted as correct, that export shipments of "controlled drugs" [i.e., those prescription products such as amphetamines and barbiturates which are subject to the 1965 U.S. Drug Abuse Control Act] consigned to persons in Mexico, and perhaps moving through bonded customs warehouses, are handed over to consignees on the U.S. side of the border purportedly for entry into Mexico. Then, it is stated, these consignees simply travel north instead of south and the products move into the illegal U.S. market in Southern California and elsewhere.

If this description is correct, perhaps U.S. enforcement agencies should take additional steps to insure that export shipments are in fact actually exported. We think this could be done [with the aid of a computer] in the following manner:

a. At the time of a lawful export shipment, the exporter would be directed to send to the Bureau of Narcotics and Dangerous Drugs (BNDD) in Washington a copy of the Export Declaration that is already required by the Department of Commerce. He would prepare and attach to the Declaration a computer punch card containing essential information about the shipment—that is, shipper, consignee, contents, and quantity.
b. A copy of the punch card would remain with the shipment itself until it actually crossed the border. At that time, the card would be handed to the U.S. Customs Inspector at the border.
c. The Customs Bureau would forward all such cards to the Bureau of Narcotics and Dangerous Drugs in Washington.
d. With a simple machine operation, BNDD could regularly check to determine that it had received, from U.S. Customs at the border, a card matching every card submitted directly to BNDD by exporters. If no matching card came from the border, BNDD could promptly take steps to find out why.
e. In the interests of cooperation with our neighboring country and to help curb illicit traffic there, BNDD might also forward to appropriate authorities in Mexico essential summary information from the punch cards so that every shipment's delivery to a legitimate purchaser could be verified. With this cooperative action by U.S. agencies the Mexican government would have the information needed to identify and prosecute diverters.

The effectiveness of this procedure would depend on careful verification at the border to make sure that shipments are crossing into Mexico at the time the punch card is turned in to Customs. Just receiving the card would mean little or nothing.

The most effective verification would be inspection of every shipment. But appropriations and manpower are not available for this comprehensive surveillance, so frequent spot checks might have to suffice. They should be an effective deterrent. □

NUMBLES CAN BE FUN — BUT SOMETIMES . . .

I. From Richard Marsh
1330 Mass. Ave. N.W., #822
Washington, D.C. 20005

Last February I dashed off a long-winded diatribe against Numbles (I had no idea you would publish it — otherwise I would have cleaned it up a bit). In a note you chided me a bit, suggesting I continue trying to solve them since they are fun.

I guess I took your advice, or more truthfully I find it hard to turn away from any good puzzle. In any event, I continued to look forward to, and worked, the Numbles in each issue. None caused me any particular trouble, and within not more than an hour or in a few cases two I had completed the solution.

I had, that is, until your Numble 6910. My solution of the numerical portion left me with IIS-IISE. Irregularities in previous Numbles had presented no problems, but IIS-IISE stopped me. I rechecked the numerical portion for any other possible values, spending at least a couple of additional hours in the process, only to find no other possibles.

I pored over the IIS-IISE some more, and the only thing that would seem to make sense was "is wise". But this would not constitute "irregular" spelling—it would be outright ridiculous. So, I set it aside.

In my mail tonight was the November issue, and I learned that "is wise" is your solution! It seemed incredulous, but there it was. And out of habit—or pique—I tackled 6911. Darned if you didn't pull the same trick again, using double I's (or Y's if you prefer). Particularly with the early warning, it wasn't difficult to come up with "twice is not always".

Which brings up the point of this letter. I agree with you that Numbles *can* be fun, but I suggest you may scare off more potential solvers than you attract with such outlandish irregularities. ESWYCE would make some sense, for example, if you wish to make it difficult; but using a double I for both the short and long sound is......well, I give up.

II. From the Editor

Thank you for your friendly comments.

I do agree that the IIS-IISE is much more outlandish and troublesome than it should have been. When Neil Macdonald worked out the Numble as a puzzle and I checked it, I erred in not realizing that the letter W did not occur in the digits of the problem to be solved, and therefore would have to be guessed out of some 17 possible letters. I think your protest is justified. I wish we had thought of ES WYCE!

I am glad you find Numbles too attractive to leave alone.

MARTIN LUTHER KING MEMORIAL PRIZE CONTEST — SECOND YEAR

(Please post this notice)

Computers and Automation has received an anonymous gift and announces the annual Martin Luther King Memorial Prize, of $300, to be awarded each year for the best article on an important subject in the general field of:

> The application of information sciences and engineering to the problems of improvement in human society.

The judges in 1970 will be:

> Dr. Franz L. Alt of the American Institute of Physics; Prof. John W. Carr III of the Univ. of Pennsylvania; Dr. William H. Churchill of Howard Univ.; and Edmund C. Berkeley, Editor of *Computers and Automation.*

The closing date for the receipt of manuscripts this year is April 30, 1970, in the office of *Computers and Automation,* 815 Washington St., Newtonville, Mass. 02160.

The winning article, if any, will be published in the July issue of *Computers and Automation.* The decision of the judges will be conclusive. The prize will not be awarded if, in the opinion of the judges, no sufficiently good article is received.

Following are the details: The article should be approximately 2500 to 3500 words in length. The article should be factual, useful, and understandable. The subject chosen should be treated practically and realistically with examples and evidence — but also with imagination, and broad vision of possible future developments, not necessarily restricted to one nation or culture. The writings of Martin Luther King should be included among the references used by the author, but it is not necessary that any quotations be included in the article.

Articles should be typed with double line spacing and should meet reasonable standards for publication. Four copies should be submitted. All entries will become the property of *Computers and Automation.* The article should bear a title and a date, but not the name of the author. The author's name and address and four or five sentences of biographical information about him, should be included in an accompanying letter — which also specifies the title of the article and the date.

"Many people fear nothing more terribly than to take a position which stands out sharply and clearly from the prevailing opinion. The tendency of most is to adopt a view that is so ambiguous that it will include everything and so popular that it will include everybody. . . . Not a few men who cherish noble ideals hide them under a bushel for fear of being called different."

"Wherever unjust laws exist, people on the basis of conscience have a right to disobey those laws."

"There is nothing that expressed massive civil disobedience any more than the Boston Tea Party, and yet we give this to our young people and our students as a part of the great tradition of our nation. So I think we are in good company when we break unjust laws, and I think that those who are willing to do it and accept the penalty are those who are a part of the saving of the nation."

> — From ***"I Have a Dream" — The Quotations of Martin Luther King, Jr.,*** compiled and edited by Lotte Haskins, Grosset and Dunlap, New York, 1968.
>
> Reverend Martin Luther King, Jr., was awarded the Nobel Peace Prize in 1964, when he was age 35.
>
> He was in jail in the United States more than 60 times.
>
> He was assassinated in Memphis, Tennessee, April 4, 1968.

c.a IDEAS: SPOTLIGHT

The Pressures on Privacy Created by the Information Processing Revolution

As philosophers remind us in a different context, knowledge is power. The issue of privacy raised by computerization is whether the increased collection and processing of information for diverse public and private purposes, if not carefully controlled, could lead to a sweeping power of surveillance by government over individual lives and organizational activity. As we are forced more and more each day to leave documentary fingerprints and footprints behind us, and as these are increasingly put into storage systems capable of computer retrieval, government may acquire a power-through-data position that armies of government investigators could not create in past eras.

To understand the current pressures on privacy created by the information processing revolution, we should note six basic trends at work. First is the general expansion of information-gathering and record-keeping in contemporary American society, even apart from computers. . . . .

Second, the mobility of persons and the standardization of life in mass society have led to the development of large private and governmental investigative systems whose function is the amassing of personal dossiers on tens of millions of Americans. . . . .

Third, general information gathering and the dossier have been radically accelerated by the advent of the electronic digital computer, with its capacity to store more records and manipulate them more effectively and rapidly than was ever possible before. . . . .

Fourth, the development of many new public programs has produced a requirement for more personal data about individuals than in previous research or record keeping. . . . .

Fifth, advances in the computer field are rapidly accelerating the sharing of data among those who use the machines. . . . .

Sixth, we have entered an era in which automatic data processing will gradually replace many of the cash transactions of the past, providing an increasing trail of records about significant transactions of the individual's life. . . . .

These six trends represent the present era in data collection and computer processing of information. Pending proposals and prospective developments of the next decade promise to raise even broader issues of privacy. . . . .

— From Westin, Alan F., ***Privacy and Freedom,*** Atheneum Publishers, 122 East 42 St., New York, N.Y., 1967, hardbound, 487 pp, $? □

SPEAKERS AVAILABLE THROUGH IEEE COMPUTER GROUP'S 1970 "DISTINGUISHED VISITORS" PROGRAM

John L. Kirkley, Administrator
IEEE Computer Group
16400 Ventura Blvd.
Encino, Calif. 91316

The IEEE (Institute of Electrical and Electronics Engineers) Computer Group is selecting outstanding authorities in the computer sciences and information processing fields to lecture and conduct informal discussion sessions at colleges and universities, organizations, and IEEE Computer Group chapters. Schedules for 1970 are now being set up.

Chairman of this program is Dr. Noah S. Prywes of the Moore School of Engineering at the University of Pennsylvania. According to Dr. Prywes, the Computer Group has set aside funds to meet the expenses of this year's Distinguished Visitors. In scheduling the spending of this money, priority will be given to colleges, universities, and IEEE Computer Chapters who appear to be most in need on the basis of being remote from metropolitan centers and not being able to afford the expenses.

To request a speaker, organizations should contact:

Dr. Noah S. Prywes
Moore School of Electrical Engineering
33rd and Walnut Sts.
Philadelphia, Pa. 19104

with information including dates, description of the expected audience in terms of its size, interests, and level of awareness of computer science, and any ability of the organization to contribute toward the expenses of the speaker.

In addition to speakers, the Distinguished Visitors Program is planning the presentation of movies and demonstrations. Dr. Prywes is currently soliciting information about the availability of suitable movies and demonstrations. □

JOINT COMPUTER CONFERENCE PROCEEDINGS FROM 1951 THROUGH 1969 AVAILABLE FROM AFIPS

AFIPS (American Federation of Information Processing Societies)
210 Summit Ave.
Montvale, N.J. 07645

All proceedings from the Spring and Fall Joint Computer Conferences covering the period from Spring of 1951 through the recent Fall Conference in Las Vegas are being made available on microfilm and/or microfiche by the American Federation of Information Processing Societies (AFIPS). Volumes 1 through 35 will be available on microfilm either as a complete set, or in three separate sets (Vols. 1-20, Vols. 21-30, and Vols. 31-35). In addition, Vols. 31 through 35 will be available individually on microfiche which can be used with all standard microfiche readers.

According to Mrs. Nelle Morgan, Production Manager of AFIPS Press, prices for the proceedings have been set below prevailing commercial rates in order to promote wide distribution of the proceedings to individuals, educational institutions and libraries, as well as to corporations, government bodies and other interested groups.

Orders or inquiries should be sent directly to AFIPS Press at the address above. □

WHERE IS THE COMPUTER INDUSTRY HEADING?

J. R. Bradburn, Executive Vice Pres.
RCA Information Systems Div.
Camden, N.J. 08101

The computer has been described as the dominant advance of the 20th century. Economists have predicted that by the end of the century more people will be employed in data processing and related industries than in any other single business.

The statisticians tell us that one year ago, the world-wide total of U.S. computers numbered 57,000 systems, worth $17-billion. Today, the figure has reached 70,000 systems, valued at $24-billion. With the industry growth rate currently projected at between 15 and 18 percent a year, the cumulative value of just U.S.-produced computers by 1972 should exceed $40-billion.

The tempo of technology itself has been a major stimulus to this market. ENIAC, the first electronic computer, had 18,000 vacuum tubes which burned brightly for 5,000 operations a second. Now silicon chips, without heat, promote billionth of a second speeds.

As we look back on these two decades we naturally can perceive areas of disappointment. One is the underutilization of such large capital investments as the computer requires. Despite some commonly held assumptions, the more imaginative uses of computer power to which we all pay lip service have yet to assert themselves to any great extent. Routine tasks—payroll, accounting, bookkeeping, customer orders and bills, inventory control—still crowd the application scene, rather than the more critical functions of management decision-making.

The reason for this is that we are finding it both costly and complicated to apply this equipment meaningfully in our own internal environment. In many cases we still suffer from myopia, failing to understand the totality of the job to be done and settling instead for mere mechanization of our old procedures.

There are other problems facing the industry, and the solutions concern all of us.

We find, for example, that our present systems are not sufficiently responsive to change. We find that they are designed in anticipation of a higher average level of technical manpower—programmers, operators, maintenance personnel—than is realistically available in adequate quantity. Our computers are inundated with software, so that much of the raw performance designed into the hardware is not realized—a condition sometimes referred to as programming overhead. And we are becoming aware of the fact that many third-generation machines are not adequately equipped for continuous operation in on-line applications.

Formidable Education Gap

Perhaps the most formidable problem of all is the shortage of qualified people. The need for trained personnel is underscored by help wanted ads amounting to thousands of column inches in our newspapers, and the appearance of that latter-day buccaneer—the EDP headhunter. The U.S. by the early 70's may be short one quarter million new programmers.

The computer education gap is a deep chasm. I consider it one of the key gating factors in the overall growth of the computer business. Ours, in the last analysis, is a people-dependent industry, limited not by technology or our ability to master economic production techniques, but rather by the number of competent individuals available both to manufacturers and users to implement computer systems.

There are two dimensions to this problem of education, at both the high school and college level. The first involves specific vocational training for those who will enter the industry directly, in an operating sense. The second involves the training of those who will not be programmers or technicians, but whose responsibilities demand that they better appreciate the role of the computer, whatever their occupation.

We know that computers will increasingly permeate every level of academic life. Several years ago, Dartmouth College—which helped pioneer the use of time sharing by students—reported that 80 percent of its graduates had developed reasonable skills in the use of computers in many disciplines and curricula. This percentage, which may well be higher now, is a measure of the extent to which computers are destined to become working tools throughout the learning process.

We have frankly done too little to dramatize the importance of the computer, both in intellectual development and as a subsequent partner for day-to-day business decision. Our manpower crisis is aggravated by the reluctance of growing numbers of young people to enter the field of business in any form. The student of today is acutely sensitive to the changing dynamics of our society and anxious to participate in full. But he is not, I submit, adequately aware of the quiet revolution which has been launched by the computer. This revolution is both challenging and exhilarating and it offers him a decisive opportunity to change things in the world.

In short, we have an exciting concept to sell, which ideally fits the temper of the young mind today. We must get across more vividly the real story of the potential, excitement and rewards which this profession affords.

We must also take on a larger burden of training, to augment our colleges and universities. Learning the computer as a profession will inevitably involve some novel—but effective—teachers. At many locations prison inmates are

"The stress in the future will be on systems which are better able to accommodate and implement change, because change has become the ultimate reality of the modern world."

now studying programming. The warden of St. Vincent de Paul Penitentiary in Montreal reports that his 21 students spend eight hours a day, seven days a week in a course sponsored by Canadair, Ltd. This sounds rigorous enough to rehabilitate anyone—and also to produce knowledgeable and vitally needed programmers.

The education problem is nothing new in our industry, but in the days ahead it will become even more acute. The background and experience of people now in the computer profession represent a vast educational pool, which must be effectively tapped if we are to meet our commitment to the future.

Third Decade: Information

These are all solvable problems, the "thin crust over the volcano of revolution." As we poise now for the third decade of the computer age—what may be termed the information decade—we face a world of data processing that will be differently structured from what it has been before. The "generation" theory of computer development has been based to date on the clear technical distance between each successive plateau . . . vacuum tubes, transistors, integrated circuits . . . millisecond, microsecond, nanosecond speeds . . . and so forth.

Now we look forward to the "fourth generation."

Quiet Fourth Generation

I believe we are quietly stepping into the fourth generation today. The changes in motion now are subtle but profound . . . differences of degree, rather than of kind . . . and demanding intelligent perception if they are to be seized. The person with tunnel vision, waiting for the next quantum breakthrough, is frankly going to miss the boat. The significant characteristics of the fourth generation seem to be these:

From a design standpoint, we will be able to see a whole range of improvements . . . better cost-performance, more hardware embodiment of control functions, modularity moved further into the system, a separation of input/output functions from processing, better diagnostic capabilities of both hardware and software aimed toward higher reliability and maintainability. Improvements in manufacturing will also add greatly to the latter.

From a functional standpoint, we can expect to see a broadened use of multiprocessing and multiprogramming, aided by the development of powerful new languages.

Above all, we will see an acceleration of the present shift from ***batch*** to ***on-line, remote, interactive computing.***

Five years ago, on-line systems made up three percent of the computer population. Today the figure is said to be 13 percent. By 1975, we expect it to be 50 percent or greater. The fourth generation will be geared in concept and operation to this undeniable pattern.

I believe there will be a strong trend toward what is called polarization, with large central computers feeding hundreds of remotely-located terminals. I frankly do not foresee the practical value of huge, bloated, all-encompassing systems. The New York power blackout of a few years ago warns against such giant networks. But economies of scale exist, and we can anticipate greater centralization as time goes on, although enlarged protective procedures will have to be provided to overcome possible catastrophic failures occurring by intent or chance.

We will also see a continuing move toward multifunction systems. These will involve extensive communications switching, as well as remote batch and time sharing operations.

Finally, the fourth generation will be characterized by improved communications between man and machine. To make a substantial difference in our lives, the computer must become accessible to people at all levels of technical proficiency. Today, the man-machine interface allows far too much system complexity to show through to the user. We must never lose sight of a basic fact—that the computer is a universal machine, and universal machines are meant to be used by everyone. Not just professionals, not just programmers, but everyone.

Computer Mystique Dispelled

The punch card was a catalyst for all that has occurred in this industry. There was a time when management viewed with suspicion the idea that a punch card could be a vehicle for recording business data. The information was only a mosaic of holes, after all, which inspired little faith among the more literal-minded.

Magnetic tape was even worse because it offered no visible evidence whatsoever of the presence of data. These subjective hang-ups, plus binary arithmetic, helped create the mystique of the computer as a tool for experts only. It may well have led to the psychology of actual, though not always visible, executive detachment, to which so many of our shortcomings trace.

But today, the state of the art has returned full circle to the man with the ledger. It offers him now an opportunity to deal directly with the black box—in terms he understands—through the medium of the display terminal. Approximately 17,000 general purpose CRT devices are in use today. By 1975, we should see 10 times this number or more.

Dr. Robert Fano has pointed out that "We must devote our technical resources to adapting computers to the needs, desires, and idiosyncrasies of people, rather than vice versa . . . their fears and personal objections will persist until computers are brought within easy reach of the public, and are programmed to act as helpful assistants."

Display technology is an important avenue toward this objective. It offers the advantage of speed in inquiry and retrieval, of graphic flexibility, and of potentially low cost.

Another avenue involves the programming languages which bind men to computers. It is difficult to conceive where business and government would be without COBOL. But it is obvious also that much work with languages remains to be done if we are to bring the computer into the mainstream of popular usage.

The public image of computers as giant brains gives rise to the frequent question: "Are people becoming obsolete?" My answer to that is a categorical no. People are still the only machines capable of being mass-produced by unskilled labor.

Despite its lingering mystery, EDP is daily becoming less intractable to ordinary humans. A brokerage house has an investment information center in a railroad station where travelers can ask a computer about stocks. A state legislator determines the status of any bill by typing out a request on a display terminal. An elementary school student receives daily drill and practice in reading, arithmetic or science from a computer, with each lesson tailored to his learning rate.

These are promising signs of a more universal man-machine relationship, and they illustrate the transition now underway in the industry.

The onset of time sharing, of course, absolutely demands closer linkage because it is bringing more and more people in direct contact with the machine. In a sense, people and their problems—rather than the system and its schedule—have become the focus of our concern. Three years ago, about 500 time sharing terminals were in operation. Today, it is reported, some 15,000 terminals are connected to approximately 200 separate computers. The time sharing service business, which was estimated at $70-million last year, will probably increase to $240-million by 1970. In five years, this could well constitute a billion dollar market.

Change is Ultimate Reality

All of this points up the direction the computer industry is taking—toward the individual and his information needs. The stress in the future will be on systems which are better able to accommodate and implement change, because change has become the ultimate reality of the modern world. The computer should be both an agent of change and an instrument for channeling and harnessing it. Information systems in the last analysis are control systems, for information itself is control. And so it is no longer tolerable to have machines with unvarying schedules of batch routines, to make programmers wait a day or more for debugging time, or to limit the use of a computer to those with technical expertness. The great goal of computer-aided management will never be reached until the fourth generation lives up to these requirements.

We can expect that system architecture, or more particularly the distribution of hardware, will change as these trends proceed. Today a typical computer configuration is divided nearly equally between processor and local input/output. In the next decade, the processor and I/O portion combined will represent only about 20 percent, and mass storage 30 percent.

A large research and development effort is being mounted by the industry to generate important new hardware for the future. Such an effort is underway on a wide variety of fronts, especially in terminals and mass storage.

We will see an attempt to increase speed, simply because our equipment must do so much more to provide a better man-machine interface. Furthermore, there are classes of problems which can absorb virtually all the computing horsepower which can be developed. Despite the fact that today's logic circuits react 2½ million times faster than the human nerve cell, they impose serious delays on some jobs. One example is weather forecasting, entailing huge volumes of data in a three-dimensional grid of space.

Faster Computers Required

A scientist recently was quoted as saying that "The models we would like to use would require computers 500 to 1,000 times faster than the ones we have now." He is talking about trillionths of a second . . . and his present field of concentration is in semiconductors, involving the large-scale integration of many circuits on a single silicon chip.

Speed has been called the only invention of modern man. To some of us who travel, this can mean breakfast in London, lunch in New York and luggage in Atlanta. But it is a focal point of computer research today.

In physics and chemical laboratories, much exploration is underway for applicable principles, techniques, devices, circuits and mechanisms to advance the state of the art.

One interesting example is the field of lasers and holograms. Our scientists have recently developed an optical converter which may someday form the basis of a laser computer, capable of moving data at a rate of 10 trillion bits per second—about 10,000 times faster than today. Such machines are at least a decade away, but they suggest the possibilities which lie ahead.

Somewhat more imminent is the "hologram," which is derived from Greek words meaning "whole writing." Hologram plates, approximately 10 inches square, are able to register "snapshots" which pack in huge quantities of data. These plates are subdivided into one millimeter squares called pages, each holding 10,000 bits which are read out of memory at a single burst with a laser beam. The data are then transferred to computer decoding logic and processed.

Holographic memories offer high speed and low cost—and we may expect to see such devices, at least in the read-only mode, within five years. Research also indicates that holographic credit cards may provide fool-proof identification for citizens in tomorrow's cashless-checkless society. Laser etched sheets with the bearer's photograph, account number and other data will appear to the eye as meaningless concentric lines until placed in low-cost, laser-activated terminals. Then the information becomes instantly recognizable and forgery is all but ruled out.

Other innovations—among them speech recognition systems permitting direct computer inquiry by voice—are now in experimental prototype stages. Together they add up to stimulating prospects for everyone in the data processing field.

Painful Transition Period

As we move into this new era, through the evolutionary fourth generation phase and beyond, we must recognize that transition is not a painless process. There are looming issues which confront the industry today, about which no one can be unconcerned or unaware. Let me briefly mention a few.

Clearly most visible is the thorny question of anti-trust action and its probable effects on the structure of our industry. Accompanying this is the issue of unbundling—separate pricing of hardware, applications programs, and maintenance services—and its unquestioned but uncertain impact on the field as a whole.

We must be concerned with the increasing interaction of computer services with the common carriers, brought about by the inexorable trend toward remote on-line operation. The recent U.S. Federal Communications Commission inquiry into tariff regulation and line use for data communications spotlights the controversy which this shift has produced.

The issue of privacy and security has also been thrust to the forefront of public concern. It has arisen partly from disclosures of abuses in the information area, particularly involving credit, and partly from the proposal in the U.S. for a national data bank. Added to this are newly-created computer files for internal revenue and police use, which offer great advantages for law enforcement, but also great opportunity for misuse unless protected by appropriate safeguards.

The computer itself, of course, poses no threat to individual privacy. But it makes possible the marshalling of vast amounts of data, accessible to those with entry to the system. While we have made positive strides in mechanizing the dissemination of such data, our control over its input is far from precise. The possibility of mistake, therefore, is very real—and with it the accompanying possibility of manipulation, chicanery, and control. Even with the best of files the latent potential for error, and its consequences, demands the closest consideration of any mass data base involving people.

The question of our banks and other financial institutions entering data processing service area; of large-scale government purchasing; of possible regulation of the so-called computer utility—all these typify the growing pains of a maturing industry.

Spearhead of Revolution

These problems challenge us and they make uncompromising demands on our professionalism. The computer is indeed the spearhead of the information revolution. All of us are together at the barricades. We must not shrink from our responsibilities, because the stakes are too great and the effects of what we do are too pervasive.

Doctor George W. Haller summed it up when he said: "The information revolution is the climactic, crucial battle in the wider development that is welding our world into one planet. This movement transcends nations and ideologies. Technology has shifted its emphasis from muscle and things to thoughts and ideas. But the goal of technological change is still the same. That goal is the betterment of mankind."

We can appreciate the force of information because we are part of the information industry. One third of the entire economy is devoted to producing and distributing ideas. Spending in this area is at a rate 2½ times faster than for goods and services. And leading the steeplechase is the electronic computer, and the profession of data management.

The fourth generation may be descending on us quietly. Its changes may seem mild compared with yesterday's technical drama, but under the surface lie the problems of an industry in transition, and they ask of us a greater effort, clearer heads, and deeper commitment than ever before. ☐

This article is based on a report distributed by RCA.

RETROSPECT, PROSPECTS AND TRENDS IN THE COMPUTER FIELD:

A Forum of Some Relevant Thoughts and Ideas

PUNCH LINES . . .

Before time-sharing becomes widely accepted by the business community, several technical, economical and social problems need to be solved. These problems include: the development of simplified computer languages; the development of low-cost applications packages tailored to the needs of the business community; a period of adjustment and acceptance of the time-sharing concept by users who are not technically oriented; and technical and economic breakthroughs to reduce the cost of communications.

–Ronald M. Poppe, Senior Manager of the Software and Information Systems Div., TRW Inc., Redondo Beach, Calif., addressing a press seminar on computers and automation.

Within five to seven years, time-sharing computer systems will be well on the way to radically re-shaping our home and business lives. The computer is going to be a commonplace, but incredibly intellectual tool that is totally unlike anything mankind has ever known. The sweeping changes wrought by this new capability of the mind will be profound, far-reaching and even shocking to some.

–T. Paul Bothwell, Vice President and General Manager of Honeywell's Computer Control Div., Framingham, Mass., in an address on the prospects for use of computer time-sharing as a tool that can help solve society's problems.

The evidence so far indicates widespread unpreparedness to absorb more than a fraction of the accumulated data, or to make truly effective use of new communications and information techniques. It indicates greater preoccupation with quantity than with quality—more concern with amassing new facts than with developing the structure and relationships that will convert them to meaningful information. **Until there is more general awareness of these shortcomings, until plans and policies are better organized to harness the new technology, we shall face the possibility of a breakdown rather than a breakthrough in our management of public and private enterprises.**

–Robert W. Sarnoff, President, RCA, New York, N.Y., addressing the Commonwealth Club of San Francisco.

The computer industry has set a pace much faster than the traditional pace of business. During the last decade, the struggle of retailers and manufacturers to keep up with demand has, of sheer necessity, focused attention more on supplying the demand than on selling. **By overcoming in-house inefficiencies in business methods, control and decision-making, store management can shift their focus from "housekeeping" to selling the consumer and enjoying his confidence—a rightful role for the merchant.**

–Douglas S. Moore, Vice President of Marketing and Public Affairs, General Electric, Schenectady, N.Y., in an address at the Electronic Data Processing Conference of the National Retail Merchants Association.

Sensitivity to the potential of the computer has been late in coming to Congress. . . . However, as Congress moves into the computer age, it is my feeling that the biggest mistake we can make is to acquire one machine for mailing service and find that another is required for research, another for file maintenance, another for publication of the Calendar, another for the Digest, and so forth. The result will be an expensive, inefficient group of incompatible machines and programs which will leave the Congress little better served and probably as far behind as it is now. **Capitol Hill computer systems must be compatible—they must be able to "talk to one another."**

–Congressman William S. Moorhead, U.S. House of Representatives, Washington, D.C., in hearings before the Special Subcommittee on Congressional Reorganization Committee on Rules.

"The latest addition to the financial personnel structure, the data processing auditor, is being bid at $20,000 average salary with a minimum of $18,000. Big corporations are willing to pay $30,000 because of the heavy demand and the short supply. **Computers can't cheat, but a dishonest programmer can mislead the mechanical brain and manipulate it to hide a fabulous embezzlement.** The Sherlock Holmes of electronic statistics who could checkmate the upper bracket thief must be skilled in accounting and EDP, and naturally suspicious and shrewd."

–Roderick Purcell, Managing Director, Robert Half Personnel Agencies, Phoenix Div., Phoenix, Ariz.

You, as data processing installation managers, should accept IBM's separate pricing policy as a challenge to your business management abilities and technical expertise. **If you haven't been an innovator in the past, you had better become one.** If you haven't been a budget manipulator in the past, learn—and learn fast. If you have been oblivious to the availability of the many outside services around you, begin to make yourself aware and update your knowledge often. If you've been a haphazard planner, begin now to do your planning in a more efficient manner."

—Stuart Tower, Manager of the Western Div., Programming Sciences Corp. (headquartered in New York), addressing a conference of the Data Processing Manufacturers Association.

THE YOUNG, NEW CROWD THAT PICKS STOCKS BY COMPUTER

(Written by Alexander Ross and reprinted with permission from October 18, 1969 edition of The Financial Post, 481 University Ave., Toronto 2, Canada)

Once upon a time, there was an American Congressman who made a lot of portfolio managers nervous by throwing darts at a pinned-up page of stock quotations from the *Wall Street Journal,* and coming up with a better performance average than many of the stodgier mutual funds.

It was a stunt, right? We all know the market isn't that simple. Sure, anybody could rack up a good performance record by throwing darts—for a while. But over the long haul, it takes brains, guts, sensitivity, luck and a well-staffed research department. Right?

Well, yes. Except that there's this young couple working at the Toronto head office of McLeod, Young, Weir & Co. who have achieved something equally unnerving, with a computer.

Using a program which they admit is extremely crude, they've had their computer trade a theoretical portfolio of 42 blue-chip Canadian stocks for four theoretical years, 1965 to 1969, and achieved an annual performance average of nearly 13%.

This isn't exactly a hot performance record. But it's better than some human managers have been known to achieve, even in the great 1960's bull market. By shrewd trading, based only on the previous ups and downs of each stock, the computer made its portfolio appreciate twice as fast as the Toronto Stock Exchange index of industrial stock prices.

The whole operation was masterminded by a husband-and-wife team, Adrian and Sandy Browne. Both of them are young, fearfully bright, and passionately dedicated to tinkering with computers. "I'm the extrovert," says Sandy—she's the wife—"and Adrian's the brains."

Several dozen brokerage houses now have computer facilities, but McLeod, Young, Weir is one of the few who are using the machine for truly experimental purposes. The Brownes are not part of the research department. Instead, they ask the machine questions in response to requests from the company's analysts.

"That way," says Sandy, "people feel free to use us for whatever they want to know. If you're part of a research department, sometimes the analysts feel you're trying to cram the computer down their throats."

An Unsophisticated Portfolio

The Brownes' theoretical portfolio was, by cybernetic standards, relatively unsophisticated. The mathematical model they built dealt only with the price behavior of individual stocks. They didn't incorporate data on the earnings, sales or other internal factors of individual companies.

Despite this mathematical crudity, they did quite nicely. "Quite frankly," says Adrian, "the results were shattering."

And how did the experts as McLeod, Young, Weir react to the news that a machine had creditably performed an analytical task that they'd spent years of their lives learning to perform?

"They all looked at it," says Sandy, "and said: 'Well, the market's just not that simple.' They're right, of course."

The Brownes' automated portfolio is only one of their projects. They're also working on a model which, using formulas developed in the U.S., may tell them how much of a portfolio's growth is due to blind luck, and how much is due to the acumen of its manager.

They're also trying to devise computerized techniques that will tell them which items on a company's balance sheet may signal a change in the price of its shares.

The Brownes are members of a new and enormously specialized tribe in the investment community—the people who know about financial analysis, and know about computers too.

An Analytical Tool

The machines have been used in brokerage houses for years, and usually for routine bookkeeping operations—customer accounts, billing, and so on. But now, at a time when most of the larger firms have installed a terminal somewhere in the back office, the computer is beginning to come into its own as an analytical tool.

At the moment, computers are used mainly as glorified slide rules—analysts use them to make routine calculations that they normally wouldn't have time for.

One of the major problem areas in this field has been the need for large, consistent data banks of financial information—"clean" data banks.

It is a slow process to compile consistent series of financial information in a format which can be used in a computer.

But there is enough research in progress, both in academic think-tanks on both sides of the border and in the offices of individual investment dealers, to suggest that, by the end of the 1970's, very few major investment decisions will be made without the computer's advice.

Gerry Tsai, the whiz-kid of the American mutual fund business, once said the computers won't make any difference to the market, because eventually everybody will be using them.

But until that saturation point is reached, some truly wondrous results are being achieved by the canny people who use computers to outguess the people who don't. ☐

THE EMPTY COLUMN

A Parable About a "New Notation" of Long Ago

Many years ago a Roman civil engineer, who was a high official in Alexandria, was approached by a young Arabian mathematician with an idea which the Arabian believed would be of much value to the Roman Government in their road-building, navigating, tax-collecting, and census-taking activities. As the Arabian explained in his manuscript, he had discovered a new type of notation for number writing, which was inspired from some Hindu inscriptions.

The Roman official presumably studied this manuscript very carefully for several hours, and then wrote the following reply:

> Your courier brought your proposal at a time when my duties were light; so fortunately I have had the opportunity to study it carefully, and am glad to be able to submit these detailed comments.
>
> Your new notation may have a number of merits, as you claim, but it is doubtful whether it ever would be of any practical value to the Roman Empire. Even if authorized by the Emperor himself, as a proposal of this magnitude would have to be, it would be vigorously opposed by the populace, principally because those who had to use it would not sympathize with your radical ideas. Our scribes complain loudly that they have too many letters in the Roman Alphabet as it is, and now you propose these ten additional symbols of your number system, namely
>
> 1, 2, 3, 4, 5, 6, 7, 8, 9, and your 0.

It is clear that your 1-mark has the same meaning as our mark-I, but since this mark-I already is a well-established character, why is there any need for yours?

Then you explain that last circle-mark, like our letter O, as representing "an empty column," or meaning nothing. If it means nothing, what is the purpose of writing it? I cannot see that it is serving any useful purpose; but to make sure, I asked my assistant to read this section, and he drew the same conclusion.

You say that the number 01 means the same as just 1. This is an intolerable ambiguity and could not be permitted in any legal Roman Documents. Your notation has other ambiguities which seem even worse: You explain that the 1-mark means ONE, yet on the very same page you show it to mean TEN in 10, and one HUNDRED in your 100. If my official duties had not been light while reading this, I would have stopped here; you must realize that examiners will not pay much attention to material containing such obvious errors.

Further on, you claim that your system of numeration is much simpler than with Roman Numerals. I regret to advise that I have examined this point very carefully and must conclude otherwise. For example, counting up to FIVE, you require *five* new symbols whereas we Romans accomplish this with just two old ones, the mark-I and mark-V. At first sight the combination IV (meaning ONE before FIVE) for four may seem less direct than the old IIII, but note that this alert representation involves LESS EFFORT, and that gain is the conquering principle of the Empire.

Counting up to twenty (the commonest counting range among the populace), you require ***ten*** symbols whereas we now need but three: the I, V, and X. Note particularly the pictorial suggestiveness of the V as ***half*** of the X. Moreover, it is pictorially evident that XX means ten-and-ten, and this seems much preferred over your 20. These pictorial associations are very important to the lower classes, for as the African says, "One picture tell thousand words."

You claim that your numbers as a whole are briefer than the Roman Numerals, but this is not made evident in your proofs. Even if true, it is doubtful that this would mean much to the welfare of the Empire, since numbers account for only a small fraction of the written records; and in any case, there are plenty of slaves with plenty of time to do this work.

When you attempt to show that you can manipulate these numbers much more readily than Roman Numerals, your explanations are particularly bad and obscure. For example, you show in one addition that 2 and 3 equal 5, yet in the case which you write as:

```
  79
& 16
  --
  95
```

this indicates that 9 and 6 also equal 5. How can this be? While that is not clear, it is evident that the other part is in error, for we know that 7 and 1 equal 8, not 9.

Your so-called "multiplying and dividing" tables also require much more explanation, and possibly correction of errors. I can see that your "Nine Times" Table gives sets which add up to nine, namely

18 27 36 45 54 63 72 81 and 90,

but I see no such useful correlation in the "Seven Times" table, for example. Since we have SEVEN, not nine, days in the Roman Week, it seems far more important to have a system that gives more sensible combinations in this "Seven Times" Table.

All in all, I would advise you to forget this overly ambitious proposal, return to your sand piles, and leave the number reckoning to the official Census Takers and Tax Collectors. I am sure that they give these matters a great deal more thought than you or I can.

This marvelous parable is of the kind that floats from hand to hand via copying machines, and stays in circulation for years. The copy we have is marked "by William J. Wiswesser, May 1950". If any reader can furnish us more information about this parable and the date and occasion of writing it, so that we can attribute it to its proper source, we shall be very grateful. □

THE FUTURE OF AUTOMATIC COMPUTERS: 1949, 1961, 1970

Edmund C. Berkeley, Editor
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"In the days to come, anyone will be able to get 15 minutes' access to a computer for 25 cents; and the great majority of us will know how to ask the computer questions, and how to make the computer's answers useful to us."

Part 1

Note: *The following was written in 1948 and published in 1949 as Chapter 11, "The Future: Machines that Think, and What They Might Do for Men", in* Giant Brains, or Machines that Think *by Edmund C. Berkeley. The publisher was John Wiley and Sons, New York, N.Y. Over 25,000 copies have been sold.*

The pen is mightier than the sword, it is often said. And if this is true, then the pen with a motor may be mightier than the sword with a motor.

In the Middle Ages, there were few kinds of weapons, and it was easy for a man to protect himself against most of them by wearing armor. As gunpowder came into use, a man could no longer carry the weight of armor that would protect him, and so armor was given up. But in 1917, armor, equipped with a motor and carrying the man and his weapons, came back into service—as the tank.

In much the same way, in the Middle Ages, there were few books, and it was easy for a man to handle nearly all the information that was in books. As the printing press came into use, man's brain could no longer handle all recorded information, and the effort to do so was given up. But in 1944, a brain to handle information, equipped with a motor and supporting the man and his reasoning, came into existence—as the sequence-controlled calculator.

Edmund C. Berkeley, editor and publisher of **Computers and Automation** 1951 to 1970, took part in building and operating the first automatic general purpose computers, the Mark I and II at Harvard University in 1944-45. He is the author of eleven books on computers and related subjects, including: **Computers — Their Operation and Applications,** Reinhold Publishing Co., New York, 1956, 366 pp; **Symbolic Logic and Intelligent Machines,** Reinhold Publishing Corp., New York, April 1959, 203 pp; **The Computer Revolution,** Doubleday & Co., New York, August 1962, 249 pp; **The Programming Language LISP: Its Operation and Applications,** co-editor; also author of one article in the book, entitled, "LISP — A Simple Introduction", Information International Inc., Boston, Mass., March 1964, 392 pp; and **Computer-Assisted Explanation,** Information International, Inc., Boston, Mass., May 1967, 280 pp.

In previous chapters we have examined some of the giant mechanical brains that have been finished; we have also considered the design of such machines. Now in this chapter we shall discuss the future significance of machines that think, of motorized information. We shall discuss what we can foresee if we look with imagination into the future.

There are two questions we need to ask: What types of machines that think can we foresee? What types of problems to be solved by these machines can we foresee?

Future Types of Machines That Think

The machines that already exist show that some processes of thinking can already be performed very quickly:

Calculating: adding, subtracting, . . .
Reasoning: comparing, selecting, . . .
Referring: looking up information in lists, . . .

We can expect other processes of thinking to come up to high speed through the further development of thinking machines.

Automatic Address Book

Nowadays when we wish to send out announcements of an event, like going to South America for a year, we may copy the addresses of our friends onto the envelopes by hand. In the future, we can see our address book as a spool of magnetic tape. When we wish to send out announcements, we put a stack of blank envelopes into the machine that will read the magnetic tape, and we press a button. Out will come the envelopes addressed.

If we wish to select only those friends of ours whose last names we put down on a list, we can write the list on another magnetic tape, place it also in the machine, and set a few switches. Then the machine will read the names on the list, find their addresses in the address-book tape, and prepare only the envelopes we want. If a friend's address changes, we can notify the machine. It will find his old address, erase it, and enter the new address.

Automatic Library

We can foresee the development of machinery that will make it possible to consult information in a library automatically. Suppose that you go into the library of the future and wish to look up ways for making biscuits. You will be able to dial into the catalogue machine "making biscuits." There will be a flutter of movie film in the machine. Soon it will stop, and, in front of you on the screen, will be projected the part of the catalogue which shows the names of three or four books containing recipes for biscuits. If you are satisfied, you will press a button; a copy of what you saw will be made for you and come out of the machine.

After further development, all the pages of all books will be available by machine. Then, when you press the right button, you will be able to get from the machine a copy of the exact recipe for biscuits that you choose.

We are not yet at the end of foreseeable development. There will be a third stage. You will then have in your home an automatic cooking machine operated by program tapes. You will stock it with various supplies, and it will put together and cook whatever dishes you desire. Then, what you will need from the library will be a program or routine on magnetic tape to control your automatic cook. And the library, instead of producing a pictorial copy of the recipe for you to read and apply, will produce a routine on magnetic tape for controlling your cooking machine so that you will actually get excellent biscuits!

Of course, you may have other kinds of automatic producing machinery in your home or office. The furnishing of routines to control automatic machinery will become a business of importance.

Automatic Translator

Another machine that we can foresee would be used for translating from one language to any other. We can call it an ***automatic translator.*** Suppose that you want to say "How much?" in Swedish. You dial into the machine "How much?" and press the button "Swedish," and the machine will promptly write out "Hur mycket?" for you. It also will pronounce it, if you wish, for there would be little difficulty in recording on magnetic tape the pronunciation of the word as spoken by a good speaker of the language. The machine could be set to repeat the pronunciation several times so that the student could really learn the sound. He could learn it better, probably, by hearing it and trying to say it than he could by using any set of written symbols.

Automatic Typist

We now come to a possible machine that uses a new principle. This principle is that of being able to ***recognize*** signs. This machine would perceive writing on a piece of paper and recognize that all the ***a***'s that appear on the paper are cases of ***a***, and that all the ***b***'s that appear on it are instances of ***b***, and so forth. The machine could then control an electric typewriter and copy the marks that it sees. The first stage of this machine would be one in which only printed characters of a high degree of likeness could be recognized. In later stages, handwriting, even rather illegible handwriting, might be recognizable by the machine. We can call it an ***automatic typist.***

The elements of the automatic typist would be the following:

1. ***Phototubes*** (electronic tubes sensitive to the brightness of light), which could sense the difference between black and white (these already exist).
2. A memory of the shapes of 52 letters, 10 digits, and punctuation marks. Fine distinctions would be required of this memory in some cases—like the difference between the numeral 5 and the capital letter S.
3. A control that would cause the machine to ***tune*** itself, so that a good matching between the marks it observed and the shapes it remembered would be reached.
4. A ***triggering control*** so that, when the machine had reached good enough matching between its observations and its memory, the machine would proceed to identify the marks, read them, and transfer them.
5. An electric typewriter, which would respond to the transferred instructions. (This also already exists.)

This machine is perhaps not so farfetched as it might seem. During World War II, gun-aiming equipment using the new technique ***radar*** reached a high stage of development. Many shots that disabled and sank enemy ships were fired in total darkness by radar-controlled guns. On the glowing screen in the control room, there were two spots, one that marked the target and one that reported the point at which the gun was aimed. These two spots could be brought almost automatically into agreement. In the same way, a report from a phototube telling the shape of an observed mark and a report from the memory of the machine telling the shape of a similar mark could be compared by the machine for likeness and, if judged enough alike, could be approved as identical.

Even the phrase "enough alike" can be applied by a machine. During World War II, tremendous advances were made in machinery for deciphering enemy messages. Machines observed various features and patterns in enemy messages, swiftly counted the frequency of these features, and carried out statistical tests. Then the machines selected those few cases in which the patterns showed meaning instead of randomness.

A machine like the automatic typist, if made flexible enough, would be, of course, extremely useful. A great load of dull office work is now being thrown on clerks whose task is to translate from writing and typing into languages that machines can read, such as punch cards. At the present time, if punch-card machines are widely used in a big company, the company must employ large numbers of girls whose sole duty is to read papers and punch up cards. A still bigger chore is the work of typists in all kinds of businesses whose main duty is to read handwriting, etc., and then copy the words on a typewriter.

Research has already begun on various features of the automatic typist because of its obvious labor-saving value. For example, many patents have been issued on schemes for dividing the area occupied by a letter or a digit into an array of spots, with a battery of phototubes each watching a spot. The reports from the phototubes together will distinguish the letter or digit. For example, if we consider *A* and *H* placed in a grill of fifteen spots, 5 long by 3 wide (see Fig.1), then the phototubes can distinguish between *A* and *H* by sensing black or white in the spot in the middle of the top row. When we consider how easily and swiftly a

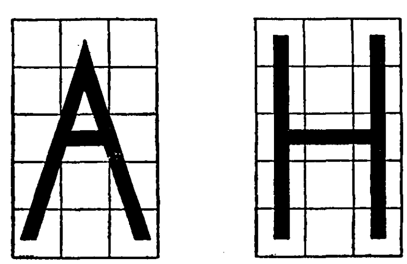

FIG. 1. Scheme for distinguishing *A* and *H* by 15 phototubes.

human being does this, we can once more marvel at the recognizing machine we all carry around with us in our heads.

Automatic Stenographer

Another development that we can foresee is one that we can call the *automatic stenographer.* This is a machine that will listen to sounds and write them down in properly spelled English words. The elements of this machine can be outlined:

1. Microphones, which can sense spoken sounds (these already exist).
2. A memory storing the 40 (more or less) phonetic units or sounds that make up English, such as the 23 consonant sounds,

p	*b*	*l*	*ng*
f	*v*	*m*	*th*
t	*d*	*n*	*r*
s	*z*	*h*	*y*
k	*g*		*w*
ch	*j*		
sh	*zh* (heard in "pleasure")		

and the 17 vowel sounds,

LONG	SHORT	OTHER
A ("ate")	*a* ("cat")	*ar* ("are")
E ("eat")	*e* ("end")	*aw* ("awe")
I ("isle")	*i* ("in")	*er* ("err")
O ("owe")	*o* ("on")	*ow* ("owl")
U ("cute")	*u* ("up")	*oi* ("oil")
OO ("roof")	*oo* ("book")	

3. A collection of rules of spelling in English, containing many statements like
   The sound *b* is always spelled *b*
   The sound *sh* may be spelled *sh* (ship), *s* (sugar), *ti* (station), *ci* (physician), *ce* (ocean) or *tu* (picture)
   and other statements based on context, word lists, derivation, etc. These are the statements by means of which a good English speller knows how to spell even words that he hears for the first time.
4. A triggering control so that, when the machine reaches good enough matching between its observations of sounds, its memory of sounds, and its knowledge of spelling rules, the machine will identify groups of sounds as words, determine their spelling, and report the letters determined.
5. An electric typewriter, which would type the reported letters.

With this type of machine, you would dictate your letters into a machine (now existing) that would record your voice. Then the record would be placed on the automatic stenographer, and out would come your letters written and spaced as they should be.

Automatic Recognizer

We can foresee a recognizing machine with very general powers. Suppose that we call it an *automatic recognizer* (see Fig. 2). It will have the following elements:

1. *Input.* This element will consist of a set of observing instruments, capable of perceiving sights, sounds, etc. There will be ways of positioning or *tuning* these instruments.
2. *Memory.* This element will store knowledge. It may store the patterns of observations that we are interested in; or it may store general rules on how to find patterns of observations that we will be interested in. It will contain knowledge about acceptable groups of patterns, about actions to be performed in response to patterns, etc.
3. *Program 1.* The element "Program 1" performs a set of standard instructions. Under these instructions, the machine:
   Compares group after group of observations with the information in the memory.
   Compares these groups with patterns furnished, or seeks to organize the observations into patterns.
   Counts cases and tests frequencies.
   Finds out how much matching with patterns there is.
   Tunes the observing instruments in ways to increase matching.
4. *Program 2.* The element "Program 2" performs another set of standard instructions. Under these instructions, the machine, if it is tuned well, matches sets of observations one after another with the patterns and so reads them.
5. *Triggering Control.* This element shifts the control of the machine from Program 1 to Program 2. It does this when the machine reaches "good matching." We shall set the meaning of this into the machine in much the same way as we set "warm" into a thermostat.
6. *Output.* This element performs any action that we want, depending on recognized patterns read and any other knowledge or instructions stored in the memory.

The automatic recognizer will be capable of extraordinary tasks. With microphones and a large memory, this type of machine would be able to hear a foreign language spoken and translate it into spoken or written English. With phototubes and with an expanded filtering and decoding capacity as in deciphering machines, the automatic recognizer should be able to read a dead language, even those (such as Minoan or Etruscan) that have so far resisted efforts to read it. The machine would derive rules for the translation of the language and translate any sample.

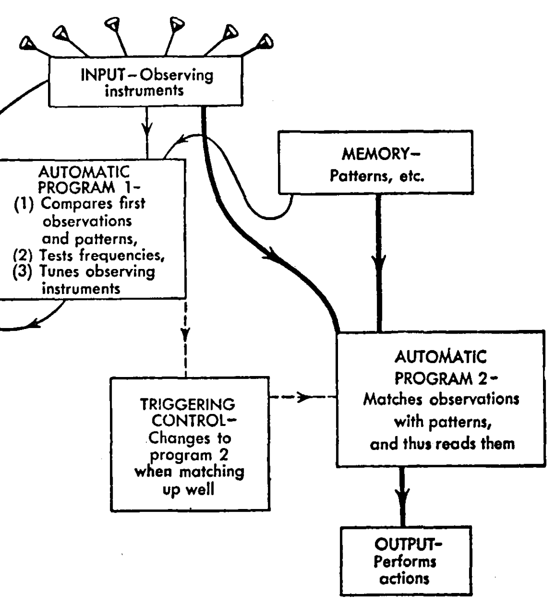

FIG. 2. Scheme of an automatic recognizer.

An automatic recognizer could perhaps be equipped with many sensitive, tiny observing instruments that could be placed around or in the brain and nervous systems of animals. Then the machine might enable us to find out what activity in the nervous system corresponds with what activity in the animal.

Types of Problems That Machines Will Solve in the Future

We turn now to the second question regarding the future of machines that think: What types of problems can we foresee as solved by these machines?

Problems of Control

Probably the foremost problem which machines that think can solve is automatic control over all sorts of other machines. This involves controlling a machine that is running so that it will do the right thing at the right time in response to information. For example, suppose that you are mowing a lawn with a mowing machine. You watch the preceding strip so as to stay next to it. You watch the ends of the strips, where you turn around. If a stick is caught in the cutting blade, you stop and take it out. Now it is entirely possible to put devices on the mowing machine so that all these things will be taken care of automatically. In fact, in the case of plowing a large field, a tractor plow can be equipped with a device that guides it next to the preceding furrow. Thus, once the first furrow around the edge has been made, riderless tractors will plow a whole field and stop in the middle.

For another example, take a gas furnace for heating steam to keep a house warm. Such a furnace has automatic controls, which respond to the following information whenever reported:

House too warm.
House not warm enough.
Too much steam pressure.
Not enough water in boiler.
Gas flame not lit.
Daytime.
Nighttime.

In fact, your own meaning of "warm" can be put into the control system; you set the dial on your thermostat at the temperature that "warm" is to be for you.

In the future many kinds of automatic control will be common. We shall have automatic pilots for flying and landing airplanes. We shall have automatic missiles for destructive purposes, such as bombing and killing, and for constructive purposes, such as delivering mail and fast freight. An article in the magazine ***Fortune*** for November 1946 described the automatic factory (see Supplement 3). This is a factory in which there would be automatic arms for holding stuff being manufactured, and automatic feed lines for supplying material just where it is needed. All this factory would be controlled by machines that handle information automatically and produce actions that respond to information.

This prospect fills us with concern as well as with amazement. How shall we control these automatic machines, these robots, these Frankensteins? What will there be left for us to do to earn our living? But more of this in the next chapter.

Problems of Science

Other problems for which we can foresee the use of machines that think are the understanding, and later the controlling, of nature. One of these problems is weather forecasting and weather control.

The Weather Brain

We can imagine the following type of machine—a ***weather brain.*** A thousand weather observatories all over the country observe the weather at 8 A.M. The observations are fed automatically through a countrywide network of communication lines into a central station. Here a giant machine, containing a great deal of scientific knowledge about the weather, takes in all the data reported to it. At 8:15 the weather brain starts to calculate; in half an hour it is finished, having produced an excellent forecast of the weather for the whole country. Then it proceeds to transmit its forecast all over the country. By 8:50 every weather station, newspaper, radio station, and airport in the country has the details. In October 1945, Dr. V. K. Zworykin of the Princeton Laboratories of the Radio Corporation of America proposed solving the problem of weather forecasting in this way by a giant brain.

The weather brain will have a second stage of application. From time to time and here and there, the weather is unstable: it can be triggered to behave in one way or another. For example, recently, pellets of ***frozen carbon dioxide*** – often called Dry Ice – have been dropped from planes and have caused rain. In fact, a few pounds of Dry Ice have apparently caused several hundred tons of rain or snow. In similar ways, we may, for example, turn away a hail storm so that hail will fall over a barren mountain instead of over a farming valley and thus protect crops. Or we may dispel conditions that would lead to a tornado, thus avoiding its damage. Both these examples involve local weather disturbances. However, even the greatest weather disturbances, like hurricanes and blizzards, may eventually be directed to some extent. Thus the weather may become to some degree subject to man's control, and the weather brain will be able to tell men where and when to take action.

Psychological Testing

Another scientific problem to which new machinery for handling information applies is the problem of understanding human beings and their behavior. This increased understanding may lead to much wiser dealing with human behavior.

For example, consider tests of aptitudes. If you take one of these tests, you may be asked to mark which word out of five suggested ones is nearest in meaning to a given word. Or your test may be 40 simple arithmetical problems to be solved in 25 minutes. Or you may be given a sheet with 20 circles, and be asked to put 3 dots in the first, 7 dots in the second, 4 dots in the third, 11 dots in the fourth, and so on, irregularly; you may be given a total of 45 seconds to do this as well as you can. Now, if a vocational counselor gives you one of these tests, and if you get 84 out of 100 on it, he needs to know just what he has measured about you. Also, he needs to know whether he can reasonably forecast that, as a result of your grade of 84, you will be good at writing articles, or good at supervising the work of other people, or good at designing in a machine shop. He needs to know the records of people with scores of about 84 on this test and to have evidence supporting his forecasts.

If we wish to make the most use of the tests, we need to carry out a good deal of statistics, mathematics, and logic. For example, it will turn out that answers to some questions are much more significant than answers to others, and so we can greatly improve the quality of the tests by keeping only the more significant questions. Powerful machinery for handling calculations will be very useful in the field of aptitude testing.

But, you may ask, what if the person analyzing your answers has to use interpretations and judgments? If the judgments and interpretations can be expressed in words, and if the words can be translated into machine language, then the machine can carry out the analysis. Usually the difference between a rule and a judgment is simply this: a rule in a case in which it is hard to express all the factors being considered is called a judgment.

Psychological Trainer

It is conceivable that machines that think can eventually be applied in the actual treatment of mental illness and maladjustment. Consider what a physician does. In treating a psychiatric case, such as a ***neurosis,*** a physician uses words almost entirely. He asks questions. He listens to the patient's answers. Each answer takes the physician nearer and nearer to a diagnosis. By and by the physician knows what most of the difficulty is. Then he must present his knowledge slowly to the patient, gradually guiding the patient to understanding. It is a psychological truth that telling a man in ten minutes what is wrong with him does not cure him. The physician seeks to free the patient from the tormenting circles of habit and worry in which he has been trapped. Often the diagnosis is short and the treatment is long; the reasons for the neurosis may soon be clear to the physician, but they may take months to become clear to the patient.

Now let us consider the following kind of machine as an aid to the physician. We might call this kind of machine a ***psychological trainer,*** for in many ways it is like the training machines used in World War II for training a pilot to fly an airplane. The psychological trainer would have the following properties:

1. The machine is able to show sound movies—produce pictures and utter words.
2. It is able to put before the patient: situations, problems, questions, experiences, etc.
3. It is able to take in responses from the patient.
4. It is able to receive a program of instructions from the physician.
5. Depending on the responses of the patient and on the program from the physician, the training machine can select more material to put before the patient.
6. The training machine produces a record of what it presented and of how the patient responded, so that the physician and the patient can study the record later.

What sort of films would the machine hold? The machine could be loaded with a number of films which would help in the particular type of neurosis from which the patient was suffering.

What sort of responses could the patient make? The patient might have buttons in front of him which he could press to indicate such answers as:

Yes	I don't know	Repeat
No	It depends	Go ahead

Also, the patient might hold a device—like a lie detector, perhaps—which would report his state of tenseness, etc., and so report what he really felt.

Where would the machine's questions come from? From one or more physicians very clever in the treatment of mental illness.

Suppose that the patient is inconsistent in his answers? The machine, discovering the inconsistencies, could return to the subject and ask related questions in a different way. As soon as several questions related to the same point are answered consistently, the machine could exclude groups of questions that no longer apply and could proceed to other questions that would still apply.

Patients would vary in their ability to go as fast as the machine could. So from time to time the machine would ask questions to test the effect of what it had presented; and, depending on the answers, the machine would go faster or would bring in additional material to clarify some point.

This machine might have a few advantages over ordinary treatment. For example, with the machine, treatment does not depend on the physician's making the right answer in a split second, as it may in a personal interview. Also, the patient might be franker with the machine than with the physician, for it might be arranged that the patient could review his record, and then decide whether to confess it to his physician.

Such a machine would enable physicians to treat many more patients than they now can. In fact, it is estimated that nearly 50 per cent of persons who consult physicians are suffering only from mental illness. Such a machine would therefore be a great help.

Problems of Business

Another large group of problems for which we can foresee the use of machines that think is found in business and economics.

For example, consider production scheduling in a business or a factory. The machine takes in a description of each order received by the business and a description of its relative urgency. The machine knows (that is, has in its memory) how much of each kind of raw material is needed to fill the order and what equipment and manpower are needed to produce it. The machine makes a schedule showing what particular men and what particular equipment are to be set to work to produce the order. The machine turns out the best possible production schedule, showing who should do what when, so that all the orders will be filled in the best sequence. What is the "best" sequence? We can decide what we think is the best sequence, and we can set the machine for making that kind of selection, in the same way as we decide what is "warm" and set the thermostat to produce it!

On a much larger scale, we can use mechanical brains to study economic relations in a society. Everything produced in a society is made by consuming some materials, labor, equipment, and skill. The output produced by one man or factory or industry becomes the input for other men, factories, industries. In this way all economic units are linked together by many different kinds and degrees of dependence. The situation is, of course, complicated: it changes as time goes on and as people want different things produced. Economists have already set up simple models of economic societies and have studied them. But with machines that think, it will be possible to set up and study far more complicated models—models that are very much like the society we live in. We can then answer questions of economics by calculation instead of by arguments and counting noses. We shall be able to solve definitely such problems as: "How will a rise in the price of steel affect the farming industry?" "How much money must be paid out as wages and salaries so that consumer purchasing power will buy back what industry produces?"

Machines and the Individual

What about the ordinary everyday effects of these machines upon you and me as an individual? We can see that the new machinery will apply on a small scale even to us. Small machines using a few electronic tubes—much like a radio set, for example—and containing spools of magnetic wire or magnetic tape will doubtless be available to us. We shall be able to use them to keep addresses and telephone numbers, to figure out the income tax we should pay, to help us keep accounts and make ends meet, to remember many things we need to know, and perhaps even to give us more information. For there are a great many things that all of us could do much better if we could only apply what the wisest of us knows.

We can even imagine what new machinery for handling information may some day become: a small pocket instrument that we carry around with us, talking to it whenever we need to, and either storing information in it or receiving information from it. Thus the brain with a motor will guide and advise the man just as the armor with a motor carries and protects him.

Part 2

Note: *The following was written in 1961, and constituted a set of notes and a commentary on Part 1. This appeared in 1961 as a part of the paperback edition of* Giant Brains, or *Machines* that Think, *published by John Wiley and Sons, New York.*

NOTES ON CHAPTER 11, THE FUTURE: MACHINES THAT THINK AND WHAT THEY MIGHT DO FOR MAN

On the various types of machines mentioned under the heading of future developments, a number already exist.

The "automatic address book" exists for ***Life*** magazine, ***Readers Digest,*** and some other big magazines. Since ***Readers Digest*** has a subscription list of 12 million, it is clear that the problem of mailing the copies of the magazine to the right people each month is enormous. Address labels are produced at very high speed on special-purpose addressing machines, controlled by automatic computers. In this way each issue of a magazine can be mailed appropriately to just those subscribers who should receive it.

The "automatic library" is approaching actuality. For an example, let us take the periodical started in 1960 called ***Chemical Titles.*** This is published by the American Chemical Society, with a delay of only about two weeks; it consists of an index and bibliography of all the papers on chemical subjects appearing in 550 important chemical journals all over the world. The publication is produced by a computer, an IBM 704; each issue is in two parts, a "key-word-in-context" index and a bibliography, showing the title, author, and citation for each paper listed in the index. Each title is listed one or more times in the index, appearing as often as it contains a key word. Here is a sample of the "key-word-in-context" index:

NITRO PHENOL AND SODIUM	SALICYLATE.	MOSESV–60–CGM
EFFECTS OF	SALICYLATE	SMITMJ–60–ESD
	AND 2.*4-DINITRO PHENOL	
RENAL METABOLISM OF	SALICYLATE	DESPOA–60–RMS
ANTIFUNGAL ACTION OF	SALICYL ANILIDE.	BAICRS–60–AAS
	AND SALICYLURATE.	
OLISM OF SALICYLATE AND	SALICYLURATE.	DESPOA–60–RMS
QUENCES OF CLUPEINE AND	SALMINE.	ANDOT–60–PMS

You can deduce most of the scheme which is being used: for example, a paper by "O.A. Desp . . . ." published in "1960" in the chemical journal coded RMS was entitled "Renal Metabolism of Salicylate and Salicylurate". So, in this SAL . . . section of the index in ***Chemical Titles,*** the paper was listed by each of the two key words "salicylate" and "salicylurate." No doubt the paper is also listed in the appropriate parts of the index under the key words "renal" and "metabolism."

The computer rejects 960 words as key words, not just prepositions and conjunctions but also such words as "use, theory, synthesis, chemistry" which contribute little or nothing to the recognition of the subject matter. As may be seen, each key word is amplified by the surrounding portion of the title (the "context") and is accompanied by an identification code for the article, which the computer determines and which enables the full title, author, and citation to be found quickly in the bibliography, part **2** of ***Chemical Titles.***

It is to be noted that the author of this publication is a computer, the IBM 704 computer, which takes in citations in machine language, and from that produces (1) the index of titles in sequence by key word in context and (2) the bibliography in sequence by author. The results are printed by an IBM 407 printer; and the pages produced by the printer are published by photo offset.

The "automatic translator" is being developed. Translation from Russian to English and from English to Russian has been accomplished by certain computers, including for example the Photoscopic Language Translator, being developed by IBM. Over 20,000 pages of English, translated from Russian by computers, have been produced.

The "automatic typist" is being developed in a form called the optical scanner. This machine is used, for example, to identify digits of numbers on oil company credit cards, and so it can prepare machine language automatically.

In several laboratories work is being done on an "automatic stenographer" which will listen to sounds (phonemes) and will recognize them. But no machine has yet succeeded in doing this in a commercial or reliable way. Probably the main reason for this failure so far is that different people say the sounds of a language in such different ways that a machine cannot recognize a phoneme unless it has tuned in to the person speaking to it. In human affairs, we notice the additional effort that we have to exert when we listen to a speaker with an accent. Consequently, the control of the machine needs to be more elaborate than just the simple recognition of certain physical types of sounds.

The "automatic recognizer" with very general powers still seems to be a distant machine. Probably this problem of recognition will be solved separately for situation after situation in a specific way, rather than generally—as for example the recognition of targets at a distance or the recognition of letters on paper.

We can sketch out at this time some other types of future computers which cast their shadows before them and which we can expect to come into existence.

The "psychological trainer" is arriving under another name—the versatile, automatic, expensive variety of teaching machine. A "teaching machine" is essentially any machine or device by means of which the student, as soon as he has taken a small step or answered a simple question, immediately receives information that he was right, or that he was wrong, so that he always knows how he did.

An example is the Tudor machine produced by Western Design, a division of U.S. Industries, Inc. It contains a reel of film, with say 5000 frames, a viewing screen, and buttons. Each frame presents to the student certain information and asks certain questions. The student sitting in front of the machine can choose one of several answers and press a button. The film will then spin to the right frame corresponding to what he pressed and proceed to state "You are right" and confirm his answer, or "You are wrong"; and your answer is wrong because of . . . . Will you please return to the frame you have just left and choose another answer?" In order to give information, the machine can either present one or several single frames, a movie of say a hundred frames, or any combination.

Another example of this kind of machine is the training simulator, such as a flight simulator. In a flight simulator, the crew members of a new kind of plane are trained so that they can handle situations which will arise with that kind of plane—before they ever leave the ground. Flight simulators trained crews ahead of time and saved many months in the introduction of jet planes to the airlines in the United States.

The problem of production scheduling by computer alluded to on page 193 has become a classic problem, solved for hundreds and hundreds of businesses by the application of computers and a mathematical method called linear programming. The computers and linear programming have solved not only the production-scheduling problem but also problems of control of inventory, routing of shipments, stocking of warehouses, and many similar scheduling problems. A recent version of a program of this kind is called Ramps, Resource Allocation and Multiple Production Scheduling, a computer program worked out by C-E-I-R, Inc., a computing service with offices in Washington and a dozen other cities. This program takes into account activities, resources, equipment, costs, objectives, etc.; it contains some 10,000 computer instructions, and it has worked out "very satisfactorily" the problem of a large construction company which wanted to allocate resources in an economic way to carry through a large number of construction projects in different parts of the United States.

The "discussing computer" will be a future development. This is a computer which has been programmed to discuss or converse, and which can deal with ideas in addition to those of mathematics and logic, which computers already handle. For example, a computer has been programmed to produce reasonable one-sentence responses to completely free questions asked and statements made about the weather; this feat is not important in itself, of course, but is a good illustration of the powers of a computer. So we can predict that in another ten or twenty years a human being in one room will not be able to tell whether he is conversing with a computer or a human being in another room.

Another future development is the general-purpose automatic factory. The automatic machine tool is at hand, and it is able to do a great deal of good work. It may be controlled by a program which "reads" blueprints describing the part to be made. Or it may be programmed by taking certain information out of plans, giving it to a computer, and having the computer compute the rest of the directions needed for the numerically controlled machine tool. A third way is for a master mechanic to make one of the parts himself and have the machine tool control set to copycat him. Then the copycat recording can control the making of the next 150 parts that might be needed. Connecting automatic machine tools together under a central control is a long stride toward the automatic factory.

Part 3

Note: *The following is written currently, December, 1969.*

Advancing Technology

During the 20 years since Part 1 of this article was written, society has seen automatic computers and electronic data processing grow from an activity affecting less than a few thousand people to an activity affecting hundreds of millions of people.

The most prominent factor that was not foreseen in the writing of Part 1 was the factor of rapidly advancing technology. To those who were in the computer field in 1949, it was not evident then that a large set of important technical inventions (such as transistors, magnetic cores, thin-film circuits, large scale integration) would almost certainly occur.

I think we should have foreseen this—because of the example of the human brain conspicuously in front of us, chemically and electrically organized in a very small space to handle a vast amount of information extraordinarily well.

So an appropriate prediction for the next twenty years is that technological advances will continue to be extraordinary both in quantity and quality—and the computers of today will in 1990 seem technically as primitive to computer people then as the computers of 1950 seem to us now in 1970.

Software

In 1949 I wrote:

> The furnishing of routines to control automatic machinery will become a business of importance.

This was an understatement. Nowadays the providing of programming and software to control automatic machines, processes, general purpose computers, etc., is a business with an annual volume of several billion dollars.

It is clear that this business will become far bigger still. By 1990 it will probably be twenty times as big, and maybe even a hundred times as big as it is now. For after all, the central purpose of the automatic computer is to apply knowledge, rules, and procedures to data, and to find out correct numbers and to recommend good decisions.

It is also likely, I believe, that the analysis of decisions and judgments by human beings will proceed much further over the next 20 years than in the last twenty years. More and more, programmed computers will produce good judgments, judgments better than those of human beings. The automation of a great deal of intellectual activity will produce a vast increase in intellectual power, and will undoubtedly have enormous effects upon society.

> For there are a great many things that all of us could do much better if we could only apply what the wisest of us knows.

Computers and Education

Another prediction that I think can safely be made is that over the next twenty years, knowledge of computers will permeate all ordinary education. The great majority of people in an advanced industrial society now have first-hand contact with automobiles, and with driving automobiles so as to travel somewhere. So, in the future, the great majority of people will have first-hand contact with computers, and with operating computers so as to obtain useful information. Nowadays in a supermarket we can get a Xerox copy out of a machine for 25 cents. In the days to come, anyone will be able to get 15 minutes' access to a computer for 25 cents; and the great majority of us will know how to ask the computer questions, and how to make the computer's answers useful to us.

> The brain with a motor will advise and guide the man just as the armor with a motor carries and protects him. □

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CALENDAR OF COMING EVENTS

Jan. 14-16, 1970: Third Annual Simulation Symposium, Sheraton-Tampa Motor Hotel, Tampa, Fla.; contact: Annual Simulation Symposium, P.O. Box 1155, Tampa, Fla. 33601, 813-839-5201.

Jan. 14-16, 1970: 1970 International Conference on System Sciences (IEEE), Honolulu, Hawaii; contact: Dr. Richard H. Jones (HICSS), Information Sciences Program, 2565 The Mall, University of Hawaii, Honolulu, Hawaii 96822

Jan. 19-21, 1970: Computer Software & Peripherals Show & Conference, Eastern Region, New York Hilton, New York, N.Y.; contact Show World, Inc., 37 West 39th St., New York, N.Y. 10018.

Feb. 5-6, 1970: The 1970 AIIE (American Institute of Industrial Engineers) Systems Engineering Conference, Sheraton-Dayton Hotel, Dayton, Ohio; contact Technical Services Director AIIE, 345 East 47th Street, New York, N.Y. 10017.

Feb. 12-14 1970: First Annual Meeting of the Association of Business Forms Manufacturers, Monteleone Hotel, New Orleans, La.; contact: John W. Randall, President, Association of Business Forms Manufacturers, 4344 East-West Highway, Washington, D.C. 20014.

Feb. 17-19, 1970: Computer Software & Peripherals Show & Conference, Midwest Region, Pick-Congress Hotel, Chicago, Ill.; contact Show World, Inc., 37 West 39th St., New York, N.Y. 10018.

Feb. 18-20, 1970: IEEE International Solid-State Circuits Conference, Sheraton Hotel, Philadelphia, Pa.; contact: Mr. L. D. Wechsler, Program Committee Secretary, General Electric Co., Electronics Park, Bldg. #3, Syracuse, N.Y. 13201

Feb. 23-25, 1970: Data Processing Supplies Association, Winter General Meeting, The Royal Orleans Hotel, New Orleans, La.; contact: Data Processing Supplies Association, 1116 Summer St., P.O. Box 1333, Stamford, Conn. 06904.

March 17-20, 1970: IEEE Management and Economics in the Electronics Industry Symposium, Appleton Tower, University of Edinburgh, Edinburgh, Scotland; contact Conference Secretariat, Institution of Electrical Engineers, Savoy Place, London, W.C.2, England.

March 23-25, 1970: Eighth Annual Symposium on Biomathematics and Computer Science in the Life Sciences, Houston, Tex.; contact: Office of the Dean, The University of Texas Graduate School of Biomedical Sciences at Houston, Division of Continuing Education, P.O. Box 20367, Houston, Tex. 77025.

March 23-25, 1970: INFO-EXPO-70, the Second National Meeting of the Information Industry Association, The Shoreham Hotel, Washington, D.C.; contact: Paul G. Zurkowski, Information Industry Association, 1025 15th St., N.W., Washington, D.C. 20005.

Apr. 2-3, 1970: First National Symposium on Industrial Robots, IIT Research Institute, Chicago, Ill.; contact Mr. Dennis W. Hanify, IIT Research Institute, 10 West 35 St., Chicago, Ill. 60616

Apr. 7-9, 1970: Computer Software & Peripherals Show & Conference, Western Region, Anaheim Convention Center, Los Angeles, Calif.; contact Show World, Inc., 37 West 39th St., New York, N.Y. 10018.

Apr. 13-16, 1970: Computer Graphics International Symposium, Uxbridge, England; contact R. Elliot Green, Cg. 70, Exhibition Organiser, Brunel University, Uxbridge, Middlesex, England

Apr. 14-17, 1970: Conference on Automatic Test Systems (IEEE), Birmingham, Warwickshire, England; contact: Conference Registrar, The Institution of Electronic and Radio Engineers, 8-9, Bedford Square, London, WC1, England.

Apr. 26-28, 1970: Data Processing Supplies Association, Affiliate Membership Meeting, Rome, Italy; contact: Data Processing Supplies Association, 1116 Summer St., P.O. Box 1333, Stamford, Conn. 06904.

Apr. 29-30, 1970: Fifteenth Annual Data Processing Conference, Univ. of Alabama, Engineering Bldg., 1919 Eighth Ave., South, Birmingham, Ala.; contact: C. E. Adams, Coordinator of Conference Activities, Box 2987, University, Ala. 35486.

May 5-7, 1970: Spring Joint Computer Conference, Convention Hall, Atlantic City, N.J.; contact American Federation for Information Processing (AFIPS), 210 Summit Ave., Montvale, N.J. 07645

May 7-8, 1970: Seventh Annual National Information Retrieval Colloquium, Sheraton Hotel, Philadelphia, Pa.; contact: Philip Bagley, Information Engineering, 3401 Market St., Philadelphia, Pa.

May 18-22, 1970: "Image 70," 23rd Annual Photographic Science and Engineering Conference, New York, N.Y., contact: Society of Photographic Scientists and Engineers, 1330 Massachusetts Ave., N.W., Washington, D.C. 20005.

C.a PROBLEM CORNER

Walter Penney, CDP
Problem Editor
Computers and Automation

PROBLEM 701: OH, SAY CAN YOU "C"?

"There's no substitute for documentation," Al remarked, looking at the program sheet on his desk. It read:

```
      A = 2.0
      D = 0.0
 10   C = 0.0
      B = A
 20   C = 1.0/(B + C)
      IF (B.EQ.2.0) GO TO 30
      B = B - 4.0
      GO TO 20
 30   E = ABS(D - C)
      IF (E.LE..00001) GO TO 40
      D = C
      A = A + 4.0
      GO TO 10
 40   PRINT 2,C
  2   FORMAT (F10.5)
      STOP
```

"Where did you get that?" asked Bob.

"It's something I found in Pete's desk. I started cleaning it out after he left last week. But I don't want to throw it out until I know what it is."

"Why don't you just run it and see?"

"I did," Al replied. "All I got was C = .46212. Now what does that tell you?"

What is the C that the program computes?

Solution to Problem 6912: The Value of Overtime

If h = regular hourly rate, A = number of regular hours and B = number of overtime hours, .1 h A + .4 h B = 16.8, .05 h A + .15 h B = 7.8, from which h A = 120, h B = 12. Joe therefore put in ten times as much regular time as overtime.

Readers are invited to submit problems (and their solutions) for publication in this column to: Problem Editor, Computers and Automation, 815 Washington St., Newtonville, Mass. 02160.

c.a

NUMBLES

NUMBER PUZZLES FOR NIMBLE MINDS —AND COMPUTERS

Neil Macdonald
Assistant Editor
Computers and Automation

A "numble" is an arithmetical problem in which: digits have been replaced by capital letters; and there are two messages, one which can be read right away and a second one in the digit cipher. The problem is to solve for the digits.

Each capital letter in the arithmetical problem stands for just one digit 0 to 9. A digit may be represented by more than one letter. The second message, which is expressed in numerical digits, is to be translated (using the same key) into letters so that it may be read; but the spelling uses puns or is otherwise irregular, to discourage cryptanalytic methods of deciphering.

We invite our readers to send us solutions, together with human programs or computer programs which will produce the solutions.

NUMBLE 701

```
      T I M E
    x     I S
    ---------
    E T N R I
  D S G D I
  ---------
= A E M A I I

      31860   95624   9416
```

Solution to Numble 6912

In Numble 6912 in the December issue, the digits 0 through 9 are represented by letters as follows:

Y = 0	A = 5
E = 1	H = 6
S = 2	W = 7
T = 3	R = 8
M = 4	C = 9

The full message is: What smarts, teaches.

Our thanks to the following individuals for submitting their solutions to Numble 6911: Eric Bender, Montreal, Quebec, Canada; A. Sanford Brown, Dallas, Tex.; T. Paul Finn, Indianapolis, Ind.; Richard Jones and Karen Criter, Madison, Wis.; Richard Marsh, Washington, D.C.; Gerry Petersen, St. Petersburg, Fla.; A.O. Varma, New York, N.Y.; Robert R. Weden, Edina, Minn.; and Robert F. Winter, Spring Valley, N.Y. □

THE INVASION OF PRIVACY AND A NATIONAL INFORMATION UTILITY FOR INDIVIDUALS

Richard E. Sprague
Personal Data Services
193 Pine Rd.
Hartsdale, N.Y. 10530

"The strange anomaly of the invasion of privacy situation is that it can only be prevented *by a National Information Utility for Individuals."*

The Controversy:

Between 1965 and 1969 a great deal of controversy has arisen over the invasion of privacy and the possibility that computer technology will create a 1984 Orwellian-style world. Fears began to develop that machines would take over and that individual privacy and freedom would decrease. These fears were expressed with great verve by many organizations and individual citizens, especially the younger generations.

Some fears *are* justified. Congressional committees really are concerned about the invasion of privacy of individuals which might occur or be made easier by the creation of "National Data Centers" covering all people. Congressman Gallagher of New Jersey, Senator Ed Long of Missouri, and Vance Packard in various publications expressed major concerns over the possibility that Orwell's 1984 was creeping up on the American public.

By 1967, Senator Long's Administrative Practice and Procedure subcommittee had held a series of hearings on the subject of Computer Privacy.[1] Several prominent scientists testified before the subcommittee.

In June 1969, an article surveying the subject listed 69 other articles and books on the invasion of privacy and computers.[2] One of these articles recommended a computer bill of rights which would help to guarantee privacy in computer-based data files.

A national credit information utility which began to take shape in 1966, which eventually could lead to the checkless-cashless society, was feared would invade the financial privacy of every citizen.

The True Situation

The strange anomaly of the invasion of privacy situation is that *it can only be prevented by a "National Information Utility for Individuals."*

[1]Computer Privacy — Hearings before the Subcommittee on Administrative Practice and Procedure of the Committee on the Judiciary, United States Senate, Ninetieth Congress, First Session, March 14 and 15, 1967; U. S. Government Printing Office.

[2]"Computers and Privacy: A Survey," Lance J. Hoffman, **Computing Surveys,** a journal of the Association for Computing Machinery, June 1969.

What most people, including Vance Packard and Congressmen Gallagher and Long, did not know until recently was that their own privacy was, and still is, being invaded every day in countless ways. None of the 71 references given stressed non-computer based invasions at all. If they had the intestinal courage required, credit managers and credit bureau operators could have told Mr. Gallagher the truth about what goes on all the the time. So could the FBI, state and local police, private detectives and many lawyers, not to mention wire tapping and bugging experts and the telephone company.

The trouble is that all of the invasion of privacy which has been occurring for years is secret, or supposedly secret. The only people not "in on the secret" are Mr. and Mrs. Average Citizen.

In 1969 William Proxmire of Wisconsin and others began to make public some of the truth about the situation, through a series of hearings in which witnesses described what can happen to an individual because of poor regulation and methods in credit bureaus. Legislation was introduced to change the laws to protect citizens. However, these are only first steps, because the invasions of our privacy go far beyond just the retail credit bureau, or the inaccuracies of the information in our files. Let's first take a look at what goes on inside a bureau.

Happenings in a Credit Bureau

A visit to any retail credit, bank credit or legal information bureau on any day of the week can be most revealing (providing the manager doesn't know about the visit). First of all, information in *your* file contains every negative thing that ever happened to you, going back to the beginning of your credit life. The data is seldom updated, corrected, or weeded out. It includes not just credit data, such as failures to make installment payments on time, but also any legal actions taken against you, divorce or offspring problem reports, newspaper clippings, private detective investigations, FBI or police reports including interviews with gossipy biased neighbors, etc.

There are very bad things about this invasion of privacy. First and foremost, ***you*** don't even know the file exists, much less know what is in it. Second, even if you did know it existed you would not be permitted to look at it unless you happen to be a credit bureau subscriber. Then, you can buy a report about yourself, or anyone else for that matter, for about $1.50. It summarizes the information in the file in a simple good-bad-average type of credit code. What did the summarizing? Not an unbiased impersonal computer. Oh, no! It was a human being in the local credit bureau, or in the bureau covering you in the community from which you just moved. He is personal and biased. He is bound to be.

You can have the entire file on yourself for somewhat more money. But the third bad thing is that ***you*** couldn't do anything about changing the contents of your own file even if you could get a look at it. You see, it doesn't belong to you, it belongs to the credit bureau.

Negative Data

The fourth bad thing is that the information in your file is old, inaccurate, obsolete and incomplete with no interpretation or explanations. You are as bad now as you ever were at your worst. The whole point here is that by their very nature, the credit and legal information bureau businesses are interested mainly in negative data. Nothing good or positive ever comes through or finds its way into your file, and if it does it is overwhelmed by negative information.

What's that you say? I've never done anything wrong and I've always paid my bills on time. O.K., good for you, if it is true. But is it? What about that time around twelve years ago when you switched jobs, and had to hold up on the refrigerator payment for a month or two? And what about that little argument you had with the real estate agent over a property line which you won, but resulted in a threatened lawsuit. Both will be in your record even if they didn't make the papers, and the record won't show why you were late or that you won the argument without going to court.

The fifth bad thing about this invasion of privacy is that any subscriber or legal agency can look at your record, and ***you don't know it.*** Who are the subscribers to the credit bureau? Practically everyone but you. They include all other credit bureaus for bankers, retailers, insurance companies, credit card companies, plus ***any*** organization to which you might apply for credit.

Worse yet, during that secret visit to the bureau, you might see FBI agents, Secret Service agents, CIA agents, state policemen, city detectives, and maybe a private eye or two all looking at records. Some of them spend a lot of time there, and any one of them could be examining your inaccurate, obsolete record without your knowledge. For what purpose? Perhaps a check on security clearance, perhaps as a result of a false tip someone gave out, or perhaps because your wife or boss paid a detective to do some checking.

Other Invasions

The retail credit bureaus, the bank credit bureaus, and the legal information bureaus are only the beginning. There are files on you which you don't know about, can't look at and don't know how inaccurate or obsolete they are, all over the Unived States. Here are some examples: FBI headquarters, CIA headquarters, Social Security Department, Internal Revenue Service, your insurance company, motor vehicle bureau, your credit card companies, individual retailers and banks, Department of Labor, hospitals, trade associations, professional societies, Veterans Administration, Blue Cross . . . . The list goes on and on.

Some of these files are in better shape than the credit bureau. Some have a lot less information in them. It is unlikely that any two of them will agree on any collection of data about you. Their uses are multifarious. Take, for example, the FBI files on you. If you've ever been fingerprinted, and who hasn't, you're in the FBI files. You're also possibly in certain state police files.

All of this has been going on for years. It constitutes invasion of privacy to the nth degree, and none of what has been said so far involves computers. In fact, the introduction of computers helps clean things up a bit, or at least reduces the total amount of data about you. Machine storage just isn't conducive to holding a newspaper clipping or a photograph or a gossipy report about you.

The National Information Utility for Individuals

How will a national information utility help solve the problem? With a single national record storage capability coupled with new laws, invasion of privacy can be ended. Here is how it can be done. Laws would be passed with the following provisions:

1. There will be one, and only one, legal record on each individual citizen from birth.
2. The citizen or his legal guardians will have the right to examine the record at any time. Periodically, the citizen will be informed of changes made in the record.
3. The citizen will have the right to change (delete, correct, update, add) his own record at any time by legally constituted means, to be defined by law.
4. The citizen will be informed, either periodically or upon occurrence, whenever any person or organization examines his record and will be told the name and purpose of the examiner.
5. All other records pertaining to the citizen will be declared illegal and null and void.
6. Access to each citizen's record will be granted according to an application procedure similar to those in existence in credit bureaus and other recordskeeping organizations.

Physically, the records need not all be in the same place. The most natural information utility (I.U.) network will be one in which there are regional centers and the citizen's record is stored in the region of his legal residence. It would move whenever he moves. A communications network interconnecting all centers would provide for inquiries between regions.

A large majority of the inquiries into records and changes in them will remain within the region. There could still be other records on the individual, and no doubt will be, but they would not be legal records and would have limited use.

The development of the national credit system and the checkless society almost demands that such a national citizens' I.U. be established. Identity probably should and could be established uniquely by always using either the Social Security or Birth number. If the current USASI efforts to establish a national identity standard for individuals are successful, that part of the technological problem will be solved. From the point of view of computer equipment and software as well as from the point of view of data communications, the technology is here today to construct such a utility.

This entire concept will, of course, be very unpopular with habitual criminals. It will also be very unpopular with the FBI, CIA, state and local police and Secret Service, who would all prefer that their examinations of records be kept secret. Yet, unless the public demands it, Big Brother will ***continue*** to watch you. ☐

Note: This article is excerpted, in part, from the book **Information Utilities,** Richard E. Sprague, Prentice Hall, October 1969

A Case History:

THE MANAGEMENT INFORMATION SYSTEM OF THE HAMBROS BANK OF LONDON

Ted Schoeters
9 Golf Close
Stanmore, Middlesex, England

"The expertise of top management must not be cluttered with anything that can be done equally well and far faster by a machine."

"We have been very fortunate in every way, but the most important factor in our favour has been the backing given to us by the highest levels of our bank's management. Jocelyn Hambro has never tied any strings to our decisions, nor to the way in which we carried them out."

In a nutshell, this describes the background to the successful four-year development by Hambros Bank of London of a computer service in many respects more advanced than those set up or being established by the big UK clearing banks, or its fellow merchant banks.

Two men: Peter Barnes, the computer operations head and Patrick Brenan, the chief accountant, have been closest to the job of turning hallowed practices, whose traditions go back many years, into modern methods. These will meet the pressures of staff shortages, accommodation problems and the need to meet constantly mounting competition from old-established rivals and the many "new boys" from the United States. They have nurtured the company's computer operation from its inception in 1961-2 when Monrobot machines were first employed.

Now they have two medium-sized computers working together, and have established forward plans for Hambros until well into the 1970's on the basis of decentralisation, using a future computer system as a live data bank and communications network to all sectors of the Hambros empire.

A Changing Objective

"We think we have a solid achievement here" says Pat Brenan. "We had a considerable throughput of transactions at the time when we first began to computerise in 1964 and we were handling 5,000 operations a day—stock purchases, sales, options and the like. By the time we had done it, the number of separate movements had increased to 10,000 a day.

"The objective was therefore changing as we worked. Now we are having to prepare to meet the demands of handling 15,000 transactions a day."

He shuddered to think of what would have happened in the company's main sterling banking operations if the computer had not come up to scratch. "We went through hell on the foreign currency side because we left the operation about a year too late."

Identical Twins

Peter Barnes seems particularly pleased with his dual installation in which an ICL 1903 and 1902A function side by side as if they were identical twins. Switching procedures have been developed so that in case of any equipment or program trouble the operations staff can always have a "minimum configuration" at their disposal.

"We had to consider quite recently whether to meet our rapidly growing work load by moving on to a much bigger machine or by off-loading on to equipment of a size we already knew we could handle. We think we have chosen well, and that it was the cheapest and best solution, looking at our next step in automation," says Peter Barnes.

He obviously thinks that the big clearing banks still have a lot of real computing to learn about. Some 85 per cent of their data processing load is the single job of clearing cheques. Naturally it was the most urgent problem since the daily average is now rising towards the 3m mark with increasingly frequent peaks of about 6m. This demands a huge retinue of magnetic character reader/sorters operating under computer control—but this is hardly "real computing"

Ted Schoeters is a corresponding editor for **The Financial Times** in London. In addition, he writes "Report from Great Britain", a regular monthly feature in **Computers and Automation.**

Even at a later stage, when big optical character readers go in to handle counter credits, direct debiting, and the like, the work will be a simple collection of like data followed by transmission to a central computer and comparatively little processing.

The Origin of Merchant Banks

Merchant bank procedures are very different and the differences are inherent in their origins. They were intermediaries smoothing the flow of trade when bulky coin was the monetary standard and transport was by horse or sailing ship. The families acting as intermediaries guaranteed that the seller would be paid and that the buyer would receive the goods he wanted by "accepting" the bill of exchange on their own behalf. This is the origin of the term "Accepting Houses", and today sixteen organisations in London belong to the Accepting Houses Committee which represents the true merchant banks.

Of course, their activities now go far beyond the narrow definition laid down several centuries ago. Every bank in this area offers financial services of many types to meet the diverse needs of international finance. New types of services are being developed and a merchant bank has to be prepared to operate anywhere, Hambros is particularly well-known in Scandinavia and on the Continent, but also increasingly in the United States.

The Management Experts

Before World War II senior partners were the repository of all the knowledge of men and affairs which meant the difference between accepting obligations from trustworthy clients, or becoming involved in a fiasco. The pace has speeded up. It is no longer possible to operate in this way when the opposition is making use of every modern technique. The expertise of top management must not be cluttered with anything that can be done equally well and far faster by a machine.

The actual volumes of information handled are comparatively low. But facts and figures derived from the bank's transactions must be readily available since management decisions have to be based on them. Inevitably the first area to be tackled in computerising the bank's work was bookkeeping. Hambros is a special case in that so much more direct banking—cash, deposit, overdraft and commercial accounts—is undertaken than in the other London merchant banks. Almost all the services offered to customers involve some form of banking transaction.

Advice to the Client

The sterling banking area is the one in which most movement takes place. Added to this is standard Hambros banking practice of advising customers of every transaction on their behalf through confirmatory notes. Moreover, interest reflecting individual arrangements in various transactions is levied. Thus each movement in an account brings in its wake a number of linked calculations and document print-outs.

The starting point of the data processing operation is the advice to the client. NCR accounting machines with a paper tape by-product are the data originators, capturing on the tape the essentials of each transaction. The day's operations are processed in time for statements to be ready at the counter or for posting, by the time the bank opens for business on the following morning. In practice, the tapes are rectified as they are completed and already by 5 p.m. most of the checking and balancing work in this category will have been dealt with.

Posting of Interest

A heavy burden comes with the periodical posting of interest to accounts. This is a complex operation. Allowance is made for forward and backward value dates and stepped interest rates. A complete history of balances is maintained and from all this full statements showing balance, number of days and rates of interest are printed for each customer every three months.

At the computer end, the transaction data is combined with information on magnetic tape from other operations to provide the basis for accounting and statement production. But at the same time there are daily, weekly, monthly and immediate scans of the accounts sector to produce analyses, for the Hambros management and Bank of England returns.

Records of transactions and statements are maintained on microfilm at a single central point.

Foreign Exchange Transactions

The foregoing does not differ essentially from what is being carried out by other merchant banks—except that some appear to have run into difficulties. But in the second major operating area to be computerised, that is foreign exchange transactions, Peter Barnes thinks his teams have made "something of a breakthrough".

He says this is one of the most complicated operations the bank engages in. Large sums in sterling, dollars and Eurocurrencies are handled all the time in deposit and loan work, and every one on a fine interest differential.

Up-to-date information for the dealers and day-to-day guidance were considered vital when the system was being designed, and it was decided to tackle the jobs in the only way which would yield a complete solution, that is, as a whole. The result is, according to Peter Barnes "a more rudimentary concept of the whole exchange dealing problem, perhaps, but the only one to give each dealer his exact position every morning of each dealing day in the major currencies and up to two years ahead.

"Maybe Skandinaviska Banken is more sophisticated in the way it manipulates spot data, but it does not give the guidance we are providing."

The operation has been streamlined and, again, since every transaction is advised to each customer, a data basis is established at the outset. These advices are produced on desk-top RUF mini-computers. A by-product is a tape for the main ICL machines which carry out the corresponding accounting entries, post currency statements, and calculate interest.

Each dealer is provided with "ladders" to show current and forward positions up to 24 months ahead as at the close of business on the preceding night. This means that everyone has ample opportunity to make a complete review of his position before dealing begins in the morning. As these ladders are being prepared, the program will extract information for Hambros management and the details required by the Bank of England.

Investment Management

A third sector, investment management, has been given computer aid. Here, even more than in currency work, the human skill of knowing the stock market and assessing the effects of national and world events is paramount. But there are many operations that can be and are being transferred to computer control, though the biggest job (putting all stock records on to tape) still has to be done.

The crux of the problem is to reconcile the Bank's holdings in a particular stock with holdings of this stock by individual customers. Ledgers have been kept manually to date.

Hambros entered the Unit Trust field in 1966 and, from the outset, decided to have an all-computer system. Total funds managed by the bank now exceed £195m and it is doubtful whether a clerical system could have expanded so fast, according to Peter Barnes.

Mini-computers capture the primary information on a type of funds and amounts (with identification of the buyer), verify them, and then produce a paper tape for central accounting—unless the purchase is being made by or for a new holder. In this case details remain on a pending file till payment and registration details have been received.

Company Registrar services cover daily registration of share transfers, payment of dividends, notification of meetings, and circulation of annual reports and accounts. With the maintenance of the Unit Trust ledgers, this operation now demands between 30 and 40 per cent of computer operating time.

Payroll is the last sector of operation, and the bank is using an ICL package to serve a staff which has risen to over 1100 from 700 in four years.

Customers' Data Bank

The current major task is examination of every program in time for decimalisation in February 1971. It is not a difficult operation but it does demand minute attention to detail, and will involve as many expert man-hours as transferring a complete large department to computer operating. Together with this, the computer team is developing a big data bank containing all details of all the work done for any one customer.

This data bank has been preceded by a manual pilot scheme intended to show just what details were required and how they could be set up in a form from which information could readily be punched for the computer. The initial system is being written for magnetic tape, though random access is the more logical procedure. The aim is a 24-hour turn-around, and in practice it is expected that not more than a handful of queries will need a faster response. Part of this system will include a progress file to hold various possible new activities between Hambros and existing or potential customers.

The institution of the customers' data bank mentioned above is a sign of the way the bank computer team is thinking. It aims to have an on-line constantly up-dated central computer service by 1972-73; it is working with consultants to determine how best to decentralise; and it has already decided that the system will have to support many terminals throughout the Hambros operation.

Peter Barnes would like to run a pilot scheme "because we can see a mass of new applications as we progress." The Hambros operations research department is forging ahead with modelling techniques applied to companies in which the bank has or may have an interest, to predict their future growth.

Small simulation models of each bank department are also being established and as the plan now stands, a decision on the next generation of machines could be taken in about one year. It is likely that the equipment will be delivered and operation of the on-line system will take place before the bank is decentralised. This will be no problem for an on-line system though it could be one for the G.P.O.

Early in the 1970's, the largest of the British merchant banks aims to have an on-line computing system as the main support of each one of its many financial, monetary and investment operations. If all goes well—and everything is being done to ensure that it will—the system could be a model, not only for City companies, but also for many firms considering the use of data banks as part of a management information system. □

Who's Who in Computers and Data Processing

Who's Who in Computers and Data Processing will be published jointly (as an annual publication) by The New York Times Book and Educational Division and Computers and Automation. The fifth edition is scheduled to be published in three volumes in hard cover in early 1970, and will include upwards of 8000 capsule biographies.

Who's Who in Computers and Data Processing is to be typeset by computer. As a result, it should be possible to include new entries (and to modify previous entries) CONTINUOUSLY -- especially since Who's Who will be published periodically.

Consequently, if you have not yet sent us your up-to-date filled-in Who's Who entry form, PLEASE SEND IT TO US QUICKLY -- the chance is good that your entry can be promptly included. Use the entry form below, or a copy of it.

WHO'S WHO ENTRY FORM
(may be copied on any piece of paper)

1. Name? (Please print)__________
2. Home Address (with Zip)?__________
3. Organization?__________
4. Its Address (with Zip)?__________
5. Your Title?__________
6. Your Main Interest?

Applications	( )	Mathematics	( )
Business	( )	Programming	( )
Construction	( )	Sales	( )
Design	( )	Systems	( )
Logic	( )	Other	( )
Management	( )	(Please specify)	

7. Year of Birth?__________
8. Education and Degrees?__________
9. Year Entered Computer Field?__________
10. Your Present Occupation?__________
11. Publications, Honors, Memberships, and other Distinctions?__________

(attach paper if needed)

12. Do you have access to a computer? ( )Yes ( )No
    a. If yes, what kind of computer?
    Manufacturer?__________
    Model?__________
    b. Where is it installed:
    Manufacturer?__________
    Address?__________
    c. Is your access: Batch? ( ) Time-Shared? ( )
    Other? ( ) Please explain:__________
    d. Any remarks?__________
13. In which volume or volumes of Who's Who do you think you should be included?
    Vol 1. Systems Analysts and Programmers
    Vol 2. Data Processing Managers and Directors
    Vol 3. Other Computer Professionals
14. Associates or friends who should be sent Who's Who entry forms?
    Name and Address

(attach paper if needed)

When completed, please send to:

Who's Who Editor, Computers and Automation,
815 Washington St., Newtonville, Mass. 02160

REPORT FROM GREAT BRITAIN

Computer Problems

The most significant news from the American EDP industry's viewpoint this last month is that, at long last, Europe is officially stirring itself to look at its computer problems.

The Aigrain Committee is a sort of technology guide to the European Economic Community's Council of Ministers. This Committee has singled out a number of areas in which European countries should collaborate more closely. But more than that, a formal proposal has been put to Britain to engage in this collaborative activity, even though this country still is not a Common Market member and may not become one for another two years (even if discussions go smoothly—as they are most unlikely to).

The Committee's list of projects is impressive, stretching as it does from oceanography to telecommunications. But within that list, fortunately, there are specific and quite well-defined proposals which have been put forward officially by Aigrain.

The Giant Looms Again

Those concerned with data processing are the ones which most involve us and the prime one is for the giant European computer which we had come to mourn two years ago. Now, like the Phoenix, it is revived and because of events in Britain which paralleled Aigrain it is likely to stay so.

The other EDP proposals take in European networks, a joint program library, and the setting up of an Institute for Information Science and Technology.

Discussions between civil servants are expected to start some time in the spring of 1970; and how long it will take for any results to percolate to industry is anyone's guess. However, International Computers, Britain's major company, killed its big machine project earlier this year for no acceptable commercial reason. In fact, none was given and the press statement was terse enough to have been written by IBM when it killed off the 90 Series.

But behind-the-scenes reaction at ICL was that the machine they had stopped developing would not have had acceptance from all potential European partners. The new equipment would have been, and in plain fact was, the "European giant."

Now, the question of just how potential European partners with a multiplicity of basic design philosophies will react to a European giant computer is fascinating to contemplate. Siemens in Germany is building strongly RCA-flavoured machines, largely IBM-compatible. Philips in Holland is plodding dourly on with its P.1000 series which are also IBM-inspired. C.I.I., France's Plan Calcul bastion, is struggling with its SDS (now Xerox Data Systems) licenses and has produced some interesting variants, but pitifully few sales. This company too is aiming at IBM-compatibility. There remain Italy's Olivetti, which is determined to make peripheral equipment, and Telefunken, which has been told by the West German Government to go and think about very big machines, as the Siemens range stops at the equivalent of a big 360/50.

The design team which develops a range of very large units to take over smoothly from *that* array—plus Britain's 1900 and System-4 series—would have to be composed of magicians; and it seems quite clear that some form of majority rule will be required.

The Aigrain Survey

That Aigrain is taking things seriously is borne out by the fact that it has commissioned a large Turin consultancy, SORIS, to go round Europe and carry out a major study.

The survey teams are operating in European Economic Community Countries – France, Germany, Italy, Holland, Belgium and Luxembourg – and in Britain. Their objective has been defined as "to determine the trends in high-performance data processing systems, both from a qualitative and a quantitative viewpoint, for the 1970's. Particular attention is to be paid to the years 1975-1980 during which a European-made large-scale system could be realised.

"This survey is an initial approach towards an analysis of the European Market for high-performance processing systems and it requires that qualitative trends of the market be analysed and then verified by means of vaster and more precise analyses," it is said.

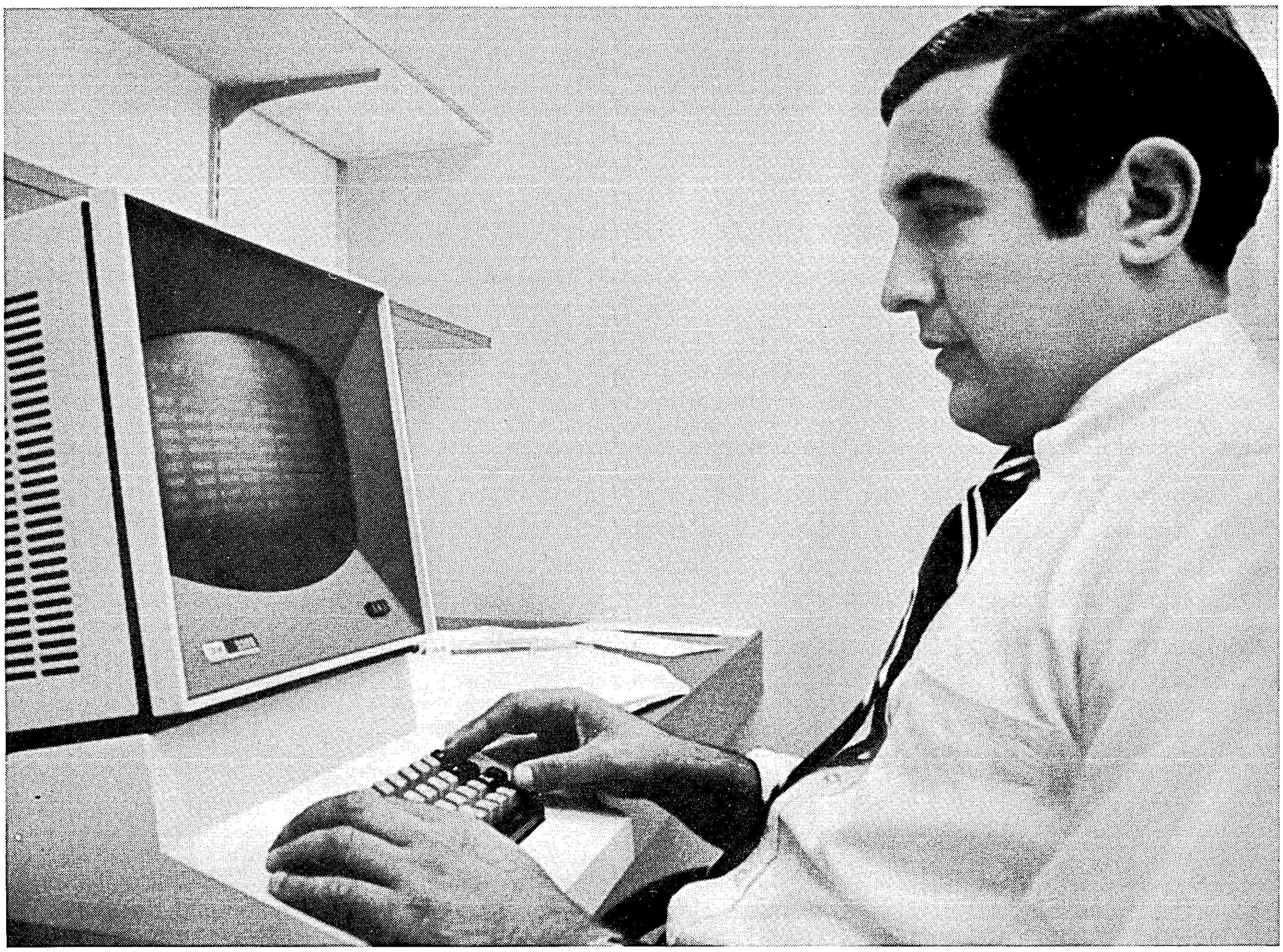
Alternatively, ICL could get on with a design that will meet most people's requirements. But money is the snag. As we all know and all computer companies have found out, with the notable exception of Control Data Corp, the quickest way to burn money is to build a giant computer. If ICL can get a venture funded by seven European Governments, then it should.

"Love Honeywell Month"

This has certainly been "Love Honeywell Month" in Britain and, one gathers, in the United States as well. The most recent event at the time of writing was the award of a contract and a letter of intent from Britain's biggest mail order house—Littlewoods—worth \$9.7m. Interestingly, it represents the first large-scale combined use of Honeywell's data processing equipment with the small, fast controllers from the DDP range. These are interposed between Cossor (Raytheon) displays and the main machines as communications controllers for the input of hundreds and thousands of agents' orders weekly.

The big order had been preceded by the disclosure that Honeywell had placed a large number—well over \$1m worth—of its "16" series with the British atomic research

(Please turn to page 58)



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JOBS AND CAREERS IN DATA PROCESSING

The Status of Women in the Field of Computing

Gerald H. F. Gardner, Senior Scientist
Gulf Research and Development Co.
726 St. James Street
Pittsburgh, Pa. 15232

The phenomenal expansion of the computing industry in the last 20 years has created literally hundreds of thousands of new jobs: Computer Operator, Key Punch Operator, Programmer, and Systems Analyst are just a few of the new job titles. IBM Corp. alone employs almost 50,000 programmers; next year, it has been estimated that there will be 500,000 programming jobs in the U.S.A.

Relative to the established professions such as medicine and the law, computing offers women opportunities that are quite good. This is not surprising. One expects more recent developments to be more liberal. However, discrimination on the basis of sex in advertising and recruiting is just as pronounced in the computer field as in any other.

Discrimination in Advertising

To collect some facts on the extent of the discrimination in advertising of job opportunities, I started with the recent survey of what are called "White Collar Office Jobs". This survey was published in July in the magazine ***Nation's Business.*** The survey presented the average weekly salary for 13 stenographic jobs and 7 data processing jobs. I rearranged these jobs in order of decreasing salary (see Table I), with the data processing jobs shown in italics. It can be seen that the Programmer and Systems Analyst command the highest salaries, although the other data processing jobs are not outstanding.

I then took a single issue of the only Pittsburgh Sunday newspaper (the ***Pittsburgh Press*** July 20, 1969) and searched it for advertisements for all these jobs. The result was very remarkable and is easily described. In Table I, all the jobs below Computer Operator were advertised only in the Female Help Wanted section, all the jobs above Secretary—A were advertised only in the Male Help Wanted section. There was no overlap.

To prove the unequivocal segregation of these jobs, I tallied all the advertisements that related to the field of computation and that mentioned salaries, as they actually appeared in the paper that Sunday (see Table II). These are all the jobs that I think a person with some ability in mathematics might consider. Since this is intended to show the existing pattern, monthly, weekly, and hourly offers were converted to annual salaries. Each figure mentioned in any ad was treated as a salary offer. Thus, "to $5000" was counted once as a job offer at $5000, "$350" was counted as a job offer at $4200, and "7K to 11K" was counted as one offer at $7000 and another at $11,000. Taking the midpoint of the range would have decreased the overlap at the lower end of salary scale with jobs offered to females.

Table I

Survey of White Collar Jobs From *NATION'S BUSINESS**

Data Processing Jobs and Stenographic Jobs	Average Weekly Salary in 1969: Canada	Average Weekly Salary in 1969: U.S.	Classification of Ads by Sex
*Systems Analyst***	$156	$196	Male
Programmer--A	155	184	Male
Programmer--B	130	154	Male
Secretary--a	107	129	Female
Computer Operator	109	123	Male
Accounting Clerk--a	110	122	Female
*Tabulating Machine Operator***	91	113	Female
Secretary--b	92	111	Female
General Clerk--a	97	105	Female
Stenographer--a	86	104	Female
Offset Duplicating Machine Operator	77	102	Female
Key Punch Operator--A	83	99	Female
Accounting Clerk--b	80	98	Female
Telephone Switchboard Operator	73	94	Female
Bookkeeping Machine Operator	74	92	Female
Stenographer--b	72	92	Female
Key Punch Operator--B	73	90	Female
General Clerk--b	68	88	Female
Typist--Clerk	68	86	Female
Mail Clerk-File Clerk	61	79	Female

*Jobs in data processing are printed in italics.

**Intermediate level.

Gerald H. F. Gardner is a mathematician working as a Senior Scientist for Gulf Research and Development Company. He is also the Chairman of the Advertising Practices Committee of the Pittsburgh Chapter of the National Organization for Women. This article is based on testimony he presented at hearings of the Office of Federal Contract Compliance in August, 1969.

Taking the lower end of the range would have slanted the salaries toward those offered any woman who dares to apply for a job listed in Male Help Wanted. There you are, Table II shows the opportunity for female data processing personnel as reflected in one metropolitan Pittsburgh newspaper on a given typical day. There is no tally of data-processing job offers under Male/Female Help Wanted; there were none.

I asked the editor of the newspaper what he would do if he were a female looking for a job. He said that he would first scan the Female Help Wanted columns and then the Male/Female Help Wanted columns. The whole point of having the ads divided into three sections, according to the editor, is that it is a convenience for the reader. Females are saved the trouble of looking through all those jobs primarily of interest to men. Now I ask you to imagine that you are a female with interest and ability in mathematics. Look at Table II and see what salary you can expect to be offered if you follow that editor's advice and do not consult the Male Help Wanted columns. If you do, what then is the point of the segregation?

Table II

Opportunities for Female Data Processing Personnel as Listed in the Help Wanted Section of the *Pittsburgh Press*, Sunday, July 20, 1969

$/year	Number of Jobs Advertised at Indicated Wages: Females Wanted	Number of Jobs Advertised at Indicated Wages: Males Wanted
<3,999	1	0
4,000 to 4,999	11	0
5,000 to 5,999	1	1
6,000 to 6,999	5	37
7,000 to 7,999	1	7
8,000 to 8,999	0	3
9,000 to 9,999	0	13
10,000 to 10,999	0	5
11,000 to 11,999	0	3
12,000 to 12,999	0	5
13,000 to 13,999	0	3
>14,000	0	9

The Effects of Segregated Ads

One consequence of segregated ads and discrimination because of sex in employment is that females are not attracted to careers as programmers, systems analysts, or mathematicians. College counselors do not recommend mathematical courses to female college students, and high school counselors have been known to encourage girls to hide a natural talent in mathematics if it starts to shine. As a result, the nation is deprived of almost half its resource in mathematical talent. The programming ability of every industry is less than it would be if able women were actively recruited.

If the present trends continue in the data processing field, "traditional" qualification for the jobs will be established. Females will be key punch operators, males will be programmers. This, if it occurs, will be senseless and tragic. Would you advise a young girl who has a natural ability with numbers to develop it if the only job "primarily of interest to women," as the newspapers put it, is that of key punch operator?

Proposed Remedies

What can be done? First, "Male" and "Female" segregation of job advertisements should be ended. Employers, who pay for the advertisements, could and should insist on this. Let jobs be classified according to the nature of the work; just as the Yellow Pages are arranged in a logical manner that has nothing to do with the sex of the reader.

A second step is to recruit at women's colleges. Almost every women's college teaches mathematics and computer science, and there are job candidates with ability to be found by going there. Steel mills, air lines, merchandising companies, hospitals, transportation companies; all either have computers and must program them or purchase the equivalent service. Hence, all these companies require talents and abilities that are possessed by graduates of women's colleges; there is no reason for recruiting trips to such colleges to be fruitless.

A third step would be to seriously consider the female applicants interviewed by the recruiter, whether at an engineering school or at a women's college. Engineering schools will discourage female students as long as they cannot be placed on the job market. Educating students who cannot find jobs lowers the job placement score of the school and creates problems for the placement bureau. Many women of competence in various fields only gained their opportunities by accepting jobs for which they were seriously over-qualified. Advancement from file clerk to systems analyst takes a little longer, but is possible. It is also expensive for the employer who could have had a competent systems analyst in the first place. ☐

REPORT FROM GREAT BRITAIN

(Continued from page 55)

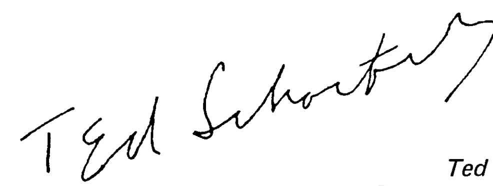
centres, previously users of Digital Equipment Corporation machines almost to a man. Perhaps Honeywell will not feel so badly about Government sector contracts in the future, since it now appears to have been treated as if it were a really British company.

Reducing Equipment Imports

Another event of broad significance in official quarters and under hot debate at the moment was the rather ambiguous pronouncement that Britain's electronic and engineering companies should not concentrate so hard on import substitution. Rather they should push equipment on which they know they can beat overseas competition and drop lost causes.

The pronouncement came after a meeting of the National Economic Development Council under Premier Harold Wilson which reviewed both areas from a lofty altitude.

But it appears to me that certain areas still are singled out as vital for a modern economy, and one of these is, as it must be, computing. The aim still is, both in industry and Government, to reduce computer equipment imports into Britain and a big drive is on the way. It will be aimed specifically at peripherals, imports of which have been growing at a fantastic pace—upsetting the trade balance for the whole of the electronic capital goods industry.



Ted Schoeters
Stanmore, Middlesex
England

ACROSS THE EDITOR'S DESK

Computing and Data Processing Newsletter

Table of Contents

APPLICATIONS

DIGITAL COMPUTER TESTS FOR POSSIBLE INTERNAL GUIDANCE SYSTEM IN FISH

The Institute of Life and Science of Texas A&M University has been using Digital Equipment Corporation's PDP-8/S for testing the possibility of an internal guidance system in common household goldfish. Such a discovery could help unravel many of the mysteries associated with animal navigation. The evidence for such a system is demonstrated by the efficient capability of the fish in compensating left- and right-hand turns, and in maintaining an approximately straight course of progression without directional cues from their environment.

In a tank 16' by 16', the fishes' movements were monitored by a series of photoconductor cells interfaced to the PDP-8/S. When the goldfish shaded one of the 2,000 rays of light generated by the photoconductor cells, the cell's location was noted by the computer. The frequency and angles of turns, sequential relationships, and the lengths of intervening straight movements were monitored. The PDP-8/S also was used to calculate the values of the velocity of locomotion and the orientation of the goldfish to their environment.

Additional experimentation will be conducted to determine whether the guidance phenomena could be maintained indefinitely or would be limited by the time or distance traveled by fish, and whether or not the phenomena exists in other species of fish.

COMPUTER POISON CONTROL CENTER OPENED BY CHILDREN'S MERCY HOSPITAL

A fully-computerized poison control center, designed to help save children's lives by quickly identifying poisons they swallow, has been opened by The Children's Mercy Hospital, Kansas City, Mo. The system uses the hospital's Honeywell Model 200 computer linked to its emergency room by teletype. Inquiries to the poison control file are handled without interruption of the computer's regular data processing jobs.

The Honeywell computer stores information on drugs, household products and chemicals that children may find and swallow. The computer is programmed to accept an inquiry -- for example, the name of a household cleaning product — and to return to the teletype within four seconds detailed information on the poison, including symptoms and suggested treatment. The system, used as a retrieval device, does not replace clinical judgment, but does save valuable time in locating the requested poison, Dr. Ned W. Smull, director of the hospital, explained.

Data for the system is stored on a disk pack. A storage design, called SWIFT, reduces the amount of data stored on a disk by about 90 per cent. The design allows listing of poison attributes only once, under a "document" format, rather than separately under each poison.

The Children's Mercy Hospital, established in 1897, is a non-sectarian, independent hospital. Most of its services are on a free-care basis. Funds for the new poison control center came from the Children's Bureau of the U.S. Department of Health, Education and Welfare.

ANTARCTIC MYSTERIES BEING PROBED BY SCIENTISTS WITH HELP OF SEAGOING COMPUTER

The U.S. Naval Ship Eltanin is nearing the end of a 70-day, 6000-mile cruise dedicated to scientific research. In probing the Antarctic, scientists are trying to find answers to such questions as: How was the earth formed? Were the continents once one huge land mass? What is the effect of cold ocean currents on world weather? What is the potential for commercial fishing in southern oceans? The ship has laboratories set apart for biology, hydrology (the study of bodies of water), meteorology, physics and cosmic ray studies, as well as a photographic darkroom and workshops for maintenance of equipment.

As the Eltanin systematically charts the Antarctic waters, an IBM 1130 computer refines data from measurements of water temperatures at various depths, salinity, currents, and wave motions. A continuous profile of the ocean bottom's mountains and valleys also is being compiled. Additionally, the computer helps speed processing of data from navigational satellites, since exact positioning of the ship is important for scientific research.

The Eltanin has dredged up fossil remains of animals known to be of African origin, and while amphibious, they were not swimmers. This suggests that the two continents once were joined. As to its potential as a fishing ground, the researchers are studying specimens of the Antarctic's marine life. To date (except for whalers) the area is largely ignored by fishermen because of its remoteness.

The Eltanin's research is sponsored by the National Science Foundation's Office of Antarctic Programs. The ship is manned by a civilian crew and carries a complement of 38 scientists representing research and educational institutions of a number of countries. The U.S. Naval Ship Eltanin is the only full-time research vessel in the area.

KODAK'S DIGITALLY CONTROLLED TV CORRECTS IMAGE SMEAR

Methods already available for restoring badly blurred photos have, in the past, assumed that all elements of the picture were blurred in exactly the same way. It is now known that this seldom is the case. Look carefully at a blurred picture and notice that the amounts of smear differ for the background, foreground and subject. Based on this knowledge, Kodak has developed a computer technique for restoration that depends on applying different corrections to the differently blurred areas within the picture.

A television camera first scans the blurred photo, and the output is converted for compatibility with a digital computer. The computer processes the picture data and feeds back appropriate signals to correct for image smear in various areas. To obtain the final restoration, the corrected data is fed into a digitally-controlled TV and the results are photographed on the face of its cathode ray tube.

COMPUTER AIDS ASTRONOMICAL RESEARCH AT ARIZONA'S LOWELL OBSERVATORY

The Lowell Observatory in Flagstaff, Arizona, is using an IBM 1130 computing system to help analyze data on "double stars" which are paired celestial bodies revolving about their center of mass — millions of light-years away. Information gathered from seven specialized telescopes is electronically coded onto paper tape and sent to the 1130 in the Planetary Research Center. The desk-sized IBM system reduces seemingly unrelated numbers to tangible results.

Because of their extreme distance, even the largest telescopes normally can't separate the stars within five seconds (1/720th degree) of one another well enough to permit accurate determination of their brightness and color. However, with new scanning procedures and computer data reduction, observations have been made of stars less than two seconds (1/1800th degree) apart. Eventually, astronomers hope to have a microwave link from the telescopes to the computer and install a display screen which would allow for information display during processing. An eclipse could then be analyzed at the time of its occurence.

EDUCATION NEWS

GOAL — TO TRAIN 1000 MINORITY STUDENTS A YEAR

The most significant function of the College of Data Processing (Los Angeles, Calif.) is its special emphasis on the training of racial minority students for high paying careers in the rapidly expanding field of data processing. Its announced goal is to train a thousand minority students a year.

Through its affiliation with Pepperdine College (an independent, private, four year liberal arts institution), the College of Data Processing offers computer sciences courses that may receive credit toward A.A. or B.A. degrees. The college also is geared to train

— College of Data Processing students watch the loading of a tape unit

company personnel in short courses in specialized areas or general instruction at the company's computer centers or at the college. Morning,

afternoon and evening classes are available for the accommodation of working students.

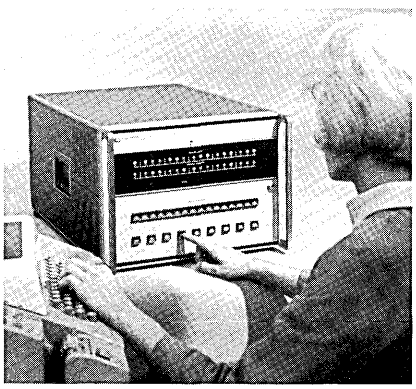
The nine-year-old technical college is one of the few (and thought to be the only Negro owned and operated) computer training schools accredited by the National Association of Trade and Technical Schools (NATTS). College of Data Processing is approved by several state as well as federal agencies and is qualified to accept students for training under programs sponsored by those governmental agencies.
(For more information, circle #41 on the Reader Service Card.)

NEW PRODUCTS

Digital

MODEL 2114B MINICOMPUTER / Hewlett-Packard

HP's Model 2114B minicomputer is designed for OEM, data-communication, instrumentation, and educational systems. The new minicomputer has a memory capacity of 4096 16-bit words (expandable to 8192)



and a memory cycle time of 2.0 microseconds. An optional direct memory access provides a high-speed data channel that's assignable under program control to any of the computer's seven input-output channels. Multilevel priority interrupt is standard.
(For more information, circle #42 on the Reader Service Card.)

GE-655 COMPUTER SYSTEM / General Electric Co.

GE's largest and fastest data processing system to date, the new GE-655, is upward compatible with the existing GE-600 line of large-scale information systems. The GE-655 system is capable of multiprogramming, multiprocessing, and executing the three dimensions of data processing concurrently — local batch processing, remote batch processing, and time-sharing.

The central processor, system controller, memory modules, and input-output controllers are packaged as separate units in order to permit users to "tailor" the system to their particular workload requirements. Memory cycle time is one-half microsecond. Each memory module contains 65,536 words, and each controller can accommodate either one or two modules. A system can accommodate up to two controllers, with a total combined capability of 262,144 words of core memory.
(For more information, circle #43 on the Reader Service Card.)

EMR 6120 MINICOMPUTER / EMR-Computer

Another entry into the small computer market is the EMR 6120 system (a 16-bit word machine) which offers full programming flexibility and upward compatibility with the EMR 6130 and 6135 systems. The EMR 6120 has an expandable memory (4K up to 32KO, high- and low-speed input-output access, and CPU communication addressing of up to 128 peripherals, with up to 38 priority interrupts.

In addition to specialized user software, the 6120 has a real-time operating system, utilities, assemblers and data communications.
(For more information, circle #44 on the Reader Service Card.)

COM COMP I MINICOMPUTER SYSTEM / Com-Comp, Inc.

Com Comp I is the first of an entire family of similar, low-cost computer systems with specialized applications for all areas of science, business and industry. An on-line, real time, time shared computer system, it is designed for service in clinical pathology laboratories. The system uses a terminal and special software (designed by Com-Comp engineers) that permits untrained personnel to operate it. The Com-Comp concept features a high-speed computer-controller that is easily programmable and can be expanded to 32K memory capacity. The controller allows simultaneous multi-terminal operation.
(For more information, circle #45 on the Reader Service Card.)

Teaching Devices

EDUPUTER[T] / Programming Sciences Corp.

A portable device, called the Eduputer®, teaches the basic functions of a computer by simulating the operations of a computer control panel. The Eduputer resembles the IBM System/360 Model 30's control panel, with similar markings, dials, switches and other features. It is, however, in no way a computing device.

Part of the training package is a set of self-instructing material that includes a cassette recorder, taped lectures, a course outline, and student and instructor guides. The courses are geared to the upper high-school grade levels, and require no previous knowlege of data processing. The Eduputer provides the advantage of unlimited "hands-on" experience without taking up time on a central processing unit.
(For more information, circle #46 on the Reader Service Card.)

IN-PLANT COMPUTER TRAINING SYSTEMS / Institute of Advanced Technology

The Institute of Advanced Technology, a subsidiary of Central Computer Corp., is now offering complete systems for in-plant computer training. IAT provides all textbooks, manuals, and materials with the in-house service, plus specially designed study booths, known as a "System/M" carrel, for presenting the material. The study booths come equipped with modern audio/visual instructional equipment, including a stereo tape recorder coordinated with a 35mm projector. Because students control individual presentation rates, they proceed at exactly their own learning pace. Comprehensive courses are offered in IBM 360 ALC, FORTRAN, COBOL, PL/1, and RPG computer programming.
(For more information, circle #47 on the Reader Service Card.)

Memories

PLUG-IN MEMORY, NANOSTAK NS-220 / Electronic Memories & Magnetics Corp.

NANOSTAK NS-220 is a low-cost, high-speed memory stack particularly suited for desk-top calculators, buffer storage, CRT displays and data terminals. The new stack uses a folded planar array, permitting compact design; has a 3-wire 3-dimension organization with 20 mil cores; and an 850 nanosecond operation for 2048 words with an 8-bit word length. Interface is provided through a standard 30-pin printed circuit board edge connectors.
(For more information, circle #48 on the Reader Service Card.)

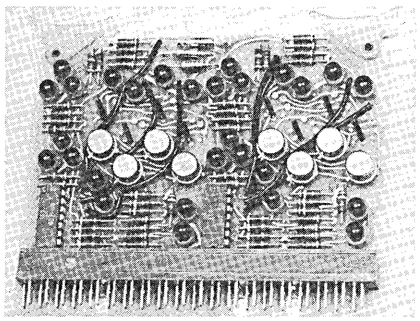
LARGE DISC STORE (LDS), SYSTEM/7000 / Data Products Corp.

The low-cost Large Disc Store (LDS), called System/7000, has up to 2¼ billion bits of storage for real-time applications. System/7000 has been designed for each memory expansion as the user's storage needs increase; a single System/7000 controller handles up to eight stores.

The discfile is system-comptabile with the IBM 360 and Univac 1108. An OEM version of the Large Disc Store (6040) also is available.
(For more information, circle #49 on the Reader Service Card.)

MOS MEMORY, MM 602 / Standard Logic, Inc.

A new monolithic memory system, MM 602, is contained on one circuit card (3.5" x 4.3") and has a maximum storage capacity of 3200 bits.



The MOS Memory is designed for serial storage and random access application. Random address systems require a second card to perform control logic functions. The MM 602 is DTL/TTL interface compatible.
(For more information, circle #50 on the Reader Service Card.)

Software

GENERAL MAINTENANCE SYSTEM (GMS) / Information Science Inc., New City, N.Y. / A general purpose system for the creation and maintenance of computer files that includes complete edit and update capabilities; programs are created for each file by the GMS "generator" and all are written in COBOL, with provision for inclusion of individual user routines. Minimum machine configuration requirements are: IBM System/360-32K DOS or OS; reader punch; printer; disk drive for system residence and one additional direct access device of four tape drives; or equivalent COBOL support configuration.
(For more informacion, circle #51 on the Reader Service Card.)

GRIPS (Gift Reporting and Information Processing System) / International Data Applications,

Inc., Montgomeryville, Pa. / An integrated information system to support fund-raising campaigns of colleges and universities and to maintain alumni and prospect records. Adaptable to an institution's individual requirements, GRIPS can be effectively shared by more than one institution. Consulting services including personnel training, custom programming modifications, installation management and conversion assistance are available.
(For more information, circle #52 on the Reader Service Card.)

JUDY (Just a Useful Device for You) / Data Usage Corp., Fort Lee, N.J. / Program performs 14 common utility functions for the Univac 9200/9300. Minimum memory size is 16K. JUDY executes all of the data conversion functions associated with card, tape and printer (e.g. card to tape, tape to printer, tape to tape, etc.). JUDY is being made available for a $10 postage/handling charge.
(For more information, circle #53 on the Reader Service Card.)

MIRACL/CPG (Cobol Program Generator) / Republic Software Products, Inc., East Orange, N.J. / Directed toward reducing turnaround time for writing and testing programs, MIRACL/CPG eliminates repetitive and time consuming aspects of detailed coding. As many as 30 or more Cobol statements are replaced by one MIRACL statement. Other features include: the ability to utilize ten I/O files, full compatibility with Cobol, the opportunity for a programmer to add Cobol coding if desired and the ability to operate as a "load and go" system whereby a completely bug-free Cobol object program is generated for execution. Rights to use the software product may be obtained through a licensing agreement with Republic Software Products, Inc.
(For more information, circle #54 on the Reader Service Card.)

MUSE (Machine User Symbiotic Environment) / Meta-Language Products, Inc., New York, N.Y. / Available to business, institutions, and government, MUSE enables man to communicate with the computer in conversational English via terminal keyboards or CRTs in his office or home. MUSE, a complete proprietary management information system, includes a simple data-loading and updating procedure and an automatic report-generator. Computer programming is "built into" MUSE. The firm offers MUSE on a licensing basis which includes: a full-time consultant in the customer's offices for six months; systems maintenance support during full term of license and free system updates until Feb. 1, 1971; and a money back guarantee if the MUSE system does not perform according to a supplied set of specifications.
(For more information, circle #55 on the Reader Service Card.)

SAM (Systems Analysis Machine) / Applied Data Research, Inc., Princeton, N.J. / Simulates digital software and hardware systems. SAM will operate on System/360 computers initially; on other systems during 1970. Useful in evaluating and comparing new hardware, software and application systems, the program is available as a package or on a service bureau basis.
(For more information, circle #56 on the Reader Service Card.)

TAPE-TEST / Systems Research Laboratories, Inc., Kansas City, Mo. / Will test up to 6 magnetic tapes and tape drives simultaneously (9 track, 800 or 1600 BPI). All tape and drive read/write errors are logged telling to what extend and where (in feet from load point) each error occurs on each tape being tested. Tape-Test is designed for the IBM System/360 (Model 25 and up) under DOS, utilizing 2400 tape drives. Processing and tape drive assignments are controlled by the operator using any combination of tape drives.
(For more information, circle #57 on the Reader Service Card.)

Peripheral Equipment

360 INTERFACE FOR MINI-COMPUTERS AND PERIPHERALS / Datametrics Corp.

A new 360 interface device, known as the 360 CHANNEL INTERFACE, is intended to help minicomputer and independent peripheral suppliers who are penetrating the IBM 360 System market. It is one of a new product line being introduced by Datametrics which will include comparable units for interfacing with the Univac 1108, Univac 9000, and GE 400/600 computer systems.

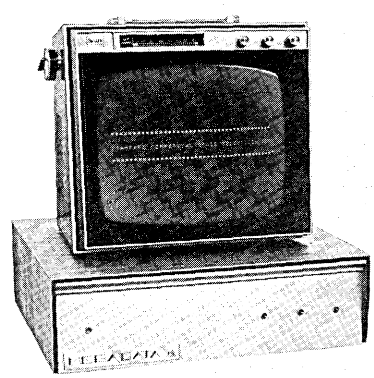
The 360 CHANNEL INTERFACE provides an IC level interface to IBM 360 selector and multiplexer channels. Connectors on the device accommodate two pairs of 360 I/O cables to permit chaining. It is suitable for 19" rack mounting and measures 17" x 19" x 12" including power supplies.
(For more information, circle #58 on the Reader Service Card.)

POINT-OF-SALE COMPUTER TERMINAL DEVICE, "REGISTRON" / Information Machines Corp.

"Registron" is a computer terminal device disguised as a cash register. The machine functions in the same way as a cash register except that it is tied in with a computer. Registron actually reads the ticket attached to the purchased merchandise. All details of each sale are recorded on magnetic tape or entered directly in the computer — in a single pass. "Registron" is in full production and has begun service at the point-of-sale in some chain stores, department stores and specialty shops throughout the nation.
(For more information, circle #59 on the Reader Service Card.)

DIGITAL SCANNER / Megadata

A new digital scanner, the S/R 1000, converts any TV set into an instant communication station over which computer information can be displayed. After attaching the attache case-sized scanner to the TV set's antenna terminal posts, anyone utilizing any computer system can simply telephone the computer's number and the requested information and detailed replies will be displayed on the TV screen.



The "conversational" communication link with the computer is provided by an electronic alpha numeric keyboard (similar to a typewriter). Programs being televised are automatically blanked out in the set to allow the S/R 1000 to function.

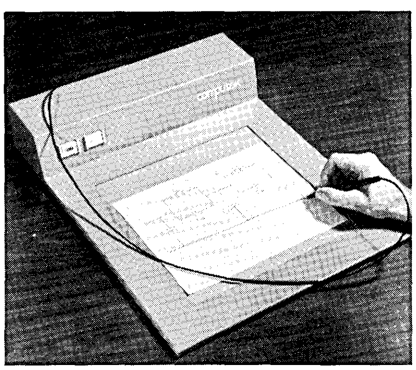
The Megadata S/R 1000 has been through a series of development and testing stages for some two years and final pilot models are currently in operation.
(For more information, circle #60 in the Reader Service Card.)

DATA POOLER / Sangamo Electric Co.

The DS-7200/9200 Data Pooler consolidates smaller multiple input tapes from Sangamo Data Stations to full 2400 foot reels of magnetic tape with 800 BPI writing density and full error check while pooling. Pooling speeds of 639 records per minute can be attained to increase throughput efficiency. To increase the transfer rate of data into the computer, a 240 character selectable memory allows upblocking to expanded record sizes. The new Data Pooler also functions as a keyboard-to-tape data entry device. (For more information, circle #61 on the Reader Serive Card.)

COMPUTER GRAPHIC TABLET / Computek, Inc.

A new graphic tablet, for converting hand-drawn data to digital form, uses an electromagnetic sensing technique incorporating a proprietary printed digital pattern. Use of electromagnetic detection results in increased reliability compared to capacitive and electrostatic methods. The digital pattern makes the Computek graphic tablet far more stable and immune to temperature variations and aging than tablets using analog schemes. Pattern accuracy is ±0.005 inch (0.05% of full scale) and linearity is ±0.05% of full scale. The tablet provides



a writing surface of 11¼" x 11¼", and can be used with graphic display terminals such as the Computek Series 400 models or as a stand-alone unit. Specific applications include positional control of display cursors, on-line interaction with graphic displays for computer-aided design, conversion of rough drawings to exact drawings, and other applications requiring digitizing or entry of graphic data.
(For more information, circle #62 on the Reader Service Card.)

HSP-3530 HIGH SPEED PRINTER / Potter Instrument Co., Inc.

Potter's new chain printer, the HSP-3530, prints up to 400 lines per minute with a 48 character set. Configurations of up to 192 characters in 132 columns are available, and incorporate 12 channel IBM compatible vertical format control as a standard feature. Designed for use with all computer and data processing systems, the HSP-3530 can be interfaced off-line with a magnetic tape transport for off-line printout. It may also be interfaced with a Data-Phone® for use as a remote terminal.
(For more information, circle #63 on the Reader Service Card.)

ANALOG SUBSYSTEM FOR PDP-10 COMPUTERS / Digital Equipment Corp.

An analog subsystem has been added as a standard interface for PDP-10 computer systems that are used for real-time data acquisition applications. The subsystem, designated the AD10, can service from 64 to 192 input channels from any combination of analytical instrumentation such as gas chromatographs, mass spectrometers and clinical analyzers. The AD10, under software control, selects the desired analog input channel, provides the proper gain and digitizes the input at a maximum rate of 10,000 samples per second.
(For more information, circle #64 on the Reader Service Card.)

DCT 1000 DATA COMMUNICATIONS TERMINAL / Sperry Rand Univac Division

Univac's new data communications terminal, the DCT 1000, is available either as a single station or with multi-station capability. Operating in a batch or conversational mode on almost any type of communications line, the terminal is designed for operation with a central computer either locally or remotely. The DCT 1000 consists of an asynchronous, input/output printer (with 132 print positions) operating at 30 cps, a control unit and a keyboard. Numerous configurations are possible via point-to-point, multipoint or multiplexed operation on switched or private lines.
(For more information, circle #65 on the Reader Service Card.)

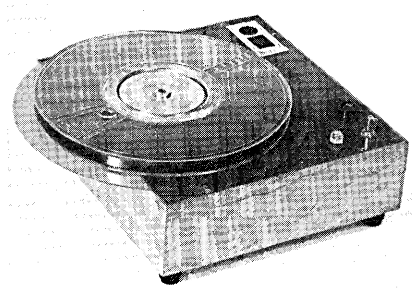
Data Processing Accessories

DIGITAL CASSETTE / Ampex Corp.

The new Series PC-800 cassette, specifically designed for cassette tape drives used as computer peripheral devices, contains up to 300 feet of full-width tested tape, compatible with any track or machine requirements. The cassette is compatible with the new digital cassette tape drives currently being introduced for use in data acquisition systems such as data-phone and key-to-tape converters, remote terminals for batch processing operations, and as input/output devices in mini-mobile computers. A new cassette design provides reliability and best tape skew and tape pack characteristics. The manufacturer says the PC-800 is the first cassette which provides the precision performance required by the computer industry. Cassettes now used in the computer industry were designed for less demanding audio applications.
(For more information, circle #66 on the Reader Service Card.)

DEMAGNETIZER / Indel Inc.

A new EDP accessory, the Indel CTDM-1 Demagnetizer, offers a fast, inexpensive way to erase all magnetic data from computer tapes. The device has a strong A.C. field, assuring complete demagnetization with no polarization. The CTDM-1 accommodates either ½" or 1" reels of tape, and up to a 14" diameter



reel. Complete demagnetization of a reel of computer tape takes about 15 seconds. An air-cooled motor permits continuous operation without damage to any component parts.
(For more information, circle #67 on the Reader Service Card.)

COMPUTING/TIME-SHARING CENTERS

GENERAL BUSINESS PROGRAMS FOR TIME-SHARING USERS ACQUIRED BY REMOTE COMPUTING CORP.

A package of computer programs, called DataBank, now are available for use by Remote Computing Corp.'s time-sharing subscribers. The package, developed by J. Toellner & Associates, can perform a wide variety of routine business functions, and can be used by relatively inexperienced personnel.

DataBank became available to Remote Computing under a Program Authors' Royalty (PAR) Plan agreement. Under terms of such agreements, Remote Computing Corp. serves as a sales representative for small software houses and free-lance programmers that require assistance in promoting the use of their proprietary programs.
(For more information, circle #68 on the Reader Service Card.)

U.S. TIME-SHARING OFFERING COMPUTER SERVICE BASED ON IBM'S DATATEXT

U. S. Time-Sharing, Inc., has announced that it will provide ATS computing service in Washington, D.C., Baltimore, and Pittsburgh. ATS (Administration Terminal System) was developed by IBM, who marketed it as Datatext through a subsidiary. The IBM subsidiary recently announced the withdrawal of Datatext services.
(For more information, circle #69 on the Reader Service Card.)

SURVEYING PACKAGE ADDED TO GENERAL LIBRARY OF CALL-A-COMPUTER

Call-A-Computer of Minneapolis, Minn., has added a package of 12 programs for the solution of common surveying problems to its general library of programs. The Surveying Package, for use by CAC computer time sharing subscribers, is a series of 12 computer programs designed to solve standard surveying problems. Knowledge of programming is not necessary to use the programs.
(For more information, circle #70 on the Reader Service Card.)

TAB CARD PROCESSING SERVICE BUREAU ESTABLISHED BY REPUBLIC CORP.

Republic Corp.'s Electronic Systems Division has established a tab card processing service bureau (in Los Angeles, Calif.) using a high speed Optical Mark Reader (Model 1501). The reader processes cards marked with ordinary #2 pencils, thus eliminating keypunching. This permits computer input data to be prepared in plain language, and at low cost, by non-technical persons.

Republic's Model 1501 simultaneously reads both sides of pencil-marked 30-row, 80 column cards formatted to customer's specifications, and containing up to 4800 data positions. The Model 1501 reads up to 90,000 cards per hour, processing the information through a computer, recording the data on IBM-compatible magnetic tape and providing a print-out or other hard copy if required.

Tab cards for FORTRAN programming, school registration and multiple choice formats are available now. Other formats can be designed and in use within four weeks.
(For more information, circle #71 on the Reader Service Card.)

ORGANIZATION NEWS

BLACK-OWNED SERVICE BUREAU GIVEN AUTHORIZATION BY STATE OF NEW JERSEY

EDAPCO, Inc., a black-owned computer service bureau, opened in September by Leonard Prather, Jr., has been authorized by the State of New Jersey to process local property tax rolls for cities and towns in the state. State authorization allows EDAPCO to submit proposals to the cities and towns.

EDAPCO, the first black-owned computer service bureau in New Jersey, has a Honeywell Model 125 system. The firm employs nine persons full time; two, including the sales manager are white. There are only four other black-owned computer service bureaus in the United States according to information from the Inter-racial Council for Business Opportunity and the Association of Data Processing Service Organizations.

TRANSNET CORP. ANNOUNCES A ROYALTY PLAN FOR COMPUTER PROGRAMS

Commercial, scientific and engineering programs using FOCAL, BASIC, FORTRAN or PAL are eligible for submission under a new royalty plan announced by TransNet Corp. The plan, according to John J. Wilk, president of TransNet, provides for the payment of royalties to authors of computer programs submitted to and used by the firm. The author will receive a royalty for each time the program is used. TransNet Corp. provides computer time sharing and data processing services to business, industry, science, engineering and education.
(For more information, circle #72 on the Reader Service Card.)

FCC ASKED TO AUTHORIZE NEW NATIONAL NETWORK

Data Transmission Co. (DATRAN), Falls Church, Va., has filed an application with the Federal Communications Commission (FCC) for authority to construct and operate a nationwide common carrier system for transmission of digital data. Thirty-five metropolitan areas, shown below, would be served by the proposed $375 million system. DATRAN

told the FCC that the new system, by eliminating the necessity of translating to and from analog (voice-type) circuits, will provide faster, more reliable, and more economical transmission service than is possible over the present voice-type circuits. The application asks permission to construct and operate 244 microwave repeater stations, 10 district offices for computerized switching, and tail circuits to locations of an estimated 160,000 prospective customers. DATRAN is a wholly-owned subsidiary of University Computing Company.

COMPSO INTRODUCES FIRST FULLY COMPUTERIZED CONVENTION REGISTRATION SYSTEM

COMPSO — the three Regional Computer Software and Peripherals Shows and Conferences — will introduce the first completely computerized convention registration/ information system at COMPSO EAST, Jan. 19-21, at the New York Hilton.

The service will operate as follows: Registrants will complete simple forms which will be encoded on magnetic tape. An identification number will be assigned to each registrant. To obtain a list of registrants who visit individual exhibits, exhibitor personnel will merely record the individual's identification number on pre-printed forms with codes for area or degree of interest. The computer system will then merge and collate all information to provide exhibitors with listings of all inquirers at individual exhibits. These listings may be geographic, alphabetical, occupational, or by area or degree of interest. Output can be mailing labels, index cards, computer print-out, or computer personalized letters. Statistical analyses will also be available for planning future exhibits.

MONTHLY COMPUTER CENSUS

Neil Macdonald
Survey Editor
COMPUTERS AND AUTOMATION

The following is a summary made by COMPUTERS AND AUTOMATION of reports and estimates of the number of general purpose electronic digital computers manufactured and installed, or to be manufactured and on order. These figures are mailed to individual computer manufacturers from time to time for their information and review, and for any updating or comments they may care to provide. Please note the variation in dates and reliability of the information. Several important manufacturers refuse to give out, confirm, or comment on any figures.

Our census seeks to include all digital computers manufactured anywhere. We invite all manufacturers located anywhere to submit information for this census. We invite all our readers to submit information that would help make these figures as accurate and complete as possible.

Part I of the Monthly Computer Census contains reports for United States manufacturers. Part II contains reports for manufacturers outside of the United States. The two parts are published in alternate months.

The following abbreviations apply:

- (A) -- authoritative figures, derived essentially from information sent by the manufacturer directly to COMPUTERS AND AUTOMATION
- C -- figure is combined in a total
- (D) -- acknowledgment is given to DP Focus, Marlboro, Mass., for their help in estimating many of these figures
- E -- figure estimated by COMPUTERS AND AUTOMATION
- (N) -- manufacturer refuses to give any figures on number of installations or of orders, and refuses to comment in any way on those numbers stated here
- (R) -- figures derived all or in part from information released indirectly by the manufacturer, or from reports by other sources likely to be informed
- (S) -- sale only, and sale (not rental) price is stated
- X -- no longer in production
- \- -- information not obtained at press time

SUMMARY AS OF DECEMBER 15, 1969

NAME OF MANUFACTURER	NAME OF COMPUTER	DATE OF FIRST INSTALLATION	AVERAGE OR RANGE OF MONTHLY RENTAL $(000)	NUMBER OF INSTALLATIONS In U.S.A.	Outside U.S.A.	In World	NUMBER OF UNFILLED ORDERS
Part I. United States Manufacturers							
Autonetics	RECOMP II	11/58	2.5	30	0	30	X
Anaheim, Calif. (R) (1/69)	RECOMP III	6/61	1.5	6	0	6	X
Bailey Meter Co.	Bailey 756	2/65	60-400 (S)	17	-	-	3
Wickliffe, Ohio (R) (1/69)	Bailey 855	4/68	100.0 (S)	0	-	-	15
Bunker-Ramo Corp.	BR-130	10/61	2.0	160	-	-	X
Canoga Park, Calif.	BR-133	5/64	2.4	79	-	-	X
(A)	BR-230	8/63	2.7	15	-	-	X
(10/69)	BR-300	3/59	3.0	18	-	-	X
	BR-330	12/60	4.0	19	-	-	X
	BR-340	12/63	7.0	19	-	-	X
Burroughs	205	1/54	4.6	25-38	2	27-40	X
Detroit, Mich.	220	10/58	14.0	28-31	2	30-33	X
(N)	B100	8/64	2.8	90	13	103	X
(1/69-5/69)	B200	11/61	5.4	370-800	70	440-870	31
	B300	7/65	9.0	180-370	40	220-410	150
	B500	10/68	3.8	0	0	0	70
	B2500	2/67	5.0	52-57	12	64-69	117
	B3500	5/67	14.0	44	18	62	190
	B5500	3/63	23.5	65-74	7	72-81	8
	B6500	2/68	33.0	4	0	4	60
	B7500	4/69	44.0	0	0	0	13
	B8500	8/67	200.0	1	0	1	5
Control Data Corp.	G15	7/55	1.6	-	-	295	X
Minneapolis, Minn.	G20	4/61	15.5	-	-	20	X
(N)	LGP-21	12/62	0.7	-	-	165	X
(2/69-4/69)	LGP-30	9/56	1.3	-	-	322	X
	RPC4000	1/61	1.9	-	-	75	X
	636/136/046 Series	-	-	-	-	29	-
	160/8090 Series	5/60	2.1-14.0	-	-	610	X
	924/924A	8/61	11.0	-	-	29	X
	1604/A/B	1/60	45.0	-	-	59	X
	1700	5/66	3.8	65-130	41-50	106-180	C
	3100/3150	5/64	10-16	68-90	15-20	83-110	C
	3200	5/64	13.0	40-45	15	55-60	C
	3300	9/65	20-28	38-100	17-25	55-125	C
	3400	11/64	18.0	12	4	16	C
	3500	8/68	25.0	1	0	1	C
	3600	6/23	52.0	30	9	39	C
	3800	2/66	53.0	18	2	20	C
	6400/6500	8/64	58.0	23-50	14-17	37-67	C
	6600	8/64	115.0	32-40	11	43-51	C
	6800	6/67	130.0	1	0	1	C
	7600	12/68	235.0	1	0	1	C
							Total: 160 E
Data General Corp.	NOVA	2/69	8.0 (S)	130	6	136	800
Southboro, Mass. (A) (12/69)	SUPERNOVA	4/70	11.7 (S)	0	0	0	0
Datacraft Corp.	DC6024	5/69	54-200 (S)	3	0	3	5
Ft. Lauderdale, Fla. (A) (12/69)	DC6024/3	-	38-200 (S)	0	0	0	0
Digiac Corp.	Digiac 3080	12/64	19.5 (S)	12	-	-	2
Plainview, N.Y. (A) (10/69)	Digiac 3080C	10/67	25.0 (S)	4	-	-	1
Digital Equipment Corp.	PDP-1	11/60	3.4	50	2	52	X
Maynard, Mass.	PDP-4	8/62	1.7	40	5	45	X
(A)	PDP-5	9/63	0.9	90	10	100	X
(9/69)	PDP-6	10/64	10.0	18	3	21	X
	PDP-7	11/64	1.3	124	36	160	X
	PDP-8	4/65	0.5	945	378	1323	C
	PDP-8/I	3/68	0.4	940	293	1233	C
	PDP-8/S	9/66	0.3	575	269	844	C
	PDP-8/L	11/68	-	561	204	765	C
	PDP-9	12/66	1.1	262	115	377	C
	PDP-9/L	11/68	-	6	8	14	C

NAME OF MANUFACTURER	NAME OF COMPUTER	DATE OF FIRST INSTALLATION	AVERAGE OR RANGE OF MONTHLY RENTAL $(000)	NUMBER OF INSTALLATIONS In U.S.A.	Outside U.S.A.	In World	NUMBER OF UNFILLED ORDERS
Digital Equipment Corp. (cont'd.)	PDP-10	12/67	8.0	76	21	97	C
	PDP-12	6/69	-	20	4	24	C
	LINC-8	9/66	-	108	40	148	C
							Total: 1200 E
Electronic Associates Inc.	640	4/67	1.2	65	20	85	10
Long Branch, N.J. (A) (10/69)	8400	7/65	12.0	19	6	25	2
EMR Computer	ADVANCE 6020	4/65	5.4	C	-	-	C
Minneapolis, Minn.	ADVANCE 6040	7/65	6.6	C	-	-	C
(N)	ADVANCE 6050	2/66	9.0	C	-	-	C
(10/69)	ADVANCE 6070	10/66	15.0	C	-	-	C
	EMR 6130	8/67	5.0	C	-	-	C
	EMR 6135	-	2.6	-	-	-	-
				Total: 90 E			Total: 30 E
General Electric	105A	6/69	1.3	-	-	-	-
Phoenix, Ariz.	105B	6/69	1.4	-	-	-	-
(N)	105RTS	7/69	1.2	-	-	-	-
(2/69-4/69)	115	4/66	2.2	200-400	420-680	620-1080	-
	120	-	2.9	-	-	-	-
	130	12/68	4.5	-	-	-	-
	205	6/64	2.9	11	0	11	-
	210	7/60	16.0	35	0	35	-
	215	9/63	6.0	15	1	16	-
	225	4/61	8.0	145	15	160	-
	235	4/64	12.0	60-100	17	77-117	-
	245	11/68	13.0	-	-	-	-
	255 T/S	10/67	17.0	-	-	-	-
	265 T/S	10/65	20.0	-	-	-	-
	275 T/S	11/68	23.0	-	-	-	-
	405	2/68	6.8	10-40	5	15-45	-
	410 T/S	11/69	11.0	-	-	-	-
	415	5/64	7.3	170-300	70-100	240-400	-
	420 T/S	6/67	23.0	-	-	-	-
	425	6/64	9.6	50-100	20-30	70-130	-
	430 T/S	6/69	17.0	-	-	-	-
	435	9/65	14.0	20	6	26	-
	440 T/S	7/69	25.0	-	-	-	-
	615	3/68	30.0	-	-	-	-
	625	4/65	41.0	23	3	26	-
	635	5/65	45.0	20-40	3	23-43	-
	655	-	80.0	-	-	-	-
Process Control Computers:	4020	2/67	5.0	113	38	151	53
(A)	4040	8/64	3.0	45	20	65	-
(10/69)	4050	12/66	7.0	22	1	23	-
	4060	6/65	8.5	18	2	20	-
Hewlett Packard	2114A	10/68	0.25	-	-	510	-
Cupertino, Calif.	2115A	11/67	0.41	-	-	650	-
(A)	2116A	11/66	0.6	-	-	361	-
(10/69)	2116B	9/68	0.65	-	-	860	-
Honeywell	DDP-24	5/63	2.65	-	-	90	X
Computer Control Div.	DDP-116	4/65	0.9	-	-	250	-
Framingham, Mass.	DDP-124	3/66	2.2	-	-	90	-
(R)	DDP-224	3/65	3.5	-	-	60	-
(10/69)	DDP-316	-	-	-	-	-	-
	DDP-516	9/66	0.8	-	-	320	-
	H632	-	3.2	-	-	2	-
	H1648	-	-	-	-	-	-
Honeywell	H-110	8/68	2.5	100	2-5	102-105	0
EDP Div.	H-120	1/66	4.2	750	140-180	890-930	-
Wellesley Hills, Mass.	H-125	12/67	6.0	70	10-15	80-85	-
(N)	H-200	3/64	9.2	800	210-300	1010-1100	-
(1/69-4/69)	H-400	12/61	10.0	46	14-30	60-76	X
	H-800	12/60	30.0	58	10-12	68-70	X
	H-1200	2/66	11.6	190	31-50	221-240	-
	H-1250	7/68	12.0	110	2-5	114-130	-
	H-1400	1/64	14.0	4	1-2	4-6	X
	H-1800	1/64	50.0	15	3	18	X
	H-2200	1/66	16.0-26.0	118	21-25	139-143	-
	H-3200	2/70	24.0	0	0	0	-
	H-4200	8/68	32.5	6	0	6	-
	H-8200	12/68	50.0	5	0	5	-
IBM	System 3	-	1.1	0	0	0	-
White Plains, N.Y.	305	12/57	3.6	40	15	55	-
(N) (D)	650	10/67	4.8	50	18	68	-
(1/69-5/69)	1130	2/66	1.5	2580	1227	3807	-
	1401	9/60	5.4	2210	1836	4046	-
	1401-G	5/64	2.3	420	450	870	-
	1401-H	6/67	1.3	180	140	320	-
	1410	11/61	17.0	156	116	272	-
	1440	4/63	4.1	1690	1174	2864	-
	1460	10/63	10.0	194	63	257	-
	1620 I, II	9/60	4.1	285	186	471	-
	1800	1/66	5.1	415	148	563	-
	7010	10/63	26.0	67	14	81	-
	7030	5/61	160.0	4	1	5	-
	704	12/55	32.0	12	1	13	-
	7040	6/63	25.0	35	27	2	-
	7044	6/63	36.5	28	13	41	-
	705	11/55	38.0	18	3	21	-
	7070, 2	3/60	27.0	10	3	13	-
	7074	3/60	35.0	44	26	70	-
	7080	8/61	60.0	13	2	15	-
	7090	11/59	63.5	4	2	6	-
	7094-I	9/62	75.0	10	4	14	-
	7094-II	4/64	83.0	6	4	10	-

NAME OF MANUFACTURER	NAME OF COMPUTER	DATE OF FIRST INSTALLATION	AVERAGE OR RANGE OF MONTHLY RENTAL $(000)	NUMBER OF INSTALLATIONS In U.S.A.	Outside U.S.A.	In World	NUMBER OF UNFILLED ORDERS
IBM (cont'd)	360/20	12/65	2.7	4690	3276	7966	-
	360/25	1/68	5.1	0	4	4	-
	360/30	5/65	10.3	5075	3144	8219	-
	360/40	4/65	19.0	1260	498	1758	-
	360/44	7/66	11.8	65	13	78	-
	360/50	8/65	29.1	480	109	589	-
	360/65	11/65	57.2	175	31	206	-
	360/67	10/66	133.8	9	4	13	-
	360/75	2/66	66.9	14	3	17	-
	360/85	-	150.3	0	0	0	-
	360/90	11/67	(S)	5	0	5	-
	360/195	-	232.0	-	-	-	-
Interdata	Model 2	7/68	0.25	-	-	16	2
Oceanport, N.J.	Model 3	3/67	0.4	-	-	163	52
(A) (10/69)	Model 4	8/68	0.6	-	-	80	57
NCR	304	1/60	14.0	15	2	17	X
Dayton, Ohio	310	5/61	2.5	8	0	8	X
(R)	315	5/62	8.7	460	400	860	-
(9/69)	315 RMC	9/65	12.0	125	45	170	-
	390	5/61	1.9	240	500	740	-
	500	10/65	1.5	1700	950	2650	-
	Century 100	9/68	2.7	200	30	230	-
	Century 200	6/69	7.5	10	0	10	-
Pacific Data Systems Inc. Santa Ana, Calif. (N) (1/69)	PDS 1020	2/64	0.7	145	-	-	10
Philco	1000	6/63	7.0	16	-	-	X
Willow Grove, Pa.	2000-210, 211	10/58	40.0	16	-	-	X
(N) (1/69)	2000-212	1/63	52.0	12	-	-	X
Potter Instrument Co., Inc. Plainview, N.Y. (A) (10/69)	PC-9600	-	16.0 (S)	-	-	-	-
RCA	301	2/61	7.0	140-290	100-130	240-420	-
Cherry Hill, N.J.	501	6/59	14.0-18.0	22-50	1	23-51	-
(N)	601	11/62	14.0-35.0	2	0	2	-
(5/69)	3301	7/64	17.0-35.0	24-60	1-5	25-65	-
	Spectra 70/15	9/65	4.3	90-110	35-60	125-170	-
	Spectra 70/25	9/65	6.6	68-70	18-25	86-95	-
	Spectra 70/35	1/67	9.2	65-100	20-50	85-150	-
	Spectra 70/45	11/65	22.5	84-180	21-55	105-235	-
	Spectra 70/46	-	33.5	1	0	1	-
	Spectra 70/55	11/66	34.0	11	1	12	-
Raytheon	250	12/60	1.2	155	20	175	X
Santa Ana, Calif.	440	3/64	3.6	20	-	20	X
(A)	520	10/65	3.2	26	1	27	X
(10/69)	703	10/67	(S)	128	20	148	10
	706	5/69	(S)	13	3	15	19
Scientific Control Corp.	650	5/66	0.5	23	0	23	0
Dallas, Tex.	655	10/66	2.1	111	0	111	25
(A)	660	10/65	2.1	27	0	27	12
(10/69)	670	5/66	2.7	1	0	1	0
	4700	4/69	1.8	13	0	13	79
	6700	2/70	90.0	0	0	0	1
	DCT-132	5/69	0.7	23	0	23	509
	DCT-32	11/69	0.3	0	0	0	3
Standard Computer Corp.	IC 4000	12/68	9.0	6	0	6	8 E
Los Angeles, Calif.	IC 6000	5/67	16.0	9	0	9	-
(N) (8/69)	IC 7000	6/69	17.0	3	0	3	10 E
Systems Engineering Laboratories	810	9/65	1.1	24	0	24	X
Ft. Lauderdale, Fla.	810A	8/66	0.9	135	2	137	30
(A)	810B	9/68	1.2	34	0	34	26
(6/69)	840	11/65	1.5	4	0	4	X
	840A	8/66	1.5	33	0	33	4
	840MP	1/68	2.0	20	0	20	11
UNIVAC (Div. of Sperry Rand)	I & II	3/51 & 11/57	25.0	23	-	-	X
New York, N.Y.	III	8/62	21.0	25	6	31	X
(R)	File Computers	8/56	15.0	13	-	-	X
(1/69-5/69)	Solid-State 80 I, II, 90,I,II, & Step	8/58	8.0	210	-	-	X
	418	6/63	11.0	76	36	112	20 E
	490 Series	12/61	30.0	75	11	86	35 E
	1004	2/63	1.9	1502	628	2130	20 E
	1005	4/66	2.4	637	299	936	90 E
	1050	9/63	8.5	138	62	200	10 E
	1100 Series (except 1107, 1108)	12/50	35.0	9	0	9	X
	1107	10/62	57.0	8	3	11	X
	1108	9/65	68.0	38	18	56	75 E
	9200	6/67	1.5	127	48	175	850 E
	9300	9/67	3.4	106	38	144	550 E
	9400	5/69	7.0	3	0	3	60 E
	LARC	5/60	135.0	2	0	2	-
Varian Data Machines	620	11/65	0.9	-	-	75	0
Newport Beach, Calif.	620i	6/67	0.5	-	-	840	350
(A) (10/69)	520i	10/68	-	-	-	70	230
Xerox Data Systems	SDS-92	4/65	1.5	10-60	2	12-62	-
El Segundo, Calif.	SDS-910	8/62	2.0	150-170	7-10	157-180	-
(N)	SDS-920	9/62	2.9	93-120	5-12	98-132	-
(2/69-4/69)	SDS-925	12/64	3.0	20	1	21	-
	SDS-930	6/64	3.4	159	14	173	-
	SDS-940	4/66	14.0	28-35	0	28-35	-
	SDS-9300	11/64	8.5	21-25	1	22-26	-
	Sigma 2	12/66	1.8	60-110	10-15	70-125	-
	Sigma 5	8/67	6.0	15-40	6-18	21-58	-
	Sigma 7	12/66	12.0	24-35	5-9	29-44	-

NEW CONTRACTS

TO	FROM	FOR	AMOUNT
Honeywell Inc., Framingham, Mass.	National Data Communications, Dallas, Texas	94 modified Model 516 computers, 50 high-speed printers and 500 disk-drives	$36.8 million
Raytheon Company, Santa Ana, Calif.		Specially designed cathode ray terminal units. The Honeywell and Raytheon equipment will be used to make up 50 REACH systems (Real Time Electronic Access Communications for Hospitals).	$19.5 million
Control Data Corp., Minneapolis, Minn.	U.S. Air Force	Two 6000 Series computer systems for the Aeronautical Systems Division (ASD) of the Air Force Systems Command	$13.8 million
IOMEC Inc., Santa Clara, Calif.	Hewlett-Packard, Palo Alto, Calif.	Multiple units of IODISC Series 1000 Data Storage Systems for integration as standard peripheral addition to H-P's 2000 Series computers	$2.5 million
Scientific Resources Corp., Philadelphia, Pa.	Globe Universal Sciences, Inc., Midland, Tex.	A joint development program and marketing agreement under which new seismic software developed by Globe would be marketed exclusively by Scientific Resources	$2.5 million
Tracor Computing Corp. (TCC), Austin, Texas	National Western Life Insurance Company	Insurance systems management contract; will take responsiblity for five years for all of National Western's data processing needs	$2 million (approximate)
Ampex Corp., Redwood City, Calif.	Western Electric Co., New York, N.Y.	Magnetic tape transports for use in automatic Electronic Switching System (ESS) centers being installed for the Bell Telephone System in the United States	$1.8 million
L M Ericsson Telephone Co.	Skandinaviska Banken, Stockholm, Sweden	An on-line real time data communication system which will connect about 350 bank offices located in all parts of Sweden to bank's own data center	$1.4 million
Computer Automation, Inc. Newport Beach, Calif.	National Data Control Inc., Dallas, Texas	51 model 816 and 216 minicomputers for use in real time data acquisition systems	$1.2 million
Digital Development Corp., San Diego, Calif.	Comcet, St. Paul, Minn.	DDC 73 series Rotating Digital Memory units for use in the Comcet 40 and 60 systems	$1+ million
Computer Memory Devices, Inc., Glendale, Ariz.	Comtel Corp., Southfield, Mich.	Disk drive systems with proper electronic interface to work with a variety of small, high-speed computers	$1 million (approximate)
The KMS Technology Center, Arlington, Va.	National Aeronautics and Space Administration (NASA)	Data processing and analysis services at the National Space Science Data Center (NSSDC), Goddard Space Flight Center	$1 million (approximate)
Gerber Scientific Instrument Co., So. Windsor, Conn.	Fiat of Turin, Italy	Two automatic drafting/digitizing systems and accessories	$700,000+
Caelus Data Products, San Jose, Calif.	Hewlett-Packard, Systems Div.	Caelus 1101 Disk Drives; initial use will be in a ground avionic checkout system	$500,000+
Princeton Time Sharing Services, Inc., Princeton, N.J.	DHR Systems, Inc., Paoli, Pa.	Computer management of stock portfolios; covers systems programming, installation and facility operation of a custom time sharing system	$500,000+
Leasco Systems & Research Corp., Bethesda, Md.	U.S. Office of Education, Educational Resources Information Center (ERIC)	Operation of the Processing and Reference Facility of ERIC	$434,859

ADVERTISING INDEX

Following is the index of advertisements. Each item contains: Name and address of the advertiser / page number where the advertisement appears / name of agency, if any

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La Prelle Associates
Data Power, Inc.
EDP Associates, Inc.
Jersey Tab Card Corp.
Viatron Computer Systems
Talcott Computer Leasing
Time Share Peripherals
Datamation Magazine
Sugarman Laboratories, Inc.
ITT, Data Equipment & Systems Div.
Mailers Tying Machine Co.
Levin Townsend Service Corp.
Bowne Time Sharing
Daedalus Computer Products
Datatrol, Inc.
Curran Computer Corp.
Realtronics, Inc.
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Kimball Systems Div., Litton Inc.
Transcom, Inc.
Comsec, Inc.
Information Displays, Inc.
Sierra Research Corp.
Electronic Associates, Inc.
National Software Exchange
Addo-X, Inc.
CPU Management Advisory Corp.
Simulation Associates, Inc.
United Computing Corp.
Computers & Automation Magazine
Caelus Memories, Inc.
Datamation Systems Inc.
Logic Corp.
EDPAC
Created Space, Inc.
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Encyclopaedia Britannica
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GDG Data Systems, Inc.
Diversified Data Services
Timeplex, Inc.
MAI Equipment Corp.
Metroprocessing Corp. of America
Commonwealth Computing, Inc.
Adpac
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Macrodata, Inc.
National Blank Book Co.
Data Processing Magazine
Computer Sciences Corp.
Datachron, Inc.
EDP Weekly
I/O Systems
Power Computer Systems, Syforex Div.
Sykes Datatronics, Inc.
Information Data Systems, Inc.
Keyboard Training, Inc.
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Computer Solutions, Inc.
General Computing Corp.
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Computer Optics
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LDD Computer Services, Inc.
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Decitron Comm. Systems, Inc.
Digital Development Corp.
DMC Inc.
Isaac Dobbs Co., Inc.
Pioneer Data Systems, Inc.
RCA Computers
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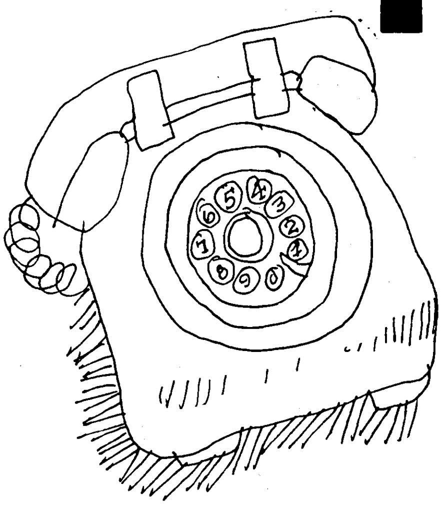

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