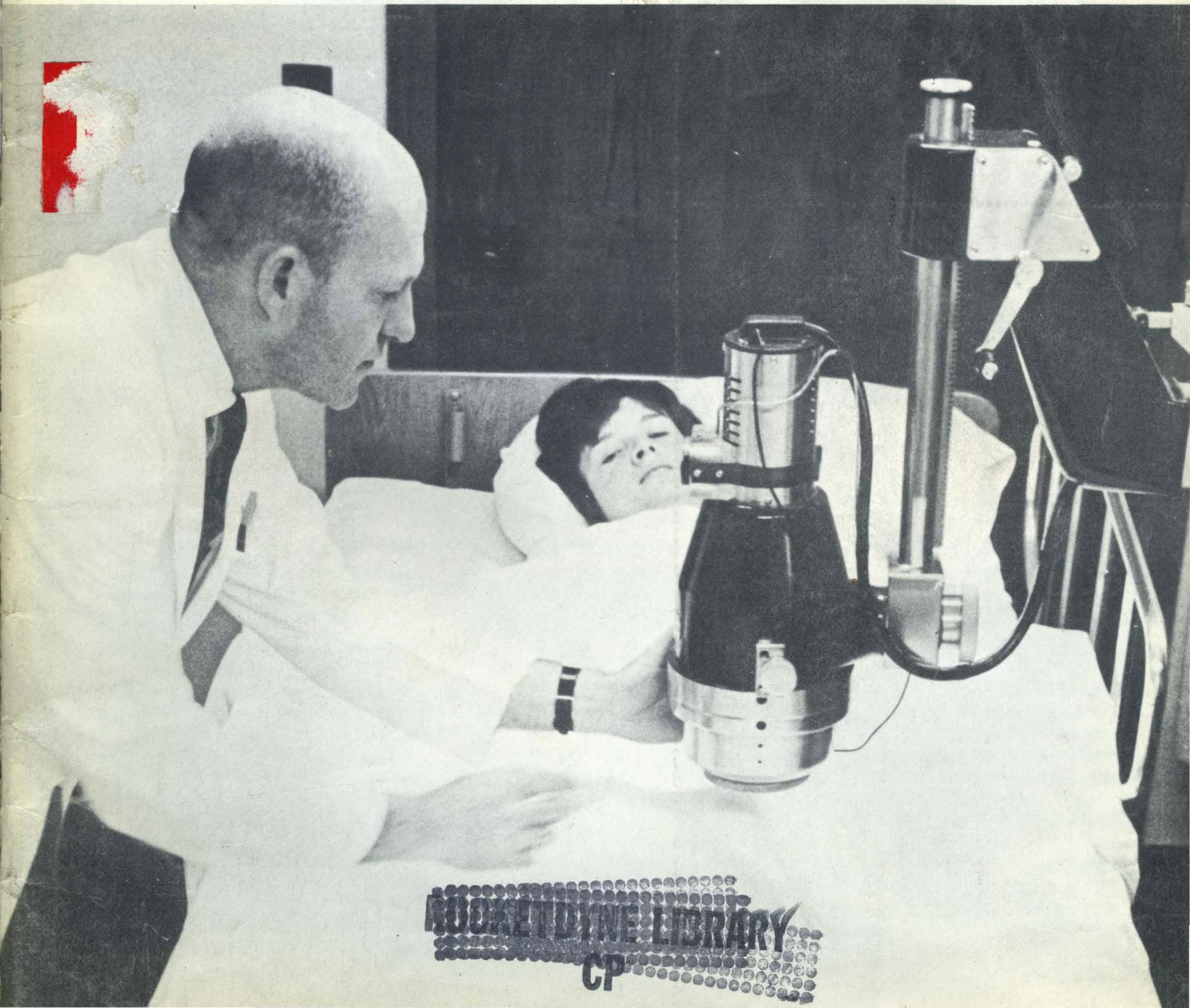
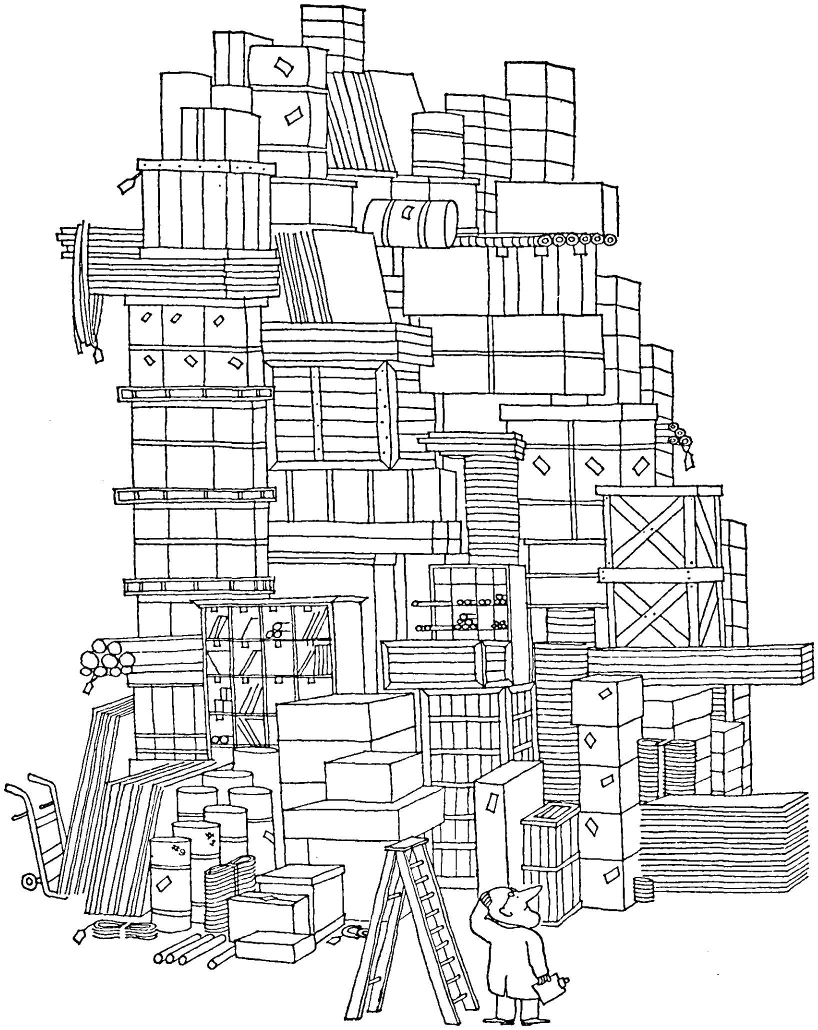
July, 1966

computers and automation

Computer Enhancement of Radioisotope Pictures



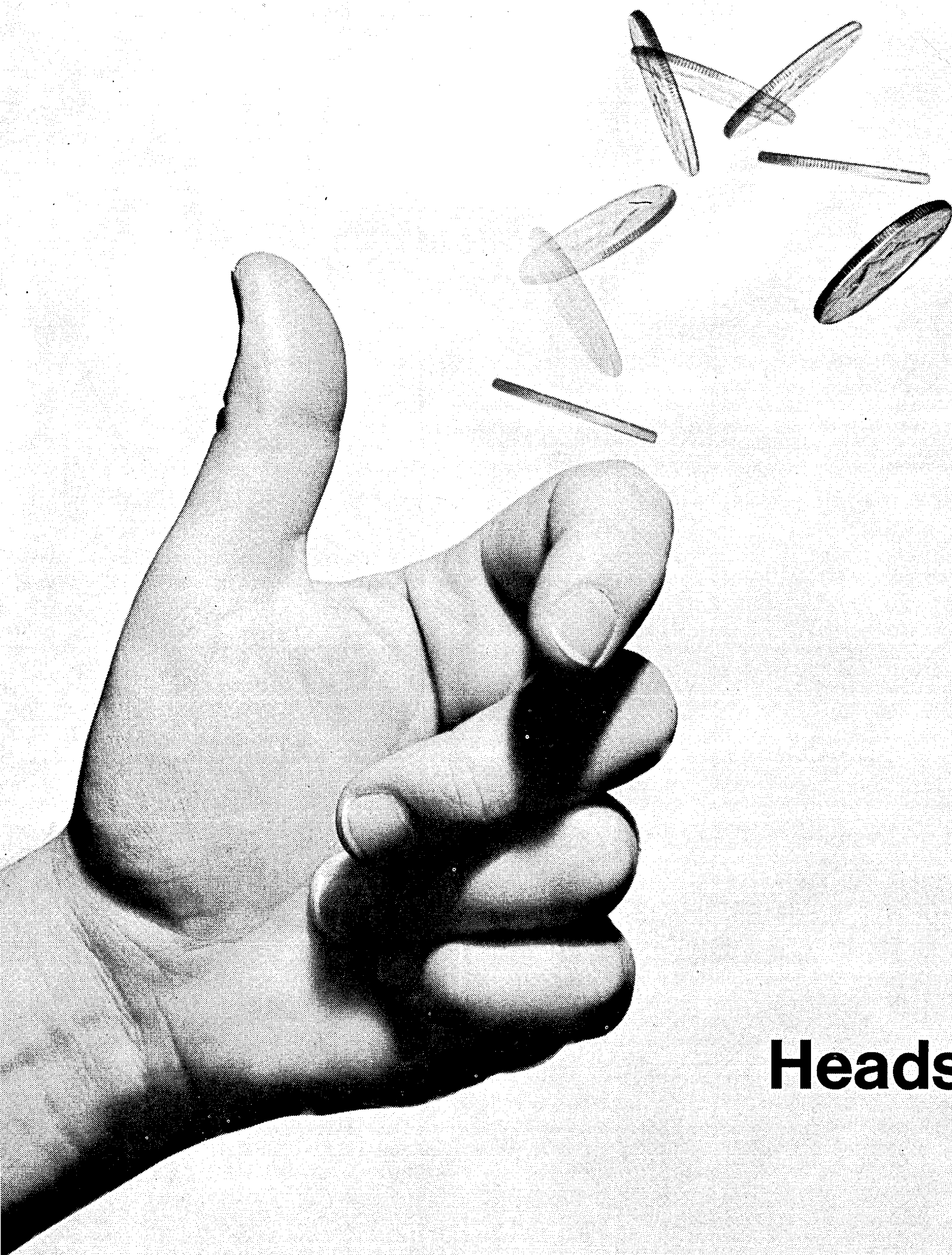


How to put your finger on one item out of 36,000

A division of H. K. Porter Company, Inc., does it by dialing a computer center. Any one of 36,000 items could be at any of seven warehouses and eight plants across the nation. When a product is sold, the information on punched cards is sent via Bell System Data-Phone* service over regular telephone lines to the Porter computer center in Pittsburgh. The information is instantly recorded on magnetic tape and fed into the computer. In a matter of milliseconds, the computer tells the production status or inventory location of the product. And the entire order is processed for shipment in one working day. (It formerly took up to fourteen days.) As ordering information flows in, the computer updates the average monthly demand, economical production quantities, and safety stocks. Replenishment orders are automatically produced when needed. The result has been a cut in inventories. And customer service is at its best. We can help you put your finger on the way to move information quickly and efficiently. Just call your Bell Telephone Business Office. Ask to have our Communications Consultant contact you.

Bell System

American Telephone & Telegraph and Associated Companies



Heads!

You don't pick precision magnetic tape this way, but we have the feeling that some people do.

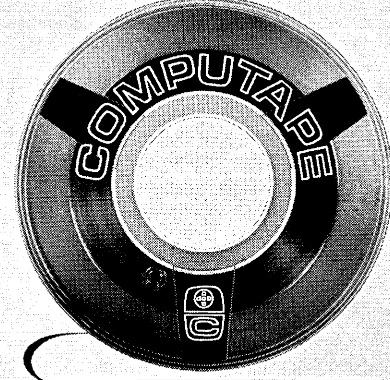
"How can you lose," we've heard it muttered, "one leading brand is as good as another."

Well, like the song says, "it ain't necessarily so."

Take Computape users. They would rather be safe than sorry. And they've found that, for long, reliable, error-free performance, Computape is about the safest tape going.

Has to be. Not a reel of tape leaves the plant that hasn't been checked and re-checked dozens of times for perfect quality and uniformity. And of course, each reel has been meticulously produced to meet the individual specifications of the equipment on which it will be used.

Nothing is completely sure in this life, but when you can come this close with Computape, why tempt fate with some other brand?



A PRODUCT OF COMPUTRON INC.
122 CALVARY ST., WALTHAM, MASS. 02154

Designate No. 5 on Readers Service Card

The front cover shows scanning equipment sensitive to radioisotope concentration; a computer enhances the resulting picture in the same way as pictures of the Moon and Mars have been enhanced by computer. *For more information see page 42.*

computers and automation

JULY, 1966 Vol. 15, No. 7

In This Issue

Special Feature: Data Communications

In Every Issue

*D ON YOUR ADDRESS IMPRINT MEANS THAT YOUR SUBSCRIPTION INCLUDES THE COMPUTER DIRECTORY. *N MEANS THAT YOUR PRESENT SUBSCRIPTION DOES NOT INCLUDE THE COMPUTER DIRECTORY.

COMPUTERS AND AUTOMATION IS PUBLISHED MONTHLY AT 815 WASHINGTON ST., NEWTONVILLE, MASS. 02160, BY BERKELEY ENTERPRISES, INC. PRINTED IN U.S.A. SUBSCRIPTION RATES: UNITED STATES, $15.00 FOR 1 YEAR, $29.00 FOR 2 YEARS, INCLUDING THE JUNE DIRECTORY ISSUE; CANADA, ADD 50c A YEAR FOR POSTAGE; FOREIGN, ADD $3.50 A YEAR FOR POSTAGE. ADDRESS ALL EDITORIAL AND SUBSCRIPTION MAIL TO BERKELEY ENTERPRISES, INC., 815 WASHINGTON ST., NEWTONVILLE, MASS., 02160. SECOND CLASS POSTAGE PAID AT BOSTON, MASS.

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THE THIRST FOR COMPUTER KNOWLEDGE

All over the world, it seems, there is a thirst for knowledge about computers: what they really are; how to apply them; how to make them; what their implications are. This was the predominant impression I received during a recent round-the-world trip which included:

— attending the conference on data processing in hospitals in Elsinore, Denmark, on April 22;

— discussing selections for the book club "Library of Computer and Information Sciences," with North Holland Publishing Co. in Amsterdam;

— giving a paper on the social implications of computers, at the British Joint Computer Conference in Eastbourne, England, on May 5;

— giving a lecture on time-shared computers and the computer programming language LISP in Moscow at one of the scientific institutes;

— talking about "garbage in, garbage out" to an editor of a magazine published in Hong Kong;

— giving three "public talks" and seven days of seminars in Tokyo and Osaka, Japan, May 16 to May 27, as a guest of the Nippon Office Management Association;

— talking about the social implications of computers to two editors in Honolulu;

— giving a paper on the intellectual implications of computers at the meeting of the Computer Society of Canada, in Banff, Alberta, on May 31;

— discussing lectures and courses in computers and information sciences in Toronto.

The Japanese audiences were the largest; I would estimate that more than a thousand persons in all came to the announced talks. But throughout the trip, it was clear to me that the force of change due to computers and automation is one of the greatest forces of this century; everywhere people are interested in and thirsty for information about computers.

This thirst is natural and desirable. With some 40,000 computers already installed in the world, and the number rapidly increasing, people everywhere need more computer information. Yet in spite of the great quantity of computer publications, much information has not yet spread from those who know to those who don't know. What can be done to remove the barriers? What can be done to increase the international flow and interchange of knowledge and information, in the best scientific tradition?

Several things can be done, it seems to me, that would significantly increase the flow of information.

First, a library or laboratory in any country, which is interested in a special subject, for example, computer programming languages, should be able to find other libraries or organizations in other countries which are working in that subject and should be able to exchange publications and memoranda with them. This kind of exchange of course already takes place often within a single country; it should be possible to have the same friendly relationship work naturally all over the world. If any organization outside the United States desires to find this kind of collaboration in the United States, we invite a "letter to the editor," and we will see what we can arrange by publishing the letter or in other ways.

Second, there is the problem of translation of important concepts in the computer field from one language to another. Here the work of the glossary committee of the International Federation of Information Processing Societies is invaluable. It is to be hoped that the glossaries in other languages besides English will be promptly published.

Third, not all ideas, principles, and questions in the computer field are equally important. It would be useful to have a committee or special interest group in the Association for Computing Machinery which would produce from time to time a reasonable selection of fundamental or important ideas, principles, and questions. For example:

1. Idea: multiprocessing.
2. Principle: The top speed of operation of a computer is limited by the speed of an electromagnetic wave in a circuit.
3. Question: What are the main reasons why it is difficult to program a computer to translate well from one natural language to another?

With such a selection as a guide, people newly coming into the computer field could learn more rapidly and their time would be used better.

There are other ways also of reducing barriers to the international flow and interchange of computer knowledge. We invite suggestions from our readers to this end.

And if any readers of "Computers and Automation," especially those outside of the United States, feel a thirst for computer knowledge and information, please write to us and let us see if we can be of help.

Edmund C. Berkeley
EDITOR

COMPUTER INSTALLATION CENSUS

I. From George Sadowsky

Director, Computer Center
The Brookings Institution
Washington, D.C. 20036

I believe that your efforts to maintain a census of computer installations and to report current changes are a worthwhile service, and I would like to offer the following information for your records.

The Brookings Institution is presently installing an IBM 7040 computer system. Brookings is a private, non-profit institution engaged in policy-oriented research in the social sciences. The computer will be used to support research in the fields of economics, governmental studies and foreign policy studies.

We will inform you of future changes in our computer configuration and areas of application.

II. From the Editor

Thank you for your letter informing us about your recent installation of an IBM 7040 computer system.

Your kind remarks and cooperation are very encouraging to us. Now that there are over 24,000 computers installed in the United States, it is a real challenge to keep track of the activity. However, thoughtful comments from people like yourself aid us greatly in keeping up.

III. From Donald E. Harris

Data Processing Supervisor
Oakland Bank of Commerce
Oakland, Calif.

Along with the enclosed subscription order, I thought you might be interested in the following installation for the "Newsletter" portion of your excellent magazine:

At: Oakland Bank of Commerce
Oakland, California

Of: IBM S/360 model 30 with 1419 MICR Reader/Sorter and 4 Disk Drives.

For: All bank applications, with current emphasis on demand deposits and savings accounting. Plans include expanded services for customers, and future conversion to on-line terminals.

From: IBM Corporation

Incidentally, I think that "Computers and Automation" is without equal in its field.

COMMENTS ON THE APRIL ISSUE SPECIAL FEATURE: "SOME PROVOCATIVE APPLICATIONS OF COMPUTERS"

From George A. Connell

Johnson and Johnson
Chicago, Ill.

To the Editor:

My hat is off to you, sir. I have in 25 years of experience in the field of data processing done a fair amount of reading. I have never however read articles of such outstanding calibre as those in the April 1966 issue by Lord C. P. Snow "Science and the Advanced Society" and Edmund A. Bowles "The Humanities and the Computer: Some Current Research Problems" plus your own illuminating editorial comments entitled "Perspective" on page 7.

Would you please send me three reprints of each and bill me?

FAREWELL FROM A FORMER SUBSCRIBER

I. From C. B. Collier

Southern Illinois University
Edwardsville, Ill. 62025

You have sent me a renewal notice to your magazine. This gives me an opportunity to tell you what I have thought about your magazine; also it gives me an opportunity to explain why I have allowed my subscription to expire.

Since 1949 I have been in data processing work. I do not remember when I first started reading your magazine but do remember that I have always thought it to be one of the best magazines in its field. Many of the features are not available in other places without much work.

Last November I changed my work and no longer am directly connected with Data Processing. Of course with so long a period of association I have the interest but do not find the time to keep up with both my new field and the old one. Thus I am dropping my subscription to *Computers and Automation.*

Let me thank you for all of the good work that you have done in the past and wish you well in the future.

II. From the Editor

We appreciate greatly your courteous letter and your kind remarks, and wish you well in your new field.

(Please turn to page 23)

BURROUGHS NEW 6500, A SOUPED-UP VERSION OF THE B5500, SHOULD GET GOOD RECEPTION

Burroughs Corp. introduced its much rumored B6500 system this past month. The announcement is likely not only to reassure existing B5500 customers that their programming expenses can be reinvested in a newer and faster processor, but also to unease the competition with the prospect of facing a computer system combining the most modern componentry with a software package field tested for over three years.

The B6500 uses the same logic organization as, and is program-compatible with, the B5500. It uses monolithic integrated circuits and a planar thin-film memory with a .6 usec. cycle time to achieve a processor performance improvement of five times over the B5500. . .at about a 50% increase in cost. In addition, main memory size (limited to 32K in the B5500) is expandable up to 106K 48-bit words. I/O capability has also been doubled by use of a multiplexer that allows up to eight I/O operations to occur simultaneously.

The B6500 is the newest member of Burroughs' B500 "family" of computers. The position of the B6500 in the B500 group is shown in the table below:

Model	Decimal? Binary?	Av. Monthly Rental	Date of Intro.	Date of first Installation	No. of Instls.	Est. No. of Unfilled Orders
B2500	D	$5,000	3/66	1/67	0	22
B3500	D	$14,000	3/66	5/67	0	18
B5500	B	$20,000	9/64	10/64	50	15
B6500	B	$33,000	6/66	2/68	0	2
B8500	B	$200,000	8/65	2/67	0	1
					50	58

Surprisingly, twenty months are to pass before the first B6500 is to be delivered. . .an announcement-to-delivery delay longer than that of any other system in its price class in the history of the computer industry! . . . and effecting an admirable strategy for preserving the longevity of B5500 rental income. New customers for the B6500 should have ample time to debug their programs on a B5500 before their new system arrives.

Acceptance of the B6500 by new customers as well as by current B5500 users will depend to a large extent upon the degree to which the hardware and software of the B5500 has satisfied the needs of its current customers. To assess the potential of this market acceptance, we conducted an informal survey of current B5500 users this past week. Here's what we found:

Q. 1: How do you rate the performance of your B5500 hardware?

Users uniformly were very satisfied; special praise was heaped upon the Burroughs "head-per-track" disk file.

Q. 2: How do you rate the B5500 software and programming support?

Users were quite pleased with it, with one user swearing it was "the best in the industry".

Q. 3: How do you rate the maintenance support for the B5500?

Comments ranged from "excellent" to "competitive", with one user giving Burroughs highest grades in preventive maintenance.

Q. 4: How do you rate the customer training program for the B5500?

Here users were less enthusiastic, saying it was "about average" to "outclassed by IBM's full-bodied productions".

Q. 5: What is your overall evaluation of the performance of the B5500?

Users were quite happy with the productivity of their B5500. One user was ordering three more; another, one more. Main complaint was the 32K limitation on the size of the main memory size. . .users would like to double it. Use of the B300 as a satellite was also cited as affording a boost in productivity.

Q. 6: What are the chances you will upgrade your B5500 to a B6500?

Nearly all users felt they may need a machine with the speed and memory capacity of the B6500. Most said they would probably stay with Burroughs, barring unforeseen experiences with their present B5500. One user said that he might order a second B5500 rather than upgrading to a B6500 because the B6500 price policy "does not offer a discount on a three year contract".

Overall, Burroughs seems to have earned claim to one of the most satisfied collection of computer users we've run across. With this base to build upon, the B6500 looks as if it will become a firm revenue producer in the Burroughs computer product line.

c & a
THROUGHPUT

PROGRAMMING LANGUAGES — WHEN?

A brief examination of the changes in the data processing industry since 1951 shows a startling re-emphasis from the viewpoint of the "average American user". The average annual cost of hardware has declined from approximately $750,000 to $125,000, both through improved technology and the advent of smaller, faster hardware. The annual costs of operating and development personnel show no such decrease: the average annual cost of data processing personnel has increased from about $120,000 to $190,000.

It is no wonder then that the average American user is beginning to become more concerned with the effective use of personnel, especially since the shortages in qualified planning personnel are being noticed widely. It is also no surprise that the user is concerned about the timely and effective delivery of manufacturer-supplied software, an increasingly vital element of the "compleat" data processing installation.

If we examine the history of software delivery, it is hard to find a precedent for timely and effective delivery. Perhaps then it should be no surprise that once again we have problems — especially now that software is complex, often all-inclusive, highly-integrated, and interdependent.

If we refer to history, dozens of Univac users used machine language. The IBM 650, 1401 and 7070 preceded their software by years. Honeywell's FACT compiler was 24 months off schedule. CDC's 6600 FORTRAN was on-time but incomplete. REX was complete but not on-time. And nobody, but nobody, discusses their first COBOL. (This should lead to the logical conclusion that all first COBOLS hereafter should be called COBOL-II.)

If we merely faced simple delays in software, the user could survive. After all, a delay is often beneficial, and provides the user with an oft-needed opportunity to finish the planning for the installation or the conversion. But we do *not* face simple delays; we appear to face highly complex delivery schedules, and a morass of misinformation and manufacturer confusion.

A number of questions come to mind, which should be simple to answer, but apparently are not:

- When PL-1 and how? A 360/40 compiler appears to be working in the basic version in England, but nothing official has been made available.
- When COBOL with disk I/O? or full OS, half-full OS, semi-duplex or half simplex OS?
- Where and how comes the 360/67 Software?
- When can we expect MULTICS?
- Where is the big SPECTRA 70 operating system?

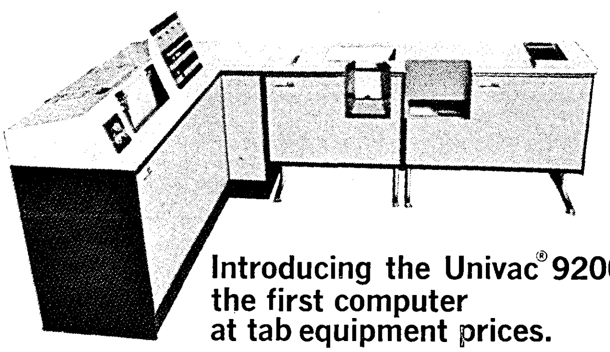
There should be no rancor on the user's part toward the manufacturer for software delays. These are understandable, forgivable, and in most cases worth waiting for. There should be considerable rancor for misinformation or missing information, and something should be done about it, right now!

Would the manufacturers please come forward and offer a list of software components and their anticipated access dates? Contributions from all sources will be gratefully accepted and acknowledged. We will gladly publish the availability data of the software of any manufacturer.

Dick H. Brandon
Contributing Editor

Sperry Rand the interlinking

Start with any one, and simply build



Introducing the Univac® 9200: the first computer at tab equipment prices.

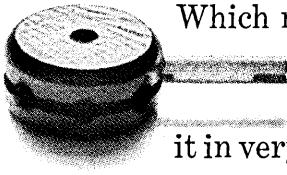
You can rent the 9200 for about $1000 a month. Or own it for less than $45,000. Tab equipment prices.

But the 9200 gets you out of the tab equipment class.

In fact, it can produce things like management reports, payrolls, invoices, inventory records, and scientific computations *eight to ten times faster* than the tab equipment you may be using right now.

The 9200 is a true computer. With a large, high-speed internal plated-wire memory. And the latest in micro-circuitry. And a complete software library.

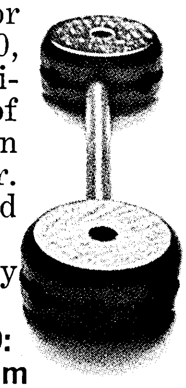
What's more, it can be converted into a 9300 high-speed tape system. Right in your office.



Which means you won't have to replace it when your business grows. You can just keep adding to it in very low-cost modular steps.

Or some peripheral steps.

One of which might be the UNIVAC 1001 Card Controller, which rents for $475 a month. Add it to the 9200, and you've got a high-speed, multi-file system that will do the work of *six punched-card machines:* An accounting machine. Calculator. Collator. Sorter. Reproducer. And a summary punch.

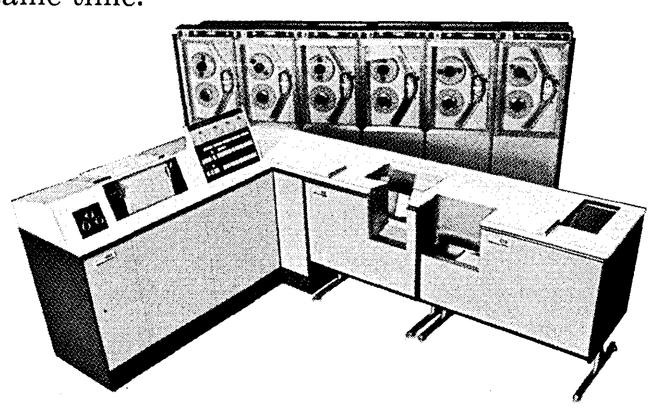


If you need more capability than that, read on.

Introducing the Univac 9300: the first high-speed tape system the small computer user can afford.

The 9300 brings you from punched-card data processing to a magnetic tape computer in one small inexpensive step.

It can read, write, and compute at the same time.

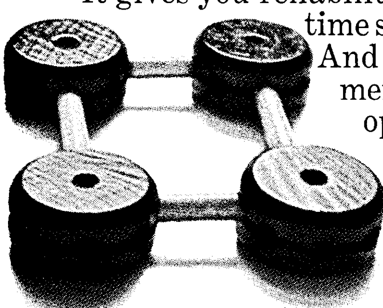


Univac announces computers.

on it as your computer needs grow.

It can run one or two peripheral tape programs and the main program at the same time.

It gives you reliability, efficiency, and a time saving of up to 50%. And far faster management control. Plus the opportunity to grow smoothly, without disturbing your business in the process. The 9300 is powerful. It starts with two tape drives, and can be expanded to sixteen.



Its effective tape read or write speed is 34,160 characters per second. This can be doubled by adding another control unit.

But the 9300 does more. It brings you complete UNIVAC software support: Tape assembler. Sort/merge. Report Program Generator. Fortran IV. Cobol. Control Stream Operations for unscheduled batch processing. Et cetera.

In other words, the opportunity to benefit from every major advance since UNIVAC invented the first electronic computer in 1946.

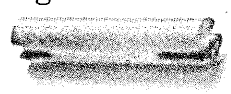
And, the 9300 is just a small step away from the next higher model in the series.

And, introducing some things to come.

The UNIVAC 9200 and 9300 are here right now.

But you might also like to know about some things we're working on for delivery in the very near future.

Like our UNIVAC 9500, which will combine real-time with batch processing and scientific capabilities never before available in a medium-scale computer. The 9500 will be able to serve even a large organization's entire data processing needs. Watch for it.

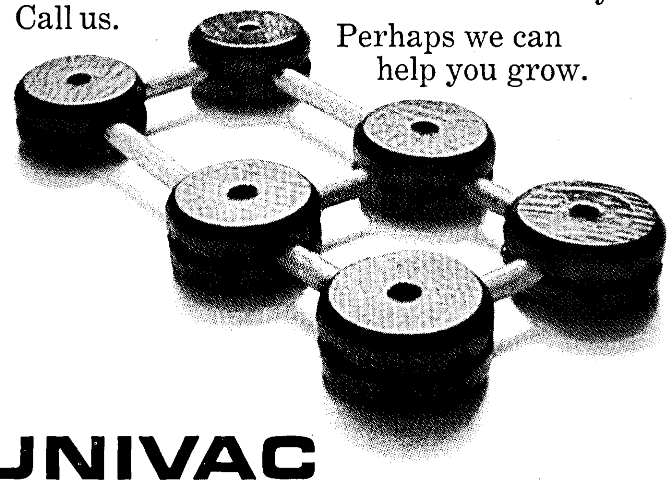


And watch for the other computers in our 9000 series. They will be as advanced in their class as the 9200, 9300, and 9500 are in theirs.

One thing more before you go.

UNIVAC has been the technological leader in the electronic computer business since we started it. We believe the computers in the 9000 series will help to demonstrate this fact. We'd like to discuss them with you. Call us.

Perhaps we can help you grow.



UNIVAC

DIVISION OF SPERRY RAND CORPORATION

Designate No. 8 on Readers Service Card

OPTICAL PROCESSING IN MEDICAL SCIENCES

by

Robert S. Ledley
National Biomedical Research Foundation
8600 Sixteenth St.
Silver Spring, Md.

The large scale quantitative analysis of photographs of biomedical structures and forms cannot feasibly be achieved by manual methods.

*One of the most important techniques in biomedical research investigation involves the examination of pictures. The medical scientist has developed highly specialized and precise methods for photographing structures, forms, and phenomena, in almost every field of biomedical research. Individual pictures hold a great wealth of precise numerical information, such as morphological and structural characteristics of lengths, areas, volumes, and densities. From sequences of pictures can be derived such quantitative results as the kinematic and dynamic characteristics of trajectories, velocities, and accelerations. Huge masses of pictures are being accumulated at an ever increasing rate. These include photomicrographs of chromosomes that relate to genetic diseases, photomicrograph sequences showing the dendritic structure of nerve cells, electronmicrographs of virus structures, films of x-ray diffraction patterns of biologically important molecules, and medical x-rays of various body parts.

The large-scale quantitative analysis of these pictures cannot feasibly be achieved by manual methods because of the tedium, manual precision, and extensive time that are necessarily involved. One method of approach to the problem is to utilize optical-processing techniques combined with the use of a digital computer. This technique promises to open up entirely new fields of investigation in biological and medical research. Two main steps are involved in the method: First, an optical scanning instrument "reads" the picture into the high-speed memory of a digital computer; and second, a computer programming system "recognizes" the object to be measured and processes quantitative data according to the requirements of the particular biological or medical problem under consideration. In our own research, we have designed a scanning instrument called FIDAC (Film Input to Digital Automatic Computer), which reads the picture directly into the core memory of an IBM 7094 computer, sampling 350,000 points of the pictures in seven different grey levels within 0.3 sec. Figure 1 shows the FIDAC instrument and a simplified block diagram of the FIDAC system. We have developed two programming language systems for picture processing: the first, called FIDACSYS, is a syntax-directed pattern-recognition language; the second, called BUGSYS, is a pointer-manipulation programming language.

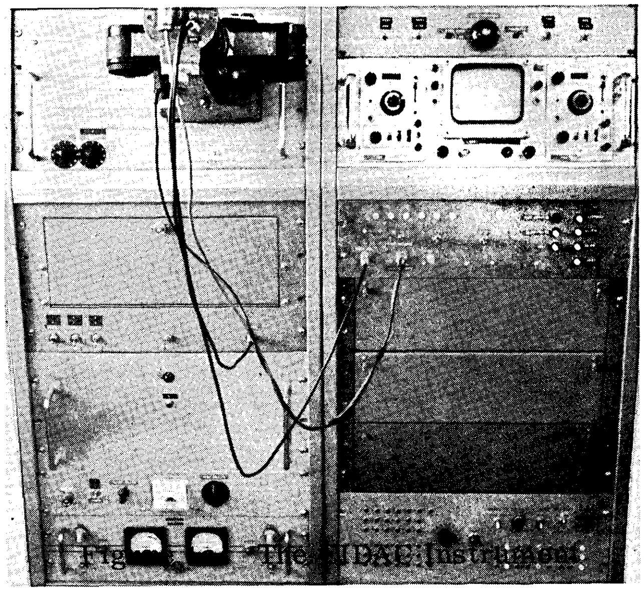
In this brief article we shall give four illustrations of optical processing in the medical sciences.

Analyzing Chromosomes

Recently, there has been much active interest in the analysis of chromosomes in the metaphase stage of mitosis, when they appear as structures split longitudinally into rod-shaped chromatids lying side by side and held to one another by a constricted area called the centromere. Certain abnormalities in the number and structure of chromosomes are particularly evident at this stage and can be related to clinical conditions in animals and in man. For example, in man, mongolism and the Klinefelter and Turner syndromes have been correlated with chromosome aberrations.

The study of chromosomes by manual methods, however, requires a great deal of time — enlarged prints must be made from photomicrographs, and each chromosome must then be cut out from the print so that it can be aligned with the others for classification into the so-called chromosome karyotype. With the FIDAC system, the time required for analyzing and classifying each chromosome can be radically reduced, to about half a second per chromosome. Here we use

*This work was supported by NIH research grants GM-10797, GM-10789, NB-04472, AM-08959, and GM-11201.



the computer for investigating large numbers of cells with respect to total chromosome complement counts, to quantitative measurements of individual chromosome arm-length ratios, densities, areas, and other morphological characteristics, and so forth.

By processing large numbers of chromosome sets and statistically analyzing the data, it is possible to give very accurate descriptions of the standard complement of chromosomes and individual-chromosome variability for particular species (see Fig. 2). This statistical technique may be the only way to uncover small variations which may prove important in relating chromosome karyotypes to diseases. For example, careful analysis of the chromosomes of individuals with myeloid leukemia, prior to the availability of automatic computer analysis, showed that the chromosomes characteristically lack a small portion of one arm; less obvious abnormalities may well be revealed by means of the computer.

Analysis of Neurons

In the young kitten's brain, certain neuron cells in the cortex will appear almost entirely within a single section, provided that the section is cut perpendicularly to the dura. Photomicrographs of such sections can be made so that an entire cell appears within a single photograph. Programs have been written which can recognize the dendrites, or extensions, of the cell, the dendrite-body junctions, branch points on dendrites, and end points of dendrites. Such an analysis enables quantitative measurements to be made of dendritic lengths, and lengths of complicated network of branches for a cell. From such measurements made on cells of animals of different ages, the ontogeny, or development, of the cell can be studied, and from measurements made on various related animals, the phylogenetic development of such cells can be studied in quantitative detail. Such measurements can also be correlated with neurophysiological and neurochemical research results. It is of interest, for example, to know whether or not the phylogenetically older cerebellar cortex in the mammal undergoes an earlier ontogenetic development than the later-evolved neocortex. Another question of interest is the general pattern of postnatal development of the two types of cortex. A further study would be the quantitative determination of the manner in which different patterns of morphogenesis are reflected in differences in functional activity. Such information can be of value in facilitating interpretations of structure-to-activity relations in mature cerebral and cerebellar cortex. Similarly, correlations of the differential development of the cortex with neurophysiologic measurements may provide important clues relevant to the problem of the susceptibility of different brain structures to various antenatal and postnatal traumatic or metabolic insults to the nervous system. For example, the effects on cortical development of starvation

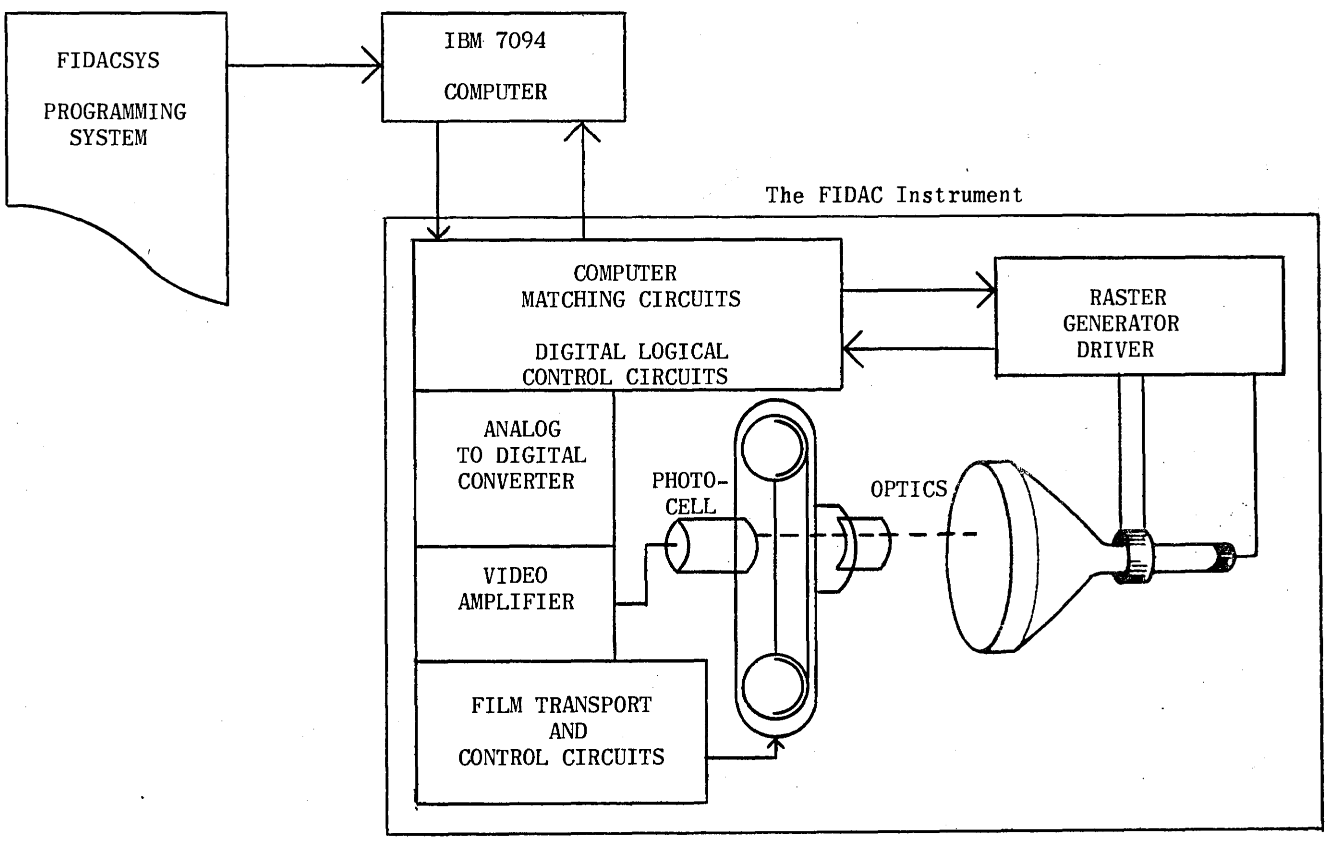


Figure 1b. Block Diagram of FIDAC System

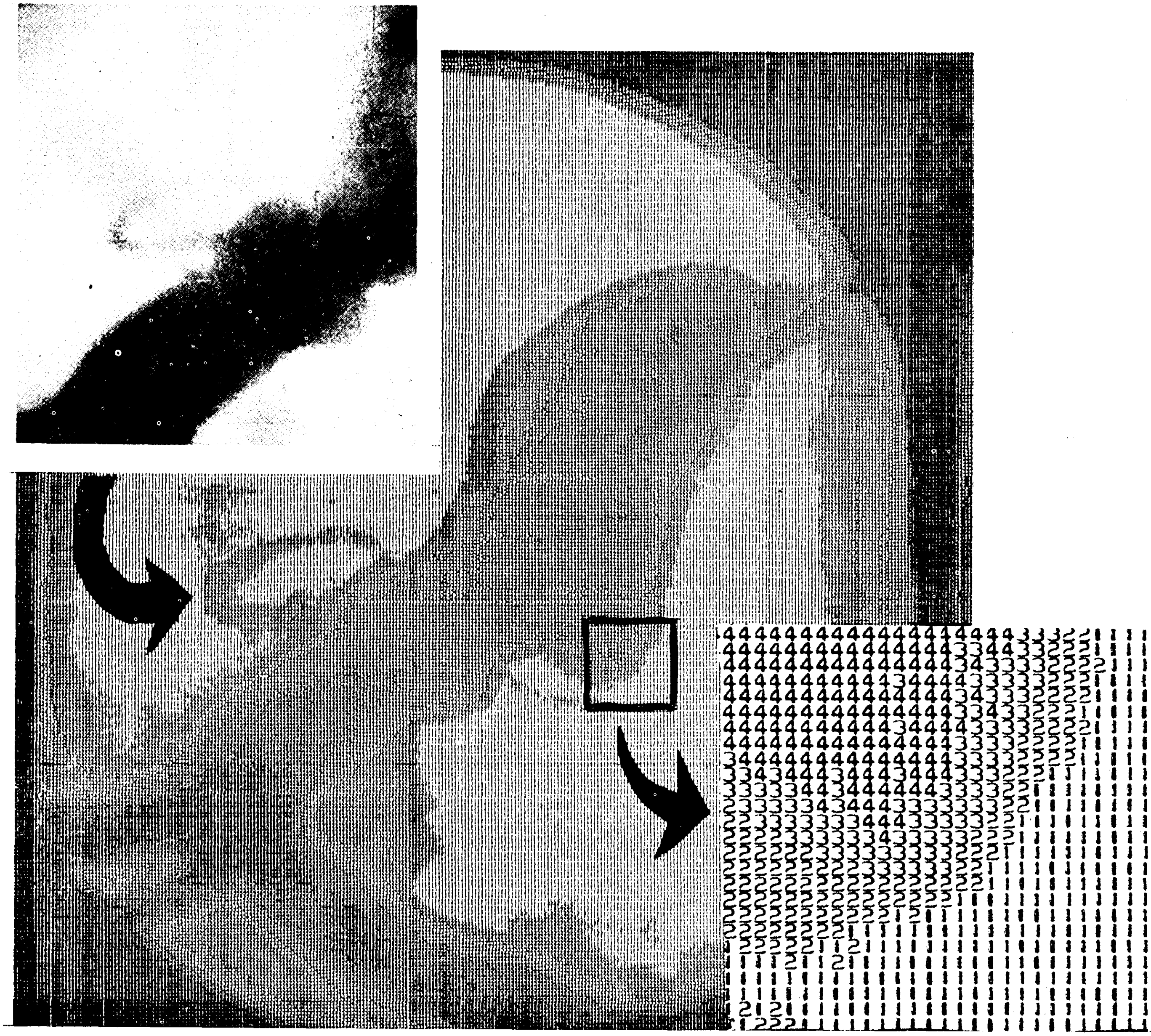


Figure 1c. At the upper left is a section of an original picture of an angiogram, or x-ray of the heart, after radio-opaque dye had been injected into the blood. In the middle is a printout from the computer's memory of the entire picture, and in the lower right an enlargement of one section of the printout.

from birth for a predetermined period, followed by a period of catch-up growth, can be studied.

Analysis of the Angiogram

Volumetric measurements taken manually from cineangiograms of the human heart are presently being utilized to produce pressure-volume curves for the analysis of the rapid ventricular events that occur during systole and diastole. However, the difficulty and tedium of making hand measurements from the cineradiographs limit the information obtainable from sequences of such pictures. Automatic methods for accomplishing this task can be utilized as a new tool for the study of the dynamic activity of the heart. The cineangiogram technique involves injecting into the blood in the heart a radio-opaque dye which makes the outlines of the ventricles clearly visible when x-ray movies are taken (see Fig. 1c). From such pictures, measurements can be made on the area of radio-opacity in the ventricle, the location of the center of gravity of that area, the locations of the lowest point and the most lateral points of the area, and so forth. As the pictures are taken, the actual ventricular pressure at the moment of exposure can also be instantaneously recorded directly on the film frame being exposed. In this way the pressure curve can be correlated directly with the area observed.

From the measurements made on each frame, the rates and accelerations are computed. The rate of change of a measurement is proportional to the difference between the measurements made on two successive frames. The acceleration of quantity is the change in the rate of change of the associated measurement. Since the acceleration is directly proportional to the force, these rates and accelerations can be utilized as a direct measure of heart activity and can be correlated with normal and diseased states of the heart. The velocities and accelerations of atrial and ventricular filling and emptying can be computed, and from this data the ventricle compliance and the velocity of myocardial fiber shortening can be calculated. The determination of these variables makes it feasible to characterize myocardial function in patients with various forms of valvular heart disease and myocardial failure, and to determine the effects of various therapeutic interventions, such as cardioactive drugs, muscular exercise, etc. The results may lead to more sensitive and specific diagnostic procedures and evaluations of treatment results.

Processing of Electronmicrographs

Electronmicroscopists are utilizing great skill and are spending much time and effort in obtaining photographs of structural and molecular patterns of great biological significance. Many of the biological structures being investigated exhibit repetitive patterns or are composed of symmetric particles. The interpretation of such pictures can be greatly enhanced and more quantitative information can be obtained from them by the use of the method of picture averaging. In those cases where picture averaging is applicable, this may be the only means for obtaining more significant information, since the noise found in electronmicrographs can be considered in part as an inherent property of electronmicrographic methods. A similar method has further applicability in neurophysiology, where the averaging of neurological reaction to evoked response, as recorded by electrodes, has greatly enhanced the results obtained.

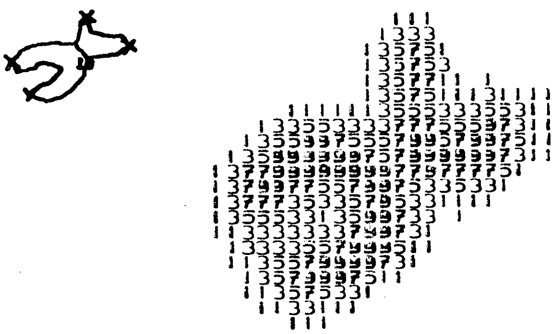


Figure 2. At the right is the representation in the computer's memory of a scanned chromosome. At the left are the plotted results of the computer analysis: the crosses represent the locations determined by the computer for the ends of the arms; the central line represents the location of the centromere as determined by the computer.

It is well known that where repetitive patterns are available, random noise that may occur in the patterns can be eliminated by averaging. Two-dimensional pictorial averaging has been accomplished by means of superimposed-photography techniques. The photographic technique has a disadvantage that a positioning jig must be fashioned beforehand for each exposure, and the successive pictures must be made from the jig in an essentially "blind" fashion. This is a tedious and time-consuming task, particularly where many trials of different superpositions must be made. Hence this photographic method is not extensively applied.

Utilizing computerized picture processing, many trials of overlapping positioning of repetitive patterns can be made rapidly. Certain theoretical problems, however, must be carefully studied, for there are many pitfalls in such pictorial averaging, such as the fact that artificial patterns may be generated due to the nature of the superpositioning process, rather than due to any intrinsic pattern existing in the original picture. But if used with care, such processing of electronmicrographs can be of great value.

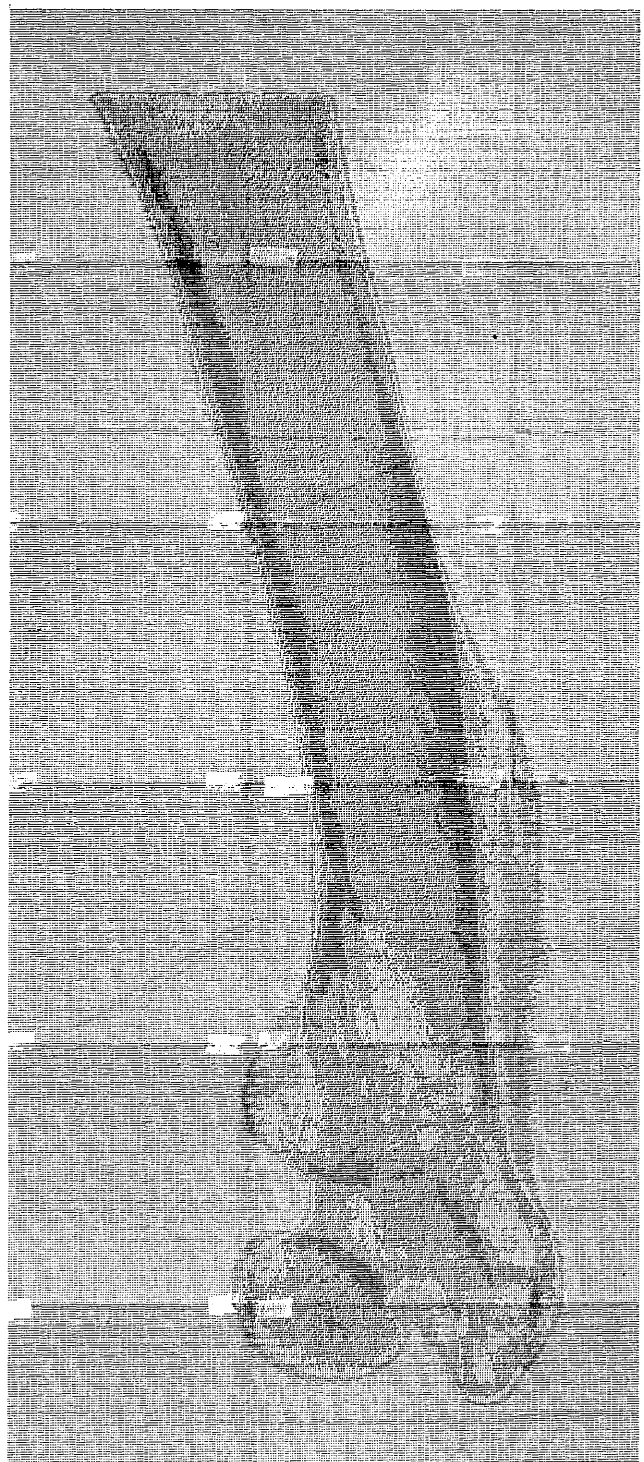


Figure 3a. Printout of the scanned x-ray of the femur of a rat.

As higher and higher magnification is obtained, many virus particles and other biological structure are seen to comprise highly regular polygonal geometric shapes. Most frequently these shapes are repeated many times in a picture, because they represent molecular structures. Measurements on these structures can give important information concerning their organization and function.

X-Rays of Bone

The growth and development of bone can be studied by means of x-ray techniques. The optical processing of such x-rays can enable the making of measurements of the quantitative density of the hard calcium structure of bone. The x-rays are absorbed by the hard structure of the bone, and therefore the optical density of the x-ray film becomes a measure of the calcium absorption of the x-rays. Such measurements on thin sections of, for example, an excised femur of a rat (see Fig. 3) can enable a more detailed description of the density distribution of the bone. The method can be utilized for the study of the effects of mechanical forces, physiologic agents, and so forth, on the growth and development of bone.

In our work we are attempting to establish a quantitative relationship between mechanical stresses and bone growth. To do this, we have constructed a theoretical model in which, for a given applied-force pattern, the stresses within the bone are computed. A relationship is hypothesized between the maximum stress developed at any point in the bone and an increment of bone growth. In our theoretical model we include this increment, which then itself changes the theoretical stress pattern, from which we again produce another increment of growth, and so forth. In this way we develop a simulation of bone growth. However, the simulation is useful only if it compares successfully with actual bone growth taking place in a real animal. The optical scanning-densitometric method mentioned above is used to check the experimental measurements with the theoretical results. Rats at different stages of development are sacrificed, and a complete three-dimensional density characterization is made of the femur of each for comparison with the model. This method of study of the detailed calcium density distribution in bone is made possible only through the use of the high-speed optical processing technique utilizing the FIDAC.

Additional applications of bone density measurements from x-rays are associated with the evaluation of the actual physiological age of a child (as opposed to the chronologic age of the child). X-rays of children's hands indicate calcium-deficient areas at the ends of the finger bones at the places where the greatest bone growth is occurring. The thickness of these epiphyseal plates has been shown to be an excellent criterion for evaluating physiologic age. Large-scale screening methods of such x-rays of the hand is made feasible only through the use of automatic optical processing on such films.

Conclusions

In this short article I have attempted to review a few of the medical applications of optical processing, choosing those in which I have had personal experience. There are, however, many more applications of such optical processing in other areas. Some of these are:

- the analysis of Schlieren photographs in the determination of the molecular weights of large molecules, utilizing the ultracentrifuge;
- the analysis of autoradiographs made by polymorphonuclear leukocytes (white blood cells) which have had radioactive material incorporated in them, for the study of leukemia and other blood diseases;
- the analysis of Papanicolau smears in the detection of cancer;
- the interpretation of photomicrographs of bacteria for laboratory identification;
- the automatic densitometric reading of crystallographic films in the determination of molecular structures of biological importance;

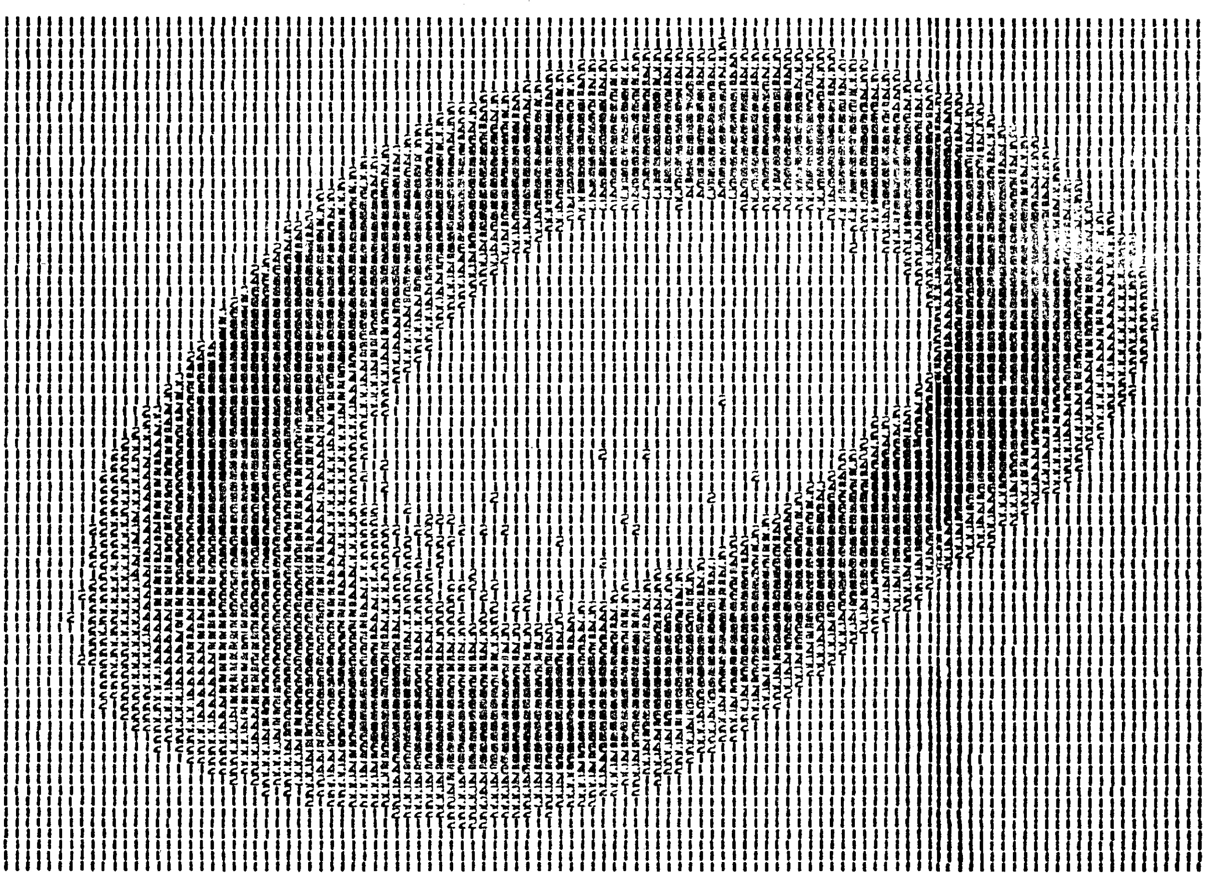


Figure 3b. Printout from an x-ray of a cross-sectional slice of the femur of a rat, showing the density distribution of apatite in the bone.

(Please turn to page 23)

MULTIPLICITY IN COMPUTER SYSTEMS

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Multiprocessing, multiprogramming, multicomputing, multipriority, multiusers . . . some definitions and implications, and the philosophy thereof.

This article is about multithings: multiprocessing, multiprogramming, and multicomputing. *Multiprogramming* means several programs operating in the same environment; *multiprocessing* means several processing units in the same computer which can operate simultaneously; *multicomputing* means there are several computers in the same environment.

Multiprocessing

Several processing units are necessary for several processes to go on at the same time. "Multi" here implies simultaneity; we consider the computer running with several different pieces of processing going on. These processes could pertain to the same program or they could pertain to several programs. The latter case is a category of multiprogramming described later. Let us examine one program with several processes going on: a single program with parallel processing.

What is required in the way of the program? Define four different pieces of processing, A, B, C and D. Multiprocessing means say that A and B may proceed together and C and D also proceed at the same time. What does this require with regard to the relations between the calculations A, B, C and D? When A and B produce results, are these required by C and D? If they are, then certainly both A and B must terminate before C and D begin. Further, we would expect that we must organize this processing so that A and C do not proceed together because the results of A are required for C.

This means each program must be organized with regard to some precedence arrangement; we establish which processes can proceed concurrently, which must proceed in a given order, and which are independent.

Programming is customarily arranged sequentially in time; the programmer writes down a sequence of steps that the computer executes in the order written. There are exceptions in terms of subroutines and loops and so forth but these can be restated to conform to this precept. For instance, a subroutine or a loop can be reduced to a point on a line where the other points on the line represent sequential processing. The line has direction: we go from start to finish even though there are loops in it.

Parallel processing requires that while we are going along one line we are also traversing a second line. This places a heavy burden upon a programmer who must indicate to the program (the program must also be capable of communicating to the computer) which calculations are sequence bound and which are sequence free.

Is there an advantage to multiprocessing? Multiprocessing requires resolution of a problem into small segments to be performed concurrently; naturally, the problem may be completed more quickly. But, given a particular investment in equipment, if it were distributed according to a multiprocessing discipline, would it result in a more effective system than if it were distributed conventionally? Certainly there would be a small class of problems which multiprocessing would definitely cause to run faster. Many other problems however do not lend themselves to multiprocessing. Further, consider the amount of time which the programmer spends determining sequence-bound and sequence-free segments and precedence relations.

It is possible that in the future software might examine programs to find sequence-bound or sequence-free segments.

A problem is suitable for multiprocessing if:

- First, the problem is reducible to concurrently processable portions or segments.
- Second, the means for the control assignment is faster than the processing or is overlapped with the processing.
- Third, the problem we solve is processor-limited.
- Finally, the majority of the time spent by the computer is in processing rather than in software.

These conditions provide an advantage to a given problem set. For an overall advantage most problems would have to be divisible into segments which permit concurrent processing: it is doubtful if such is generally the case.

Multiprogramming

In multiprogramming, several programs are executed simultaneously. Several programs reside in the memory at once and, during a given period of time, several of these are processed. After we process a portion of program 1 we process portions of other programs and then return to program 1. For *true* simultaneity of program execution we would have to have multiprocessing. Let us rule that out for the moment.

We distinguish several levels of multiprogramming:

- First and most basic, we have simple *simultaneity of input/output;*
- Second (not usually considered multiprogramming), is the *coexistence* of software and a program in memory both used by the computer within the same interval of time
- Third is a level built on the last level: *segmentation*: A program, too big to be held in memory, is broken into several segments, some of which co-occupy memory at different times.
- The fourth level is *interleaved programming* where a piece of each program is done in round-robin fashion.
- Fifth is *background-foreground multiprogramming* with a dual priority structure;
- The sixth is *priority multiprogramming* with a complete priority schedule;
- The seventh is *user-operator multiprogramming* — the time-shared systems, such as MAC (multiaccess computer) at Mass. Inst. of Tech. where there are several users-programmers who are also operators.

Simultaneous Input-Output

Simultaneity means that IO operations take place while processing is going on. If we consider IO as a kind of processing, then simultaneity looks like multiprocessing: information is put in as other information is being processed. Here processing is independent of input. The IBM 1401 and the RCA 301 both have simultaneity of this sort.

This takes on the guise of multiprogramming when the IO device receives a sequence of steps, as for the IBM 7090 and its brothers and sisters. A sequence of commands obtained from memory by the channel controller is given to one or more IO units which execute them at the same time the main program is under way, via the main control subsystem and processing subsystem. This is an example of two programs which take place in two different subsystems.

Software Coexistence

We are aware of these kinds of software:

- The system supervisor coordinates all the other pieces of software.
- The foreman or executive accepts interrupt information from simultaneously operating IO channels. Interrupt is used to stop the computer from performing its present program to repair or monitor program incoming and outgoing information.
- The translator takes information in source-oriented form and converts it into machine language.
- The input-output control system, integrated with the foreman (IOEX), receives interrupts, making sure that buffering assignments, blocking, deblocking and so forth proceed as required.
- The loader brings in new programs, coordinates them with subroutines, macros, and the library and does relocation as needed.

While the program is running, we see what takes place in a large software system. The IO interrupts the present program, calls in the foreman, which handles incoming or outgoing information and makes sure that it does not need to be repaired in any way. Then it turns over control to the input/output communication system to determine the next assignment and to properly organize the incoming information with regard to the program. The IOCS usually returns control directly to the program. In turn the program may make calls upon IOCS which takes control out of the program proper into IOCS which makes assignments and queues up requests for IO devices. IOCS returns control to the program where it was left off.

The program, during this interaction, is multiprogrammed. Also, main pieces of the program are interrelated with subordinate pieces. These are parts of the subroutine library which the programmer has requested and which the loader has properly entered into the memory.

Again, during normal execution of an untried program there may be reporting back and forth between that program and the system supervisor and the debugging or dump routine. After dump, or when a program is completed, return is made to the system supervisor which coordinates bringing in new programs and working with the programmer's requests with regard to new programs. For instance, after one program is completed, the new one that comes in may require translation. The supervisor must go back and forth between the translator and the requests of the programmer. When the program is finally compiled and translated, return goes to the loader which brings in anything else that is required and finally turns over control to the translated program.

Since here some of the time the program is managing the computer and other times the software, this is the first approach to a multiprogramming environment.

One final point about software-program relation involves **memory protect.** Multiprogramming requires sovereign areas inviolable to a given program and which should not be interfered with by any other programs. This is possible with memory protect. A running program could not clobber the software if memory protect is provided. Unfortunately this is not the case for many middle-sized systems and often the program *does* clobber the software.

This is repaired rather simply when there is a copy available, either in another part of core or in auxiliary memory.

Segmented Programs

Here, as previously, there is a program and software in memory. However, the program consists of several segments, all of which cannot fit into memory at once. A goodly portion of the program is in an auxiliary memory medium such as magnetic tape, disk or drum. As one portion of program is completed and another is needed, the loader is called upon to bring it in. The loader or a portion of it exists in memory, along with the segment being processed. The main program calls upon the loader which goes to the auxiliary medium to pick up more of itself, after which it can then again go to the auxiliary medium and pick up the next segment.

This segment is **overlaid,** placed over the current segment, and then control given over to the new segment. While this happens, we may keep a small portion of main program in memory.

Round Robin

I doubt that anyone would deny that round robin operation, offered in the Honeywell 800 and 1800 for four or five years, is multiprogramming. It uses a memory protect feature and it permits several *completely different* programs to be performed in the computer simultaneously. The Honeywell 800 provides for eight programs in memory each with a separate hardware control unit. These control units are time-shared. They are examined in sequence by a commutator; each is given a fixed amount of active time. When control unit 1 is on, it performs commands from program 1 until its time has expired. The commutator then assigns control to control unit 2, giving it a fixed time. If a control unit has *no* request for time it is skipped — it loses its turn.

The arrangement may revert to uniprogramming when only one control unit is in control; once its time has expired it regains control.

Let's suppose with several programs going a control unit has made an IO assignment which is vital to it and without the data therefrom it is unable to continue. It must wait for data to come in; it becomes hung up. It is pulled out of the commutator cycling. When the commutator examines this control unit, since an IO operation is in progress for it, it is disregarded. The next control unit is hence examined.

How effective is this system for handling programs? It does several programs at once and masks delays caused by IO devices even when simultaneity is not provided. An IO device goes off on its own, cutting off its program; we continue with whatever programs are left. When IO reports in, *this* program is re-embraced by the round robin milieu.

This is a neat way, without elaborate IOCS, and without simultaneity, to provide efficient device manipulation and efficiently running programs. It is especially useful when we combine IO limited and processor limited programs. But it is even effective when the programs mixed are all IO limited, provided they don't all require IO at the same time.

To implement this system Honeywell provides limit registers for each control unit so that one program does not clobber another, and so that one program can be debugged while other programs, previously debugged, are performing useful work — no fear of them being clobbered. This is truly multiprogramming because several programs are run at the same time. The software may be on a separate control unit or it may be called in to any particular control unit as required. For instance, when one program terminates, that channel may call in the supervisor which takes over just as in any uniprogrammed environment. The supervisor reviews the system input device and determines the next program, calls in the translator which will then occupy that channel and so forth and so on.

No problem arises when two or more programs terminate at the same time since they can be processed on a priority basis. The problem which does arise is the amount of memory available to each of the eight programs and to the software. This becomes a limiting factor only when we try to use eight large programs.

Foreground-Background

This multiprogramming has been adopted by Univac III which combines two tasks. It gets one of them done in the spare time that the other one provides.

As long as we have simultaneity, interrupt, and the ability of software and a program to coexist in memory, it is fairly simple to get *two* programs and software to coexist; this is the philosophy that the Univac people used for Univac III. With programs that are IO or processor bound, other facilities are lying fallow; so why not have two programs? One of these is of primary importance, but when it gets hung up, we take the other program which is in the background and make it use the computer until the facilities which were tied up become free. Then the foreground program can continue.

This works well where the background program is a card-to-tape, tape-to-card or card-to-printer conversion, one of the utility programs which we don't like to spend a lot of time on directly but which are necessary to the proper operation of the facility. We do this efficiently because main-frame computer time which would otherwise be wasted is applied to this peripheral problem.

The alternative which some installations adopt is a satellite system — multiple computers.

Multipriority

It is a simple matter to extend the foreground-background concept to embrace a multiplicity instead of a duet of programs. This requires a hierarchy of importance embodied in a priority structure. The discipline for selecting the next program for execution when another program has temporarily expired distinguishes multipriority schemes from each other and deserves much more attention than can be provided in this paper.

Personally, it seems to me the most important avenue opened by multiprogramming is multipriority. To continue the metaphor, I hope my scythe may hack away some of the underbrush impeding our progress but on a different occasion.

Multiuser Operator System

This is the on-line, time-sharing system. There are a number of consoles, each of which communicates between the computer and a user who is also the programmer and operator. The user has a problem to solve; he constructs a program for it on line. He sits at a console, enters information into it and receives results back from it — the interaction is in **real time.** If we furnished him with a large computer and put it at his disposal as long as he needed, it would cost several hundred dollars an hour. By permitting the computer to do other tasks in between the short time required to respond to the user, most efficient use is made of the computer.

The system consists of

- multiple consoles at each of which one user may sit
- one or more background programs
- software — all the software we discussed earlier — if not to handle the multiprogramming environment, then to handle the background program
- a monitor for the multiprogrammer
- a philosophy (built into the supervisor)

consoles

Foreground programs are entered at the user's console with source language commands which the computer compiles or assembles for him, as required. He also enters control instructions to the monitor, telling it what he wants done. He also enters:

- data
- program segments to be translated
- routines which have already been compiled into machine
- language

He enters this information on line when he thinks it is needed.

user time

About each user we ask:

- how much time does he get?
- how often?

These questions amount to the multiaccess philosophy.

At this juncture the crucial question is "What benefit do we derive from multiaccess?" The usual answer is, "There is a reduction in turnaround time compared to the conventional computer installation. **Turnaround time** measures the time between the moment when the programmer submits a program and the moment when results are returned to him. Conventionally, turnaround time can be anywhere from minutes or hours to days since it includes time to:

- schedule the program
- run it
- get the results out
- return results to the programmer.

For multiaccess we give information to the computer directly, hence the turnaround time is

1. the entry time
2. the interservice time
3. the processing time.

Hence **interservice time** is the time it takes for the computer to get around to our program. Certainly we get a faster system. Can the user apply the information as quickly as it is returned to him? In many instances the answer to that is "yes."

software

Next we ask what software is required. We need a translator, but how about a foreman and an IOCS? It is not extensive for the short programs for the computer to solve directly. But we can't expect this setup to be devoted entirely to the user-operator! Payroll problems or matrix inversion problems which have been run before are the background programs for which a large amount of time is required and for which loading, IOCS and our whole deal is required.

We DO need software! We don't need a loader for the consoles but we do need the multiaccess monitor which picks up console requests according to the multiprogramming philosophy.

What are the extant philosophies?

- **to-completion philosophy** — finishes each user's task as it arises
- the **round-robin philosophy** has been discussed
- the **use-priority philosophy** delegates time according to how much a user has already been allotted
- the **need-priority philosophy** examines a user's rating with comparison to others. As an example, we might give increased importance in sequence to student, teacher and researcher.

Philosophy Contrast

to completion

This is really not as bad as it sounds. If the average use-time for the computer, i.e., the average time required to service a request, is small, then it's not going to lead to trouble. As soon as a request comes up, it is acted upon: the computer takes over, and works on this request until it is done. As other requests arise, they are queued up and wait until the computer becomes free. If average use-time is small, most often the computer is working at the background task when the next request comes in. In general, as long as there are no excessive work periods the expected waiting time will not be very great.

Let's see what difficulty we might get into. Suppose we get into a non-terminating loop. Then a program which has requested use of the computer may really throw us for a loss because we'll never get hold of it again; we'll just stay in the loop. So it seems like the "to completion" strategy is effective as long as we don't run into a non-terminating loop or something like that. On the other side of the coin a request by a user to try out a small segment of program will last maybe milliseconds, or at most seconds. This is in our favor because the simple philosophy removes the need for software to determine who's next. All we need is a "loop buster" and we have a workable system.

round robin

Besides entry-time round-robin operation depends on two things:

- the time it takes to process a request;
- the time allotted to each user.

Suppose we allow a very short period for servicing a user. We commutate from one console to the next, giving each user a little time to work on his program. There are two difficulties.

The shorter we make the servicing period the more frequently a user will have to get his request serviced. This punishes the longer program because it must wait for many tasks, as many as intervene to be serviced (at least partially), before he gets his program finished. Most of these interloping tasks (as far as the long program is concerned) will have some portion completed before this task gets finished. But even more important is that a lot of time is spent with the monitor as we skip from one program to the next. With only one control unit the multiprogramming monitor has full responsibility for saving information from an expired program and readying information for the next program. Housekeeping time expands as the service period becomes shorter.

When the service period becomes longer, shorter programs can be finished in one period. As the service period becomes longer and longer, we approach the "to completion" strategy. A noninfinite long service period allows loop takeover and monopolization of the machine.

use priority

Now we punish the long user even further. We use the round-robin strategy but augment it to use the program's history. For a program which has used more time than others:

- the servicing period becomes short, or
- its turn is skipped occasionally or frequently.

This punishment seems unfair because the longer programs are going to require extra servicing by the multiprogramming monitor thus punishing the system too.

System effectiveness depends upon:

- the service period
- the average user-time-to-program-completion
- the average number of user-programs requested
- the background program.

need philosophy

We give a person time according to his priority class.

1. A researcher with a basic need for problem completion is given a high priority;
2. A teacher preparing classwork for his students or with some other worthwhile purpose gets second priority;
3. We continue thus until we come to the student doing a class assignment;
4. The student who is just playing around will get last priority.

According to the priority class we either:

- give high priority a longer service period and low priority shorter service periods, or

• give more turns to higher priority.

More turns means more interdiction by the monitor; every time the monitor comes into play there is a shuffling around of information for which the system suffers. Need priority rewards the person with the high priority and punishes the one with the low priority.

Multicomputers

Here several disparate computers are used together in the same installation. If they are identical, why not replace the two small ones with a larger one? The supersystem we examine is two or more computers which differ in balance, complexity, ability to do certain jobs and so forth. An example is an installation with one IBM 7090 and one or more IBM 1401s. It is common for the 1401 to do all the IO, conversion and so forth. The 7090 on the other hand takes data from a very fast input medium such as magnetic tape or disk and does all the processing, putting out information on a similar fast medium which is returned to the 1401 for final output processing.

An ostensible advantage is the independence of the two systems: if the 1401 fails the 7090 can do the input and output processing; if the 7090 fails the 1401 can't do much more than prepare a lot of information for the 7090 until it is back in working condition. This apparent advantage is outweighed by a multiprogram system of either the foreground-background or priority type, which makes use of the fallow time of the large computer in doing secondary tasks while the other limitations are in effect.

LEDLEY – OPTICAL PROCESSING

(Continued from page 18)

• the analysis of events that occur in tissue culture preparations utilized in the study of cancer;
• the analysis of the kinematics of red blood cells as seen by means of high-speed photomicrography of capillaries in living systems.

Optical processing in the medical sciences can contribute in a significant manner to furthering quantitative biology and medicine.

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FORUM

(Continued from page 8)

REPORTS ON DATA PROCESSING CENTERS
I. From Harold S. Carroll

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First National Bank
Fort Collins, Colo.

I would like to express my feelings toward your publication as I feel it is tops in the information contained within. Your format is excellent as it normally contains useful information and a person doesn't thumb through pages of limbo to access pertinent data.

May I also note here the type of Data Processing Center which we have in operation? Due to the size of our bank and our somewhat remote location we have a rather unique data center. We installed our computer system in a building which was designed and constructed specially for computer occupancy. Our repertoire of processing varies from Banking needs into the field of Scientific applications. In your publication of case histories, we feel our operation could be of value to firms considering the implementing of a Computer system. I'm sure you receive many requests from users of computer equipment for publication of their system in your magazine. However, if you would be interested in our center, I'm sure you would be pleasantly surprised in our approach to a contemporary computer facility.

Again, keep up the quality of your publication . . . it's worth its weight in core memories.

II. From the Editor

Thank you for your letter and your much appreciated complimentary remarks about our magazine.

From the comments in your letter, I am sure that many of our readers will be interested in learning more about your computer installation. Can you prepare a write-up on your equipment, plans, and activities which we might use in the "installations" section of our magazine?

We would be most pleased to bring the achievements of your computer center to the attention of our 30,000 readers in the computer field.

COMMENTS ON "A DATA COMMUNICATIONS CONTROLLER"

E. G. Benson

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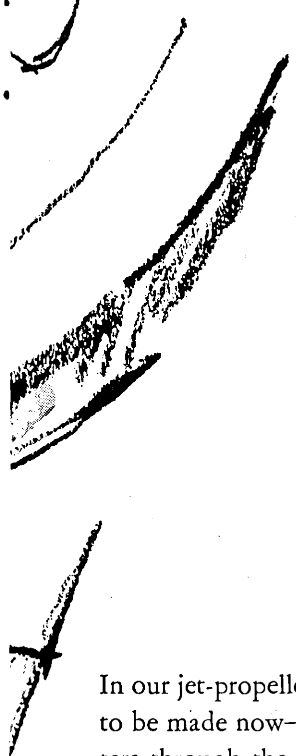
New York, N.Y. 10022

This is in reference to your issue of "Computers and Automation" for May 1966, the article starting on page 18 "A Data Communications Controller" by Dennis W. McGee.

In the second paragraph of column 2 on page 18 of this article, Mr. McGee stated "All of the trivial control, testing, and decision must reside in, and be performed by the host computer." In my opinion this statement is currently inaccurate. IBM has available a remote multiplexor 2905 (RPQ M20071) which *will* relieve the host computer of *all trivial* control functions.

how to get data fast enough for timely decisions



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COMPUTERS: NO LONGER A BIG BARGAIN FOR UNEDUCATED USERS

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St. Louis, Missouri

It is most important that manufacturers, universities, and associations encourage computer users to develop their own in-house skills in programming and systems analysis.

Computer Professionals

The growth of computing has been paralleled by the development of a group of computer professionals concerned with computer management and use. They are causing hardware and software to become increasingly sophisticated, and the process is continually accelerating. The full and efficient exploitation of computing equipment has come to depend increasingly on the knowledge which these professionals have accumulated.

Unfortunately, the broad mass of users has no share in this knowledge. A user is a person who wishes to solve a problem utilizing the high speed and logical powers of the computer available to him. His knowledge resides in the materials from which the "problem" originally arose; supplies the approach, procedure, and sometimes the algorithm with which his problem can be resolved. His knowledge is "problem-oriented." He knows practically nothing nor does he care much about the four-fifths of effort, not visible to him, that makes it possible for a computer to accept his program, proceed with its execution, and render him an answer efficiently and cheaply.

Information about Equipment Possibilities

The gap of knowledge and understanding bewteen the computer professional on the one hand and the user on the other is becoming wider and wider. Now this gap can no longer be bridged by simple explanations. Instead at least some users must become better informed about software and hardware possibilities. The electronic industry in its steep growth produces an increasingly bewildering array of computers and related hardware promising ever greater sophistication, speed, power, versatility, and economy; and supporting software systems are being produced which actualize the hardware potentials. Accordingly the managers of business and scientific efforts must make decisions involving large sums of money about which hardware and software to acquire and how to use them to best advantage. Errors in selection and usage policy will have far-reaching effects on the economic welfare of the user.

Lack of In-House Talent

With few exceptions, today's computer installations are operated with hardly any in-house or resident capacity beyond the coding level. This is true predominantly for large routine business-oriented computing installations. However, it is also true for a surprising number of universities, medical centers, large government installations, and special purpose groups. Their investment in computing systems, often exceedingly large, is backed internally by a nominal programming effort, limited to straightforward routines for meeting specialized requirements. The bulk of the support comes from external sources as packages from the manufacturer, from users' groups, and from an increasing number of software houses devoted exclusively to this type of work.

In previous years the ignorant user could survive because he, like most of his colleagues in a given field, was still in the initial exploratory stages with computers. Direct automation of long used and well defined data handling techniques produced appreciable savings in time, effort, and money. Accordingly, many users believed they could go on to the development of new procedures and techniques in much the same way. Today, the uninformed user is faced with a prolific choice of processors and an even more bewildering array of peripheral gear; and he is not equipped to define a configuration which would best suit his needs and would justify removal of his present system. Nor is he capable of supplying the considerable amount of in-house systems support most new equipment demands, regardless of its manufacturer.

More significantly, the ignorant user operating in a competitive environment may find himself with an increasingly noticeable economic handicap, because this lack of systems capability is not necessarily universal for a given field of users. Though difficult to assess, the advantage effected by possessing systems capability must be substantial and growing rapidly, because an increasing number of users are recognizing that the gap between what they know and what they should know is a very serious problem and must be examined closely.

How Overcome the "Ignorant-User" Philosophy?

Why should the perpetuation of the "ignorant user" philosophy continue to dominate the computing community? What are the obligations of the various groups guiding the development of computer technology in alleviating this situation? How can these obligations best be met?

Four somewhat overlapping groups are directly involved in the revolution centered around computers. One is the hardware and software manufacturers, whose business it is to supply users with equipment and technology. Second are the general users, who, by and large, appear to be the immediate and major sufferers from this problem. Third is a group of more knowledgeable users whose work by its nature forced them into higher-level software undertakings. Finally, there are the colleges and universities, which have a rather unusual set of circumstances and obligations.

Responsibilities of Manufacturers

Computer salesmen during the early fifties often did not hesitate to assure potential customers that involvement with computers was simple and relatively cheap. Since this zealous approach was aimed at a still small population, the problems engendered by it remained modest. When a user ran into some software difficulty, it was likely that he could receive the necessary aid from the equipment manufacturer, who handled the problem in much the same way as he would a hardware malfunction. This comfortable arrangement encouraged more and more people to become exposed to computers and computing. Consequently, it created a desire to use computers with even less knowledge about them, by moving away from machine-oriented languages. Growing pressure from government and industrial users brought about the creation of higher-level source languages such as FORTRAN, COBOL, and many others. The usefulness of these, as well as that of their offspring, is certainly indisputable. Furthermore, the introduction of basic monitors and the resulting swing to batch processing brought the benefits of this burgeoning technology to an ever widening range of users. Software houses began to augment computer manufacturers as suppliers of systems support, and the consequences of the ignorant-user philosophy were, to a large extent, averted for a time. Emergence of new hardware, with its emphasis on input-output flexibility, complex interrupt systems, remote access capabilities, etc., has raised this problem again, this time with greater urgency. Huge operating systems, I/O packages, priority executives, and other supervisory software are being prepared in support of an intensive marketing campaign which is designed to leave users with the impression that although they are procuring equipment which is faster, more powerful, and considerably more complex than previous configurations, the stupendous software necessary to support it is all being taken care of and the user will find his new machine no more difficult to manage.

The manpower commitment required to design, develop and implement such systems support is so gigantic that even equipment manufacturers find it necessary to supplement their own staffs by contracting portions of this work to software suppliers. Consequently, it is impossible for today's user to receive the type of service to which he has become accustomed over the years. This withdrawal of help comes at a time when it is felt most strongly. Even if the user could simply go ahead and use the software as delivered, now more than ever he must have a pretty fair idea of what his software package is and how it works in order to exploit the speed, power, and flexibility for which he is scrapping his present installation. Even fairly small modifications, when made in such huge systems, take considerably more systems knowledge than most users have acquired.

Blame Manufacturers

It is very simple, almost natural, to heap all of the blame for this situation on the manufacturers. And that is exactly what is beginning to happen. A growing number of users have awakened to the dangers of inadequate in-house systems capability, and are joining some of their more knowledgeable colleagues in taking manufacturers to task, both at private confrontations and in open forums, for selling the computing community a bill of goods. Some of this criticism is useful in that it brings this problem to the attention of more people. On the other hand, it can be extremely harmful if we ignore a universal factor which is crucial in the development and proliferation of any concept or technology. When computers became commercially available the applications market had to be built virtually from scratch, and a large number of people had to be convinced that computers had something to offer and warranted an investment of so much money. In this respect the field is no different from many others. Let us not lose sight of the computerniks who stimulate and promote usage throughout their organization by hustling in very much the same way. True, many of the accomplishments fall short of the promised results, but a large number of solid successes and genuine benefits are born from just such huckstering.

Blame Customers

Just as natural as it may be for the user to blame the manufacturer, it is expected that the manufacturer accept this blame cheerfully as part of his public relations image. After all he wants to sell machines, not bicker with his customer. So he acknowledges imaginary sins which he again promises to correct by new and better software and, where software will not do the job, to provide hardware that will permit new and efficient equipment to operate in the mode of the old and outdated equipment. He offers again to resolve whatever problems exist for the user. We think such a course of action must lead to disaster.

Customer Skills

At this point in the development of computers and computer technology it is most important that manufacturers actively and officially encourage their customers to develop some resident systems skills. We do not say that each computer installation should design and develop its own particular software system, language, or compiler. Rather, the user should be encouraged to aim for a level of capability which allows a user to evaluate the software supplied for its machine and, with only nominal help from the manufacturer, maintain that system and modify any of its features in the specific interests of the user. Any need for capability beyond this level depends on the nature of the installation and its scope of application as compared with the general design structure and operating characteristics of the packaged software.

Responsibility of Special Users

A relatively small number of scientific users, particularly in the aerospace and nuclear fields, but also in some universities, have become conspicuous in the computer community. Because of their work they could not avoid developing and maintaining large, highly competent systems groups from a very early date. Since computers play a crucial role in the progress of their projects, these installations often produce software for their own use which precede the packages to be supplied with the equipment. In many instances such a user-designed system may serve as the nucleus around which a more elaborate structure is developed for general distribution. In fact, some arrangements have been worked out with manufacturer wherein such a user becomes, in effect, the supplier of basic software for a given machine. Similarly, their needs often receive special consideration in the design of hardware.

These users continue to exert a disproportionately strong influence on the development of computer technology. This position of prominence brings with it an obligation to the general computing community. As users, these installations have long recognized the indispensability of in-house systems personnel and should alert others of this need. The prestige enjoyed by such installations can aid greatly in convincing a greater number of users that the additional investment in acquiring and/or training their own systems people is not only worthwhile but necessary.

Responsibility of General Users

There is no reason to exempt the computer field from the "caveat emptor" — "let the buyer beware" — which prevails in many other endeavors. However, too many purchasers and renters of computing equipment were willing to swallow the "ignorant-user" sales pitch and philosophy without more than a cursory investigation, despite the size of their financial commitment. Once this philosophy spread among users, it became increasingly difficult to reverse it. In fact, a growing number of users began to demand that manufacturers design their hardware and software with the ignorant user in mind. This helped to foster a self-aggravating cycle in which manufacturers were, to some extent, compelled to perpetuate a claim which was becoming more and more uncomfortable to cope with.

Users are now considering the purchase or rental of new-generation equipment. Part of this process involves an attempt to limit the accompanying software investment to an amount equaling or falling below the hardware figure. To do this and still exploit the new equipment's capabilities, they rely on manufacturers for "emulators." In essence what they are doing is accepting new machines because they will do what the old machines did for them before. True, they may do it a good bit faster. However, the same job reasonably reprogrammed and recast could be done in a considerably better way.

Even worse is the user's somewhat timid insistence to program exclusively with inefficient compilers which have the merit, however, that programs written in their language can be transferred with little changes onto the new machine. The user is willing to commit large amounts of programming and computer time to perpetuate the use of a compiler which could and should have been restricted.

The origin of his failure, of course, is that the user is firmly convinced that his only investment is in renting or buying hardware. On careful investigation it may turn out that the investment in hardware is perhaps no more than half and probably as little as one-third of the total necessary to swing from one machine to the next. Insofar as the user does not realize this, he is headed for trouble. As painful as it may be for him, he must begin to put aside funds and personnel to master the professional side of computation despite claims by the manufacturer that this is at the moment an unnecessary investment. Far from unnecessary, it is vital.

Responsibility of Universities

With a few prominent exceptions, universities and colleges have acted by and large like run-of-the-mill business users. Investment has been predominantly in hardware, and little thought has been given to software. This lack has affected not only operation of hardware but also in creating the necessary faculty and staff that would concern itself with the logic of systems as its major responsibility.

Failure to provide adequate technical and faculty level appointments in computer sciences has been masked by strong intramural infighting between the business office, natural science and engineering, and medicine and biology over what is really the best hardware for a university and where to place it. Many medical schools and administrative offices have strongly maintained that they definitely and positively must have their own computers on their own premises and they have not really worried whether they had anybody on the staff who knew what to do with them. If a central facility was advocated, it was on the argument that the greatest hardware value could be obtained by combining all resources. The strongest argument for a unified computing center, that of pooling necessary people and talent, was seldom if ever heard.

One cannot really blame universities for the lack of adequate analysis of their own needs, since the shortage of computer science personnel on the university campuses is probably more severe than in business, industry, or scientific research establishments. No computer science departments existed in early years to guide university administrations toward the best course of action. Also, unfortunately, the fate of universities is all too often decided by foggy heads rather than clear ones.

The major responsibility of the universities in the area of computer science is to start acting like universities — to do research, to teach, and to encourage both vigorously.

The development of systems concepts is a large and prolific area of academic pursuit which may be summed up under the heading of "computer sciences." This is a field in which intensive research is both possible and necessary; and the profit to business, industry, and other sciences is so clear that liberal support should be forthcoming.

The teaching responsibilities of universities are more difficult to implement. If the user is to understand the total systems problem within his own use of computers, he should have had some adequate courses during his formative years. What these courses might be, when to teach them, what materials to supply in them, and what texts to prepare for them, are all concerns of academic faculties.

Courses Needed

Three types of courses are needed. There are computer science courses, whose development is now well underway. There are user-oriented survey courses, in which the less mathematical and more empirical disciplines (such as biology, medicine, sociology, etc.) and the humanities are introduced to the capabilities of computers, what they can do, and how they do them. These can be exciting ventures in teaching: they may generate a good bit of applied and theoretical research. Finally, there are those courses which examine the revolution around automation and computers in the setting of the history of our civilization and of the Industrial (and other) revolutions.

To fulfill these responsibilities requires a considerable investment in people and time on the part of universities. Faculties in the computer sciences, and people who have become computer scientists, must be willing to educate their colleagues and administrators and struggle with them appropriately. Additional support must also come from such professional organizations as the Association for Computing Machinery, who can supply university computerniks with appropriate materials, articles, arguments, and speakers, stressing needs and responsibilities.

Steps Toward a Solution

The problem of the widespread ignorance among users is not academic. Fortunately, considerable economic motivation is forcing correction of the present state of affairs.

As long as competing users are equally inefficient and expend equivalent amounts of moneys needlessly, neither one of them is aware that he is losing a profit. However, as soon as one of the competing users discovers that more efficient utilization of his resources will give him a substantial competitive advantage, he will seize it. As computer costs become a substantial part of some product, it will become economically necessary to view all expenditures in this area very critically. If it should turn out that investment in personnel, time, and knowledge among users would pay off eventually in greater profits to business and industry, some far-thinking concerns will make this investment and reap the consequent benefits. Such actions will, of course, force other businesses and industries to follow suit since they will have to bring their own costs down to remain competitive. The problem probably will not be so much as how to motivate change but how to bring it about.

An obvious remedy to the ignorant-user problem would appear to be including systems analysts and designers in users' computing groups. Unfortunately, no large pool of such people exists. Most of the available personnel are concentrated with hardware/software manufacturers and special users who, having always had to grow many of their own systems people, are intensifying this activity for themselves and attempting to provide it for others. The scope of systems-oriented courses and workshops being offered is widening very rapidly. This is an excellent start, but it can hardly be more than that. Development of systems competence is a pragmatic process requiring intimate contact with real and challenging problems. The environment necessary to stimulate such activity is not a simple thing to provide. There must be a willingness to commit time, funds and people without realizing an immediate return. The general user has to consider this as a basic investment, and management at the appropriate level must convince itself of the necessity for it. The computing group in an installation should be urged to explore company functions which involve information handling. Familiarity thus gained with a variety of procedures, coupled with a growing knowledge of computer technology obtained first-hand often leads to imaginative and profitable computer applications.

For universities, the creation of an environment to stimulate the development of systems competence is not only an investment but an obligation. University administrations need to look beyond the service bureau aspects of a computing facility and to encourage the exploration of systems concepts, languages, techniques, and other areas of computer science. Installation of a computer does not constitute the total fulfillment of this obligation. The financial outlay for hardware may have to be matched or surpassed by investment in people to learn its use and take advantage of new uses. If this type of work is a profession, which we are convinced it is, then universities must be the primary source of its computer professionals.

CALENDAR OF COMING EVENTS

July 25-27, 1966: Rochester Conference on Data Acquisition and Processing in Biology and Medicine, Whipple Auditorium, Univ. of Rochester Medical School, Rochester, N.Y.; contact Dr. Eugene Agalides, General Dynamics Electronics, 1400 Goodman St. N., Rochester, N.Y. 14601

August 17-19, 1966: Joint Automatic Control Conference, Univ. of Washington, Seattle, Wash.

August 22-24, 1966: COINS, Computer and Information Sciences Symposium, on "Learning, Adaptation, and Control in Information Systems," Battelle Memorial Institute Auditorium, Columbus, Ohio; contact Dr. Julius T. Tou, Battelle Memorial Institute, Columbus, Ohio 43201

August 23-26, 1966: Western Electronic Show and Convention, Los Angeles Sports Arena and Hollywood Park, Los Angeles, Calif.; contact Don Larson, Wescon, 3600 Wilshire Blvd., Los Angeles, Calif. 90005

Aug. 30-Sept. 1, 1966: National ACM Conference, Ambassador Hotel, Los Angeles, Calif.; contact S. F. Needham, Exhibits Chairman, National ACM Conference, P.O. Box 90698, Airport Station, Los Angeles, Calif. 90009

September 26-28, 1966: International Systems Meeting, Systems and Procedures Association, Queen Elizabeth Hotel, Montreal, Canada; contact Richard B. McCaffrey, Systems and Procedures Association, 7890 Brookside Drive, Cleveland, Ohio 44138

October 4-7, 1966: American Documentation Institute Annual Meeting, Miramar Hotel, Santa Monica, Calif.; contact Mr. Jules Mersel, Informatics, Inc., 5430 Van Nuys Blvd., Sherman Oaks, Calif.

October 17-21, 1966: Business Equipment Exposition/Conference, Business Equipment Manufacturers Assoc., McCormick Place, Chicago, Ill.; contact George L. Fischer, Jr., BEMA, 235 East 42 St., New York 17, N.Y.

October 24-26, 1966: International Symposium on Microelectronics, Munich Fair and Exhibition Grounds, Munich, Germany; contact INEA — Internationaler Elektronik-Arbeitskreis e. V., 8000 Munchen 12, Theresienhohe 15, Germany

October 24-27, 1966: Annual Instrument Society of America (ISA) Conference & Exhibit, New York Coliseum, New York, N.Y.; contact Daniel R. Stearn, Public Relations Mgr., Instrument Society of America, 530 William Penn Place, Pittsburgh, Pa. 15219

October 25-28, 1966: Data Processing Management Association Fall International Conference, Los Angeles Biltmore Hotel, Los Angeles, Calif.; contact R. Calvin Elliott, Exec. Dir., DPMA, 524 Busse Highway, Park Ridge, Ill. 60068

Oct. 31-Nov. 1-3, 1966: Annual Meeting of UAIDE (Users of Automatic Information Display Equipment), Vacation Village Hotel, West Mission Bay, San Diego, Calif.; contact Marvin J. Kaitz, Dept. 200-312, Space and Information Systems Div., North American Aviation, 12214 Lakewood Blvd., Downey, Calif. 90241

November 8-10, 1966: Fall Joint Computer Conference, Brooks Hall, Civic Center, San Francisco, Calif.; contact AFIPS Hdqs., 211 E. 43 St., Rm. 504, New York, N.Y. 10017

c&a CAPITAL REPORT

A Special Report from C&A's Washington Correspondent

A summary of the Government's attempts to bring down the cost of computers was given at a recent American University seminar by Edmund D. Dwyer, director of the data processing coordination staff in the General Services Administration.

One of the most successful cost-saving techniques in the Government is the transfer of computers considered excess in one agency to another agency that needs a computer. Each month, GSA circulates a list of these computers throughout the Government, and agencies must consider this list before going to any other type of acquisition. From July 1965 to January 1966, $40 million worth of computers found additional use in another agency. Dwyer said the agencies reported a savings of $9 million in the period from this practice.

As reported in this column previously, the Department of Defense found additional users for more than $32 million worth of computing equipment in fiscal 1965. DOD has its own screening office for this purpose, although it cooperates with GSA as well.

Dwyer also noted the recent approval by the General Accounting Office for agencies to lease equipment from independent leasing companies, rather than only from computer manufacturers. He said in a 14-month period, 116 companies outside the Government transferred computing equipment titles to these companies and then leased the equipment back at a considerable savings ". . . because the independent leasing company is satisfied with less profit on a piece of equipment." He said this is a possible source of savings to the Government also.

Computer time-sharing and service centers are finding favor in the Government, Dwyer noted. Computer time worth $24 million has been shared, and, although it will be at least two years before the service center program can be called effective, there have been examples of highly-successful centers. One he mentioned is at Slidell, La., where the National Aeronautics and Space Administration and six of its customers have pooled equipment and programmers at a savings of at least $15 million.

One area that Dwyer said is still loaded with questions concerns the lease and purchase of computers. It is still a highly controversial area as well, with the General Accounting Office saying that more computers should be leased and agencies saying they should not. Dwyer said the Government now owns 54 per cent of the computing equipment it uses, but an important question is yet to be answered: If the Government owned 100 per cent of its equipment, would it slow down the state-of-the-art? He said he thinks it probably would, but studies are needed to determine the best lease-purchase mix.

Dwyer also said the Government must obtain better terms and conditions in its computer contracts. In line with what has been said by several Congressmen, he maintained that the Government should receive concessions since it is the largest computer customer in the world. He said it should not have to accept the same contract terms as a private firm buying just one computer.

In other areas, Dwyer said computer software may be procured separately from hardware in the future. One reason: "We don't even know what we are paying for software today." In a budget system where an agency climbs Capitol Hill each year to tell Congress how much money it needs and what it needs it for, this is far from ideal.

In addition, many in Congress look skeptically at an agency when it tells them a low bidder on a computer contract was rejected because his software was not up to par, especially when the agency cannot explain in lay terms exactly what software is.

The management of all United States construction projects in South Vietnam has been placed on computers under control of the critical path method, a technique for scheduling and monitoring the progress of a project to achieve optimum efficiency.

Information Systems Company is providing the management services under a $2.5 million contract from a consortium of U. S. contractors known by the initials RMK-BRJ. According to R. W. Harbison, of Lear Siegler, which owns Information Systems, this is the largest construction program ever scheduled and monitored by the critical path method.

The Navy Department's Bureau of Yards and Docks administers the South Vietnam construction program.

The Federal Government is currently spending $160 million each year to gather and publish statistics. Almost $25 million of this total is spent on electronic data processing, and 63 per cent of this $25 million goes for personnel.

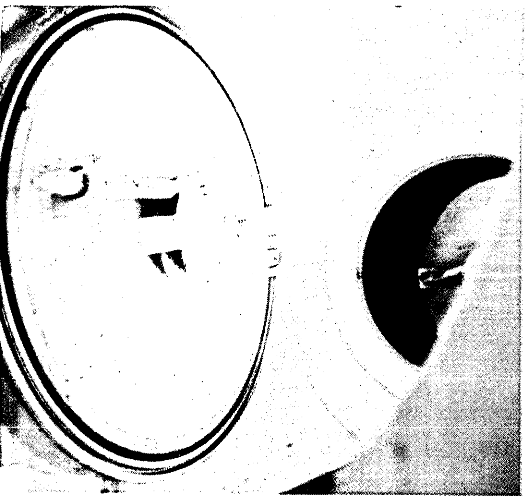
The House Subcommittee on Census and Statistics, which collects these figures every two years, has concluded that this is too much money to spend on people to run costly EDP equipment. It noted that throughout the rest of the Government, the majority of the money spent on EDP goes for equipment, but not in the statistical area.

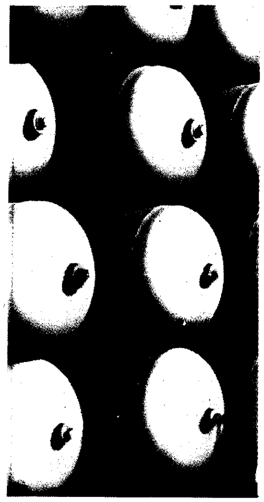
The subcommittee singled out no specific agency as guilty — more than 20 agencies collect and publish statistics — but it has asked that the Budget Bureau find out why these personnel costs are so high and report back to Congress.

A separate study of statistics began earlier this year by a White House task force seeking ways to improve statistical storage and retrieval. The White House would like to see more standards in this area and some form of easy access to available, but unpublished, statistical data.

James Titus

JAMES TITUS



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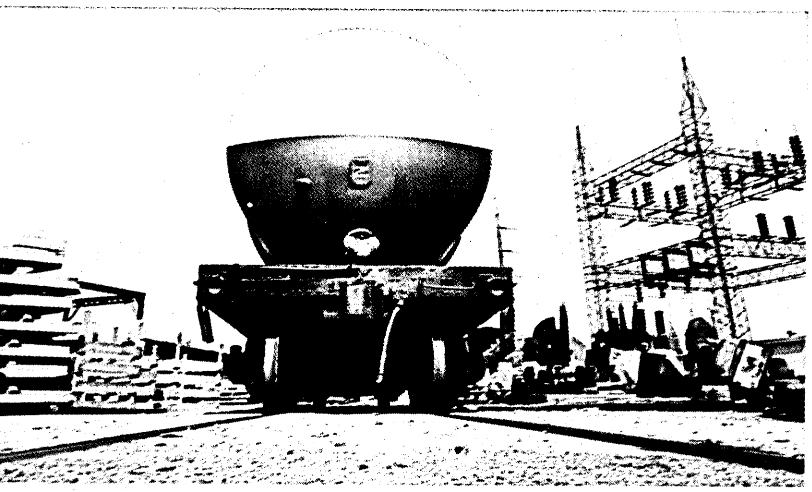


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THE USE OF COMPUTERS AS INDUSTRIAL COUNSELORS

Magoroh Maruyama, Ph.D.
Berkeley, Calif.

In the development of computer applications to human dialogues, we have a long way ahead of us — but we have also come a long way.

Dialogue with computers has been accomplished, and has reached considerable sophistication. Among the investigators who have worked on it are R. P. Abelson, K. M. Colby, J. P. Gilbert, J. C. Loehlin, R. C. North, J. A. Starkweather, J. B. Watt, and J. P. Weizenbaum. This technique can be applied directly to industrial counseling, though as yet no program specifically for this purpose has been written. It is the purpose of this article to make clear how a significant portion of industrial counseling can be programmed, including emotional rapport between the programmer and the user via a computer and what I call "relevantial information."

In Stockholm, if a man is thinking of committing suicide, he may dial an emergency telephone number which connects him directly to a city clergyman on duty for such calls. The man may simply want the pastor's prayers for dying; but most likely the pastor talks him out of suicide.

Can this type of "answering service" be performed by a computer? Obviously it is not enough to hook up a tape-recorded message. The device must be able to induce a dialogue with the user, win his trust, ask him relevant questions to uncover his personal and psychological problems which he may not be able to formulate or analyze himself, and propose a constructive solution.

This may sound like a wild task to put on a computer. But several recent experiments have taken us quite a few steps toward such an application of computers. I am referring particularly to work by Drs. Kenneth Mark Colby, James B. Watt, and John P. Gilbert at Stanford, Dr. John A. Starkweather of University of California Medical Center in San Francisco, Dr. Robert P. Abelson of Yale, and to some extent also the work of Dr. John C. Loehlin of University of Nebraska and Dr. Robert C. North of Stanford University.

The Work of K. M. Colby

Colby, for example, is working on a program to carry out a psychiatric dialogue with persons. His program does not counsel, but reacts to the input by the user and steers and prods the dialogue to help the user formulate, express, and gain insight into his problems. This is a pioneering work, and let us review it before exploring the application of computers as counselors.

Currently, Colby's computer program accepts only written statements. It produces written output on a video screen. Here is a sample of dialogue which came out of an actual computer run:

Computer:	How can I help you?
User:	I don't know.
Computer:	Try to tell me something about it.
User:	No.
Computer:	Can you elaborate?
User:	I am sick and tired today.
Computer:	Do you have any idea why?
User:	Yes I'm old.
Computer:	Please go on.
User:	I seem to have lost interest in everything.
Computer:	Tell me more about such feelings.
User:	I have some idea why I feel this way too.
Computer:	You have?
User:	It seems that I miss having a family.
Computer:	What makes you feel you miss having a family?
User:	There is a challenge about it.
Computer:	Why is that important to you?

Principle

Colby's program is based on the following principles: Sentences are put in through a typewriter into the computer.

Each of the 26 letters of the alphabet is converted to a code, and a word becomes a string of code patterns. Like numbers, these patterns can be stored, catalogued, searched after, compared, identified, substituted, and manipulated. The program contains a pre-set list of about 500 keys, key words (such as "father") and key word combinations (such as "I would not want", "I don't know"). The program has 450 ways to respond to the keys found in the sentences put in by the user. For each key in the input, the program had several alternative responses which may be selected according to whether the dialogue is at its beginning, middle or end. One type of response consists of pre-set sentences, for example "In what way?". Another type of response consists of sentences obtained by transforming a portion of the input. For example:

User: I am upset by my job.
Computer: How long have you been upset by your job?

If the input does not contain any keys, the program steers the user into a relevant topic. For example:

User: It is rainy outside.
Computer: Let's go back and talk further about your job.

In addition to giving responses, Colby's program keeps statistical track of important topics for their bearing on future topics. In this way the program can help the user formulate and express his problems and record them, though it does not give an answer to questions like "Does my child resent me?", nor offer advice in answers to questions like "What should I do?".

Though Colby was primarily interested in psychiatric dialogue, we can envision the application of similar computer procedures to such areas as industrial counseling. Some basic techniques are already available. Their refinement, development, and actual use in industry are fully possible.

Programming Computer Counseling

Several aspects are involved in the programming of computer counseling:

1. Establishing and maintaining an emotional rapport with and trust by the user.
2. Creating and maintaining a logical flow in the dialogue.
3. Prodding, exploring, directing, scanning, and identifying the topic by means of key words in the input.
4. Elaborating on the topic.
5. Diagnosing the problem.
6. Putting out advice or a proposed solution or transferring the case with summary in formation to an appropriate human counselor.

Aspect 3 has been extensively explored by Weizenbaum and Colby, and to some extent by Abelson, North and others. Colby and Weizenbaum worked on Aspects 2 and 4. In psychiatry, aspect 5 has not been worked out because of its complexity; but in industrial relations, some of the recurring problems can be identified after a certain amount of exploring and directing in the dialogue. Tentative diagnosis can then be fed back to the user for discovering discrepancies. For problems which can be diagnosed by the program, it is possible to put out an advice, a solution, or a referral to a human counselor specializing in the specific problem. Problems which cannot be diagnosed are also referred.

Aspect 1 has not been explored to any great extent in a dialogue program, though Starkweather dealt with it to some extent in his question-and-answer programs. He used human beings, who were not programmers, to prepare outputs in a natural dialogue style. But emotional rapport can be worked out directly between the user and the programmer through the program.

Some Dialogues

To illustrate this as well as the other aspects mentioned, let us consider two hypothetical dialogues:

Supervisor: I have an employee who cuts working hours. What can be his problem?
Computer: Is the employee a man or a woman?
Supervisor: A man.

Computer: Is he single or married?
Supervisor: He is single. He is planning to go back to college and does not want to get married yet.
Computer: Is that so? Is he intelligent enough to go back to college?
Supervisor: He seems intelligent. He does his work faster than others.
Computer: Is his work fairly simple?
Supervisor: Sometimes complicated. But mostly routine.
Computer: Perhaps he is bored. What do you think?
Supervisor: It is possible.
Computer: Can you think of any other reasons?
Supervisor: Not anything I can think of right now.
Computer: I suggest more challenging work for him.

Or, a dialogue may run as follows:

Employee: I don't like this place. I want to quit.
Computer: Where do you want to go?
Employee: I don't know. I just want to get out of this place.
Computer: I see. Is there any way this place can be improved?
Employee: This place is OK for other people. But not for me.
Computer: Please tell me more about it.
Employee: I mean I like my work. But people bug me.
Computer: What do they do to you?
Employee: They talk about me.
Computer: What do they talk about you?
Employee: I don't know.
Computer: How do they talk about you?
Employee: They talk Spanish and I don't understand them. They laugh all the time.
Computer: Do you talk with them?
Employee: Not much.
Computer: Is there anyone you talk with?
Employee: I go to Wing 4 and talk with a girl there.
Computer: Please see Mr. Anderson. I will tell him what you told me.

Program Sophistication

In this second hypothetical example, the computer program is unable to give advice to the user, and so it refers the user to a human counselor. The program however can be designed to diagnose the problem as to whether it pertains to work, to relations among employees, to relations with a supervisor, to family situations, etc.; and it can refer the user if necessary to an appropriate human counselor. The program can print out the dialogue on the teletype at the human counselor's desk, and by the time the employee arrives at the counselor's office, the counselor has reviewed the dialogue. Such arrangements are possible with present-day computers. A large computer may handle simultaneously a few hundred dialogues on high-speed time-sharing basis; and a company need not have its own computer, since several companies can be connected to a large external computer by means of teletype connections. Or an organization with a small computer may utilize its computer for counseling on a part-time basis as needed.

The degree of sophistication of the task the computer performs depends on the degree of sophistication in the ability of the programmer. A computer does not do anything by itself; it simply follows the detailed instructions laid out by the programmer. What types of features have to be incorporated into a program in order to perform dialogues like the hypothetical ones given above?

When the user sits at the input typewriter, the program does not know whether he is an assembly-line worker, a supervisor, a manager, or a cook at the cafeteria. The computer cannot "see" the user, but it is not necessary to ask "what is your position?". In fact, it is better not to ask such a question, as it may frighten the user or put him on the spot. The computer output should be designed to make the user feel comfortable, relaxed and accepted. Some users may lack self-confidence and may be sensitive. Others may be attention-seekers or approval-seekers. Some may simply want somebody to talk to. Others may be chronic complainers. The first task of the program is to gain the trust of the user by minimizing the threat or the anxiety of the situation. Computers have no emotion. But the programmer can establish an emotional rapport with the user through the program.

Procedure

The program may greet the user by the following output: "I am glad you came to see me. My name is Friendly Computer. Please use the typewriter to talk to me. When you have finished writing and you want me to say something, please press the green button. Please write your name so I may know you, and press the green button." Actually, this style of introductory output was used by Dr. Starkweather in his question-and-answer programs, and was found to be effective. The name input identifies the user for record-keeping purposes. If there are reasons to believe that the user may want to remain anonymous, the programmer may add "If you wish to remain anonymous, please write X and press the green button."

After the user's name has been inputted and the green button pressed, the program may respond: "Thank you. It is nice to know you. Is this Mr., Mrs. or Miss Jones?" This question is given to identify the sex of the user. This way of asking is better than "Are you male or female?" The user may write: "Mr.", "Mrs.", "No Dr." etc. In case of an anonymous user, the question is still meaningful with Mr. X, Mrs. X, etc.

Some users who are unfamiliar with computers may not immediately respond. If the user remains without response for 10 seconds or so, the program can further output "I would like to know if I may call you Mr. Jones, Mrs. Jones or Miss Jones. Please tell me." The user may write out a sentence like "Oh, just call me Jane." In that case the program may have to consult a pre-inputted list of first names for sex identification. If the first name is unusual and is not listed, for the sake of politeness the program may simply give up sex identification.

The user often forgets to press the green button. If this happens, the program may remind "Please press the green button when you have finished writing".

Initiating Dialogue

The next step is to initiate a dialogue. The program may say "It is nice to know you, Mrs. Jones. Please tell me what brought you here." This is better than "What is your problem?". Even "How can I help you?" may be interpreted as patronizing by sensitive users. Let us suppose that Mrs. Jones is the supervisor who came to consult the computer about the employee who cuts his working hours. The input is "I have an employee who cuts working hours. What can be his problem?" Here the useful keys are perhaps *employee, cut working hours,* and *what . . . problem?* which can be searched in the pre-inputted list of keys. But *I have* has to be included as a key also, because the user may be saying "I am an employee. . ." This *I have* identifies the *employee* as not-the-user. "Cuts working hours" has to be transformed to *cut working hours.* "Cuts" has to be changed to *cut.* This can be done by looking up a pre-inputted list of key-equivalence which includes cut-cuts, write-writes-wrote-written etc., and by substituting the root form for the conjugated form. *What . . . problem?* is a key which can fit *"What* is their *problem?", "What* was her *problem?", "What problems* exist in this case?" etc.

Identifying Situation

Now the program identifies the situation as some employee, who is not the user, cutting his hours, and the user is wondering why or how. Now, the program wants to know the sex of the employee. Since the employee is not-the-user, the program asks a direct question without the risk of impoliteness: "Is the employee a man or a woman?" The program asks this type of question when it finds that there is a third person involved, regardless of whether the person is a foreman, salesman or anything else. If the person is the president of the company or a secretary, it may be silly to ask the question. In order to avoid such a possibility, the program may be written to look up a preinputted list of sex of job categories. Such sophistications are up to the programmer. Too much complication leads to overgrowth of the program which may well become inefficient and slow because of too many things to check for each input. An optimal balance between the size, the efficiency and the sophistication of the program has to be attained, mostly by trial and error. For each input, there are several possibilities of output. For example, when the user answers "A man", the program can ask "How old is he?", "Is he an alcoholic?" etc. The choice of output depends on the most probable relevance in the situation. The program may have a built-in criterion for the choice, or the programmer may specify an *a priori* choice. In any case the choice is not simply a logical question. It is a matter of situational relevance which may well vary from factory to factory, from industry to industry, or from city to city. There have to be a variety of programs for companies with varied situational relevance.

The program also has to keep track of the direction of the dialogues in order not to get off the main topic, to avoid repetitious questions or going in a circle.

Rapport

At each step of the dialogue, the program has to maintain appropriate rapport with the user. For example, after suggesting "Perhaps he is bored", the program adds "What do you think?" in order to avoid appearing authoritative, to indicate possibility of other interpretations, to show respect for the user's own opinion, and to develop further discussion. The program may occasionally remark "Is that so?" etc. to show that it is impressed by the user's input. The program has to take special care to avoid putting the user on the spot. For example, if the input is "My boss dislikes me", it would be a poor relationship to say "What makes you think so?" or "Why do you think so?" It would be better to say

"Tell me what he does to you", "Tell me specific instances" etc. The program should not be condescending. "Try to tell me something about it" can be replaced by "I would like to know more about it."

In the second dialogue, the user puts in "I don't like this place. I want to quit." There are two ways to respond to this type of input. One way is to find out the reason for his disliking the place. Another way is to find out what he likes instead of this place. Dissatisfaction arises in two ways. One is discomfort or disapproval without an alternative. Another is factual or imaginary existence of something more desirable. The two kinds of dissatisfaction have different dynamics. By asking "Where do you want to go?" or "Is there any way this place can be improved?" the program tries to identify the type of dissatisfaction. The input "This place is OK for other people, but not for me" is unspecific. A way to respond to it is "What do you mean by it?". But "Please tell me more about it" is less antagonistic and more inviting. Again, "They talk about me" can be responded to by "What makes you think so?", which may put "you" on the spot. I would prefer "What do they talk about you?". Then the user comes up with "I don't know". At this point, an unsophisticated program might respond "What don't you know?" or "Why don't you know?" But by keeping track of the previous output "What do they talk about you?", the program can "remember" that "I don't know" is a response to the previous question. It is a good policy to respond to "I don't know" by an output slightly different from the previous output, such as "How do they talk about you?" or "Why do they talk about you?"

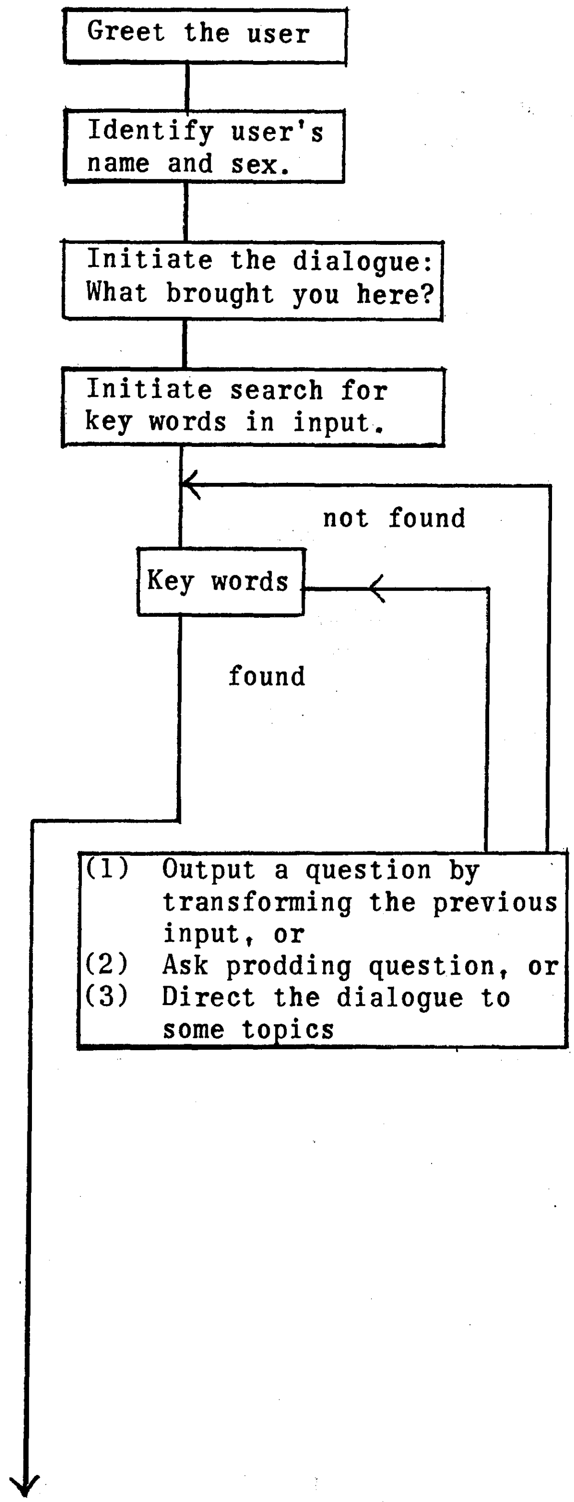
Difficult Input

The input "They talk Spanish and I don't understand them. — They laugh all the time", is difficult to program. A human counselor would know at this point that the user is paranoid. But at the present our program technique is incapable of recognizing this in the input. An unsophisticated program may respond "Why do they talk Spanish?", "Why do they laugh?", etc., or still worse, "Why do they talk Spanish and you don't understand them — they laugh all the time." This last response is quite probable if the program simply puts "why do" in front of the previous input.

One of the difficulties in this input is that the words used are unlikely to be found among the keys. In such a case, the program may be designed to go back a few steps and pick up a topic from there. For example, it can go back to "They talk about me" and produce an output of "Do you talk about them?" A greater sophistication is attained if the program contains a preference list of word combinations for output. For example, "talk to" or "talk with" has a higher preference than "talk about (person)". This degree of sophistication may render the program too cumbersome. But let us imagine we did this. Then the output becomes "Do you talk with them?" For the new input "not much", the program can be designed to look for "with whom else". Then "Is there anyone you talk with?" is outputted.

In the input "I go to Wing 4 and talk with a girl there", the program picks up "talk with a girl". Then it notices that the topic has shifted from "they" to "a girl". At this point, the program may bring the conversation back to "they", or pursue the new line of the girl. Another possibility is that a set time limit for the dialogue is reached around here, and no definite advice has been worked out. In such a case the program may refer the user to a human counselor and print out the dialogue on the counselor's desk, or may ask the user to come back next day, and transfer the summary of the dialogue to external storage such as a magnetic disc or a magnetic tape.

In summary, Aspect 1 is handled by the sensitivity and tactfulness in programming the outputs. Aspects 2 through 6 may be put in a flow chart form. One way to diagram them is shown in the accompanying flow chart.



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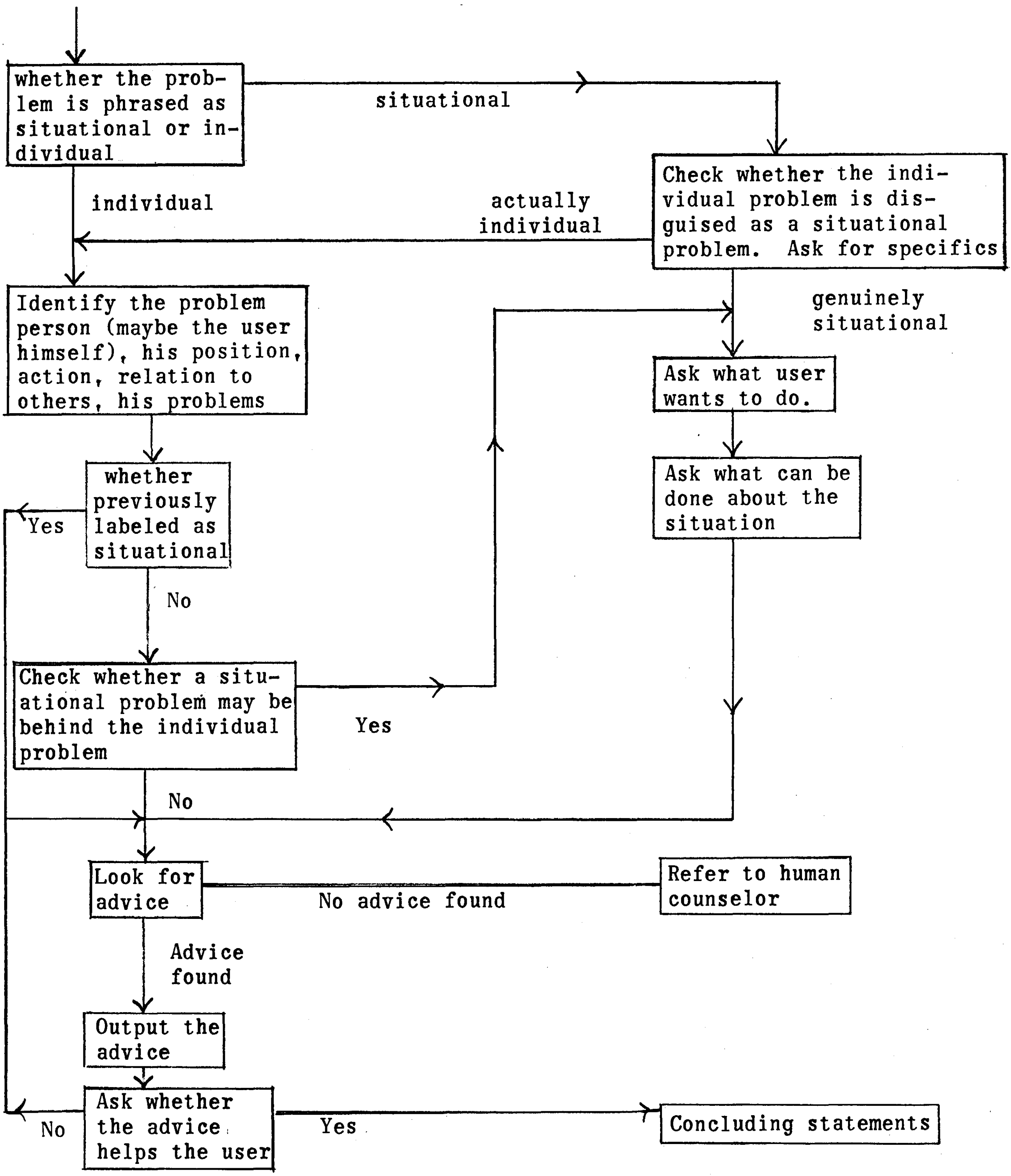
whether the problem is phrased as situational or individual
situational
individual
Check whether the individual problem is disguised as a situational problem. Ask for specifics
actually individual
Identify the problem person (maybe the user himself), his position, action, relation to others, his problems
genuinely situational
Ask what user wants to do.
whether previously labeled as situational
Yes
Ask what can be done about the situation
No
Check whether a situational problem may be behind the individual problem
Yes
No
Look for advice
No advice found
Refer to human counselor
Advice found
Output the advice
Ask whether the advice helps the user
No
Yes
Concluding statements

Versatility

All this is easier said than done. Writing a computer program is a complex, exacting, and time-consuming task. A program has to be versatile — designed to handle every possible sort of input, even input containing errors, misspellings, nonsense, and deliberate attempts for confusion. After being written, a complex program has to be test-run for all possible kinds of input to detect any malfunctioning. Since it is impossible to foresee all the variations of human input, a dialogue program has to be developed by trial and error with human users. After a program gets to the point of running without serious errors, there is always room for improving efficiency and adding sophistications. It regularly takes several months, and often a few years, to develop a complex computer program.

Out of Reach Still

Of course, many tasks are beyond the capacity of present-day programming technique. For example, the user may be looking for approval or support. The input may be "He cannot do that to me", "I almost feel like dropping the whole matter", or "Maybe I hurt his feelings when I said that." Such inputs cannot be handled yet. Although computers can recognize such inputs appropriately, nevertheless programming knowledge has not developed a way to break down into step-by-step instructions the process of recognizing such emotional needs as support-seeking, approval-seeking, or attention-seeking. Nor can we program so far recognition of chronic complainers, argument-pickers, sarcasm, metaphors, and jokes.

Human beings can recognize humor, jokes and sarcasm in printed form as well as in spoken form. But the recognition of them is not a matter of analyzing the words and word combinations. Humor, jokes and sarcasm are cultural forms rather than linguistic forms. They have cultural structure, and are understood only in context with the cultural background information, not by themselves. Some day we may be able to program the handling of cultural structure and cultural background information.

Human Relations

While we have a long way ahead of us in the development of computer applications to human dialogues, we have also come a long way. We have begun to deal with "relevantial information", which is the answer to personally relevant questions like "Will she misunderstand my intention to help her?", "How can I prove to myself that I can rely on myself?" or "What kind of person should I marry, and how can I find such a person?". These questions deal with one's meaning to others, one's meaning to himself, or search for personally important relations. Relevantial information concerns specific individuals in specific situations, and involves subjective meaning of self to self, self to others, and others to self.

Until now relevantial information was handled by human counselors. But now we are opening an era of technological processing of relevantial information. Our technology is ready to incorporate such human considerations as emotional needs, meaning of self, etc.

Though computer-counselors are inferior to human counselors in many respects, they also have some advantages over human counselors. If the user wants to be anonymous or does not want to expose his problems to another human, or is worrying about how his act of seeing a human counselor may affect his relations to other people, then a computer-counselor might serve him. Development of computer counseling is essentially a matter of programming technique. The present-day computers can handle much more sophisticated programs than those that are in use. Our next step is to train programmers who are versed in psychoanalysis, human relations and communicational epistemology, as well as computer logic.

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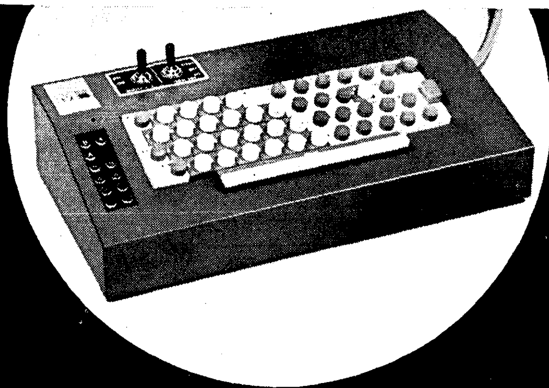

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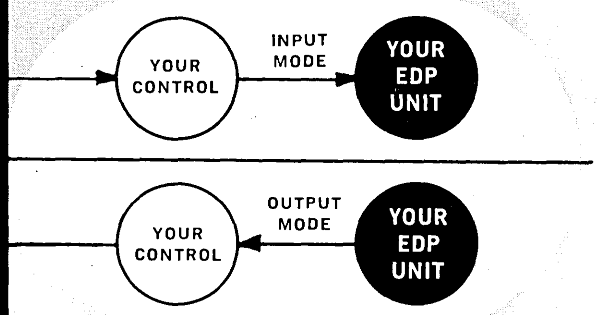

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Computing and Data Processing Newsletter

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APPLICATIONS

LAWYERS FOR INDIGENTS ASSIGNED BY COMPUTER

Case assignments and background information on indigent defendents are being handled by a Sperry Rand Corporation UNIVAC computer for the Houston Legal Foundation, Houston, Texas, according to an announcement by Judge Sam Johnson, Director. "Our UNIVAC computer will enable us to match the lawyer to the case much more economically than could ever be done by clerical assistance," said Judge Johnson.

Houston has over 3600 lawyers available for appointment in the State and Federal Courts of Harris County, from cases ranging from the most serious State of Federal felony, to misdemeanors, juvenile delinquency, mental health, and habeas corpus matters. In addition, counsel must be provided for appeals before the United States Court of Appeals for the 5th Circuit, the Supreme Court of the United States and the Texas Court of Criminal Appeals.

The UNIVAC computer has been programmed with objective data about the lawyers, and as time progresses, careful records will be kept of the criminal cases they handle on assignment.

Since it is possible to predict, with reasonable accuracy, the number of lawyers needed in any given month in the future, the computer will be used to apportion the cases fairly among the lawyers in advance. Then, after a lawyer is assigned to a particular case, the data concerning that case will be fed into the computer to establish a record for the lawyer. Rotation will give all lawyers an equal opportunity to serve.

MENU-PLANNING BY COMPUTER

Sara Mayo Hospital, a small hospital for women and children in New Orleans, La., is using a computer full-time to plan its menus. The time-and money-saving computer program is the product of four years of research by a Tulane University computer research team directed by Dr. Joseph L. Balintfy, associate professor of operations research in Tulane School of Business Administration. The project, financed by a three-year, $242,600 grant from the National Institutes of Health, began in 1964. Its objective was to establish an experimental central computer system to plan daily menus for hospital patients in three New Orleans hospitals and at the University of Missouri Medical Center.

The Tulane system applies advanced mathematical techniques and an IBM computer to the problem of menu planning. An IBM 7044 computer system at the Tulane Computer Center was modified to provide for remote terminals linking Sara Mayo and the other two hospitals and the University of Missouri Medical Center. Through the IBM 1050 data transmission terminals, information was entered into and menus retrieved from the 7044.

In Dr. Balintfy's approach, menu-planning problems at Sara Mayo (or at any other hospital) were identified and formulated into linear programming problems. A complete dietary information system was designed to feed pertinent data into the mathematical model. Three major kinds of data were placed in the computer's memory file. First was the content of 19 different nutrients for each of 2500 foods which could be contained in hospitals' recipes. Second item of information to be developed in quantity was the popularity of menu items on each hospital's protected recipe list. Third, the recipe file was entered. (At Sara Mayo, 400 recipes were stored in the computer's disk files.)

This is the way the system works for Sara Mayo. From the hospital's data input, the special mathematical program computes and prints out in seconds a menu for each day. Sara Mayo's dietician sits at an IBM 1050 remote terminal in her office, enters nutritional specifications and may change items for a particular meal. The rest of the menu is automatically adjusted by the computer to meet nutrient requirements. Hospital food service personnel periodically updates food costs according to market fluctuations so that the computer menus will reflect seasonal differences.

The menu fulfills all nutritional allowances specified by the hospital — or by a particular diet — at lowest possible cost per patient. Dr. Balintfy said, "A hospital now can save up to 24 per cent of its raw food costs with simultaneous improvement in the quality of food service and patient care."

HUGHES' COMPUTER SCHEDULES WORK FOR ITSELF AND OTHERS

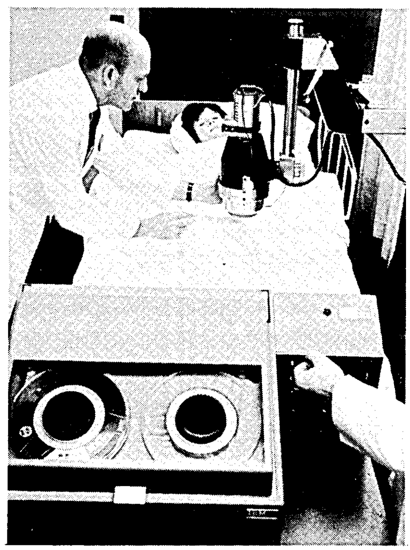
Hughes Aircraft Company's Fullerton (Calif.) facility has an IBM computer scheduling work for itself and other computers. Robert W. Carlile, manager of industrial dynamics for Hughes-Fullerton said, "computers today are so fast that ordinary operational procedures cannot keep them busy. The big problem is to keep the machines working by allowing the jobs and operators to move in a streamlined fashion. We've put all our scheduled work into the computer and programmed it to print out the operating schedule for each day. In this way the masses of work that we must do for all segments of Hughes-Fullerton are organized and listed in recognizable form and can be used by the operator to make maximum use of the computer with a minimum of job set-up delays."

The facility's entire library of more than 5000 magnetic tapes is indexed on an IBM 1401 computer. At the start of each day, programmers submit special requests and changed jobs on console run sheets. These "crunsh" sheets are transcribed to punched cards and entered into the computer which matches the requests for changes with existing tape files. The computer then prints out specific operating schedules for each of the computers, physical tape labels and updated library lists and console run sheets. Computer operators for each of Hughes' computers use these printouts to set up the jobs on the various computers and to maintain control of the magnetic tape library.

Hughes' computer self-scheduling techniques provide: time estimates for scheduled work which allows the company to cope with its unscheduled work load on a planned rather than emergency basis; a complete record (estimated, actual and historical) of computer operations for management review; an audit trail which tells what was done, when it was done, and for whom it was done, and; a determination of which tapes are outdated and can be re-used or removed from the library. This figure sometimes runs to hundreds a week.

COMPUTER PROCESSING OF ISOTOPE SCANNING DATA BY MAYO-IBM IN JOINT STUDY

Working under a joint study with the Mayo Clinic, IBM Corporation has developed experimental equipment and computer programs to help radiologists locate tumors and malignant tissue in body organs. The objective of the joint study is to capture and enhance the data obtained from radioisotope scanners of a type used by many hospitals for diagnosis. Just as a computer was used to improve the pictures of the moon received from our space probes, similar techniques are giving doctors a clearer view of the images painted by a radioactive compound chosen to go to the organ being studied.



— Dr. Nelson W. Tauxe of the Mayo Clinic positions radiation scanning equipment over patient to record radioisotope data on the Mayo-IBM system (foreground).

The area of interest is scanned with a radiation detector to see how the isotope has distributed itself in the organ. Unlike ordinary scanners which produce a paper chart or film record, the experimental Mayo-IBM system records all data on magnetic tape for computer processing. On the tape goes a new radiation record every tenth of a second and the exact location were the reading was made.

Dr. Nelson W. Tauxe of the Mayo Clinic reports that his hopes for improved contrast and resolution have been fulfilled. "We can see many more things on a computer-processed scan than we can on a film record," he says, "and I can imagine cases where the improved contrast would be of crucial diagnostic importance."

Besides improving the clarity of the displayed image, computer processing of isotope scanning data offers other advantages, according to IBM project leader Donald W. Chaapel. For example, data is always available in machine readable form for later research or in case repeat processing is necessary. Also, the computer can be programmed to compensate for the rapid decay of newly introduced isotopes which radiologists prefer because they provide high radiation for a short time without endangering the patient.

COMPUTER BEING USED AS SUPER STOP WATCH

Scientists at the Union Carbide Sterling Forest Research Center, Tuxedo, N.Y., are using an electronic computer as a super stop watch in an effort to probe some of the basic forces at work in liquids and solids. Working with a privately owned nuclear reactor, the Union Carbide scientists are timing and counting low energy (cold) neutrons which have collided with samples of matter. The targets for the flying subatomic particles range from nylon to the artificial polynucleotides which are related to the basic chemicals of life.

The computer being used to time the flying neutrons is a general purpose Digital PDP-5, with what is described as a "time-of-flight front end" especially built into it by the manufacturer, Digital Equipment Corporation of Maynard, Mass. Technically known as a Multianalyzer, the computer and its accessories track neutrons along a known flight path after they have been used to bombard the sample matter in the target area. By determining the final velocity of the neutrons, the scientists can determine what energy was gained from the target sample, and thus investigate the forces at work in the substance under study.

The PDP-5 is used to study the forces and molecular structure in the samples in their solid or liquid states, discover what they are and how they relate, and in this way investigate the structural chemistry involved. Use of a general-purpose computer like the PDP-5 for this work is a comparatively recent development. Previously, fixed-purpose devices had been in widespread use in similar research programs.

NEW CONTRACTS

FROM	TO	FOR	AMOUNT
Braniff International, Dallas, Texas	IBM Corporation	An advanced IBM airline reservations and management information computer system which will include two IBM Systems/360 model 65's	$7 million
Department of the Army	Sylvania Electric Products, Inc., a GT&E subsidiary, Needham, Mass.	Production of electronic communications equipment	$2.5 million
The Bendix Corp., Bendix Mishawaka Div., Mishawaka, Ind.	ACCO Gyro Div., American Chain & Cable Co., Inc., Waterbury, Conn.	Rate Gyro Packages using the 54 Series ACCO SUPERGYRO® for use in the Navy's TALOS Missile	about $1 million
U.S. Office of Education	Iowa Educational Information Center, Iowa City, Iowa	Development of a statewide educational information system to serve publis elementary schools in the state	$435,837
California Youth and Adult Corrections Agency, Sacramento, Calif.	System Development Corp., Santa Monica, Calif.	One year study assisting Institute for the Study of Crime and Delinquency in the development of a computer-based information system for the Agency	—
Southern California Edison Co., Los Angeles, Calif.	Leeds & Northrup Co., Philadelphia, Pa.	LN4000 computer system — to control the generation and distribution of electric power to some 6.8 million people	$500,000
International Telephone & Telegraph Corp.	Sylvania Electric Products Inc., a GT&E subsidiary, Needham, Mass.	Special purpose receiving equipment to be used in an Air Force electronic system	$1.7 million
NASA Kennedy Space Center, Fla.	Scientific Data Systems, Santa Monica, Calif.	Six data acquisition subsystems to support Saturn V/Apollo moon launch	about $1 million
National Science Foundation	Special Libraries Association, New York, N.Y.	Support of the compilation and publication of a cumulative index of scientific, engineering, and technical articles, patents, monographs, and symposia proceedings that have been translated from foreign languages into English	$80,530
U.S. Post Office Department	Honeywell Inc., Electronic Data Processing, Wellesley Hills, Mass.	Purchase of seven computer systems (H-1200's) which will process all information generated in the management and operation of the Post Office Department's $20-billion-a-year total transactions	$3.3 million
U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.	Scientific Control, Dallas, Texas	Design and manufacture of a Digital Data Acquisition System for use as an on-line data handling system	$50,000
Air France	Univac Division, Sperry Rand Corp.	An electronic reservations system, scheduled for early 1968 service and designed for year by year expansion through 1977	—
Los Angeles City Planning Department, Los Angeles, Calif.	System Development Corp., Santa Monica, Calif.	Application of mathematical models to determine nature of interrelationships between residential, commercial, industrial, recreations, and transportation activities	—

NEW INSTALLATIONS

AT	OF	FOR	FROM
Lockheed California Co., Rye Canyon Research Laboratory, Burbank, Calif.	EAI 8400 Digital Computing System valued at over $1 million	Use as major component in flight simulation of wide variety of aircraft and for the study of an advanced aerial fire support system for a heavily armed helicopter	Electronic Associates, Inc.
Oakland Bank of Commerce, Oakland, Calif.	IBM System/360 model 30 with 1419 MICR Reader/Sorter and 4 Disk Drives	All bank applications; current emphasis on Demand Deposits and Savings Accounting — plan future conversion to on-line terminals	IBM Corporation
Sun Oil Company, Computation Center, Philadelphia, Pa.	Olivetti-GE-115 data-communications computer system	Eventual use as remote terminal connected by telephone lines from Sun Oil's Marcus Hook refinery to GE-625 system housed at Computation Center	General Electric Co.
Jos. Schlitz Brewing Co., Milwaukee, Wisc.	IBM 1130 computer	Evaluating attitudes, tastes, habits, size and whereabouts of beer consuming public — market research	IBM Corporation

AT	OF	FOR	FROM
Telemax Corp., a subsidiary of Maxon Electronics Corp., East Orange, N.J.	Two UNIVAC 491 Real-Time Computers	Use as part of $6 million reservation service for hotels, motels, rent-a-cars, travel agents, cruise ships and tour wholesalers	Univac Division, Sperry Rand Corp.
Square D Company, Circuit Breaker Div., Cedar Rapids, Iowa	IBM System/360 Model 20	Accounting and production tasks	IBM Corporation
University of Texas, Austin, Texas	Control Data 6600 Computer System valued at nearly $6 million	Academic research and teaching	Control Data Corp.
Western Geophysical Division of Litton Industries	Two SDS 9300 computers, combined value — $1,700,000	Speeding the processing of seismic data	Scientific Data Systems
Marine Bank and Trust Company, Tampa, Fla.	Second NCR 315 computer system	Serving additional banks and expanding commercial processing	National Cash Register Company
University of Texas, Defense Research Laboratory, Austin, Texas	Control Data 3200 computer system	Wide variety of applications including general purpose scientific work, simulation studies, and business data processing	Control Data Corp.
Cleveland Board of Education, Cleveland, Ohio	IBM System/360 Model 30	Automating all record keeping and scheduling tasks in school system	IBM Corporation
Dynamics Research Corp., Stoneham, Mass.	GE-415 computer system	Variety of applications ranging from routine business accounting to complex weapons systems calculations	General Electric Co.
American Motors Corp., Kenosha, Wis.	IBM System/360 Model 40	Accelerating development of industry's production control and management information system	IBM Corporation
Northern Virginia Technical College (NVTC), Baileys Crossroads, Va.	Honeywell 300 computer	Student use in data processing program	Honeywell EDP
American Bosch Arma Corp., American Bosch Div., Springfield, Mass.	IBM System/360 Model 40 valued at $1,300,000	Statistical controls and record keeping at all levels of operation	IBM Corporation
First National Bank of Arizona, Phoenix, Ariz.	A GE-415 computer valued at $½ million to supplement two GE-210's	Processing commercial, livestock and conventional real estate mortgage loans	General Electric Co.
Naval Air Reserve Training Command, Glenview Naval Air Station, Glenview, Ill.	IBM System/360 Model 20	Handling flight records, personnel matters, maintenance records and schedules, and Marine Air Reserve Training Command maintenance and supply information	IBM Corporation
First National Bank of Montgomery, Montgomery, Ala.	IBM System/360 Model 30	Basic banking applications now handled by a 1401; later plans include expansion of data processing services offered to customers and correspondent banks	IBM Corporation
LaBarge Pipe & Steel Co., St. Louis, Mo.	IBM System/360 Model 20	Pipe and tube inventory control	IBM Corporation
Chrysler Corporation Stamping Group, Detroit, Mich.	GE-415 computer system	Integration and tightening of production and inventory control at group's seven manufacturing facilities	General Electric Co.
HYDRONAUTICS Inc., Laurel, Md.	IBM 1130 computer	Fundamental and applied hydrodynamic research	IBM Corporation
Jacksonville Paper Co., Fla.	Honeywell 300 computer system	Sales, distribution and inventory control; processing manufacturing cost data; and general business use	Honeywell EDP
Carpenter Funds Administrative Office of Northern California, Inc., San Francisco, Calif.	IBM System/360 Model 30	Keeping track on day-to-day basis of carpenters eligible to receive benefits and dollar amount contributed by their employers to the various Trust Funds	IBM Corporation
General Telephone Company, Marion, Ohio	RCA Spectra 70/45 computer system	Processing 1,800,000 toll calls each month	Radio Corp. of America
Rose Polytechnic Institute, Terre Haute, Ind.	IBM 1130 computer	Training of all students in computer programming; student use to solve major mathematical, science and engineering problems	IBM Corporation
Data Processing Management Association, Park Ridge, Ill.	Honeywell 120 computer system	Maintaining membership and subscription records of over 20,000 professional EDP management personnel, processing data for dues, income, expenses, inventory and cost control, and to forecast additional member needs	Honeywell EDP
Independent Exploration Co., a Division of Teledyne, Inc., Houston, Texas	IBM System/360 Model 40G	Application of advanced techniques in geophysical data processing and analysis in firm's world-wide petroleum exploration services	IBM Corporation

ORGANIZATION NEWS

INDUSTRY INFORMATION SERVICE ANNOUNCED BY IBM

IBM Corporation has announced its entry into a new business — the sale of computer-prepared market research reports to U.S. industry. The new computerized market research is called Industry Information Service and is aimed specifically at companies whose products and services are sold to the industrial market.

The IBM market research reports will provide detailed analyses of a company's market and of its untapped market potential. The analyses will provide occupancy and share-of-market percentages for each cross-section of the firm's market — by line of business, plant size, sales territory, and combinations of these.

Computerized market research is part of IBM's new Industry Information Service. The service will be sold nationally by an Information Marketing group formed by IBM within its Data Processing Division.
(For more information, designate #41 on the Readers Service Card.)

BENDIX TO ACQUIRE SCULLY-JONES & CO.

The Bendix Corporation has signed a contract to purchase for cash the assets and business of Scully-Jones & Company, Chicago, Ill. Purchase of Scully-Jones will provide Bendix with a leading line of machine tool accessories that will complement Bendix expanding role in the machine tool industry, according to A. P. Fontaine, chairman and chief executive officer of Bendix.

Scully-Jones is a leading manufacturer of tool holders and cutting tools for machine tools. The company also has developed a line of precision, anti-friction devices known as "Tychoway" recirculating roller bearings and recirculating ball screws to meet the needs of tape controlled machine tools.

ITT AND SAMS COMPANY ANNOUNCE TERMS OF PROPOSED MERGER

International Telephone and Telegraph Corporation and Howard W. Sams & Co., Inc., Indianapolis, Ind., recently announced that agreement had been reached on the terms under which the Sams Company will join the ITT System. The transaction will involve the issuance by ITT of a maximum of 285,942 shares of common stock and 159,925 shares of the preference stock.

It is expected that the business of the Sams Company will continue to be operated as a wholly-owned subsidiary of ITT. The transaction is subject to approval by the stockholders of Sams at a special meeting to be called later this year.

Howard W. Sams & Co., Inc. is an important factor in educational areas as a diversified publisher and printer of books, magazines, training and reference services, particularly in the electronic fields and other technical areas.

MICROELECTRONICS DIVISION ANNOUNCED BY AEROJET

Following four years of intensive activity, a new organization has been formed at Aerojet-General Corporation, Azusa, Calif., to produce and market thin film microelectronic circuitry. William L. Rogers, Vice President and Plant Manager of Aerojet's Von Karman Center, said the Microelectronic Division, an outgrowth of Aerojet's Astrionics Division, will provide high volume microelectronic production for military, aerospace and consumer applications.

Aerojet has developed an advanced thin film technology, Rogers said, which includes new materials as well as new processes capable of making almost every type of sophisticated circuitry, for analog as well as digital systems.

Aerojet is a subsidiary of The General Tire & Rubber Company, Akron, Ohio

NCR OPENS 23rd OVERSEAS DATA CENTER IN NEW ZEALAND

A National Cash Register Company data processing center has been opened by the company's International Division in the port city of Auckland, New Zealand. The center's NCR 315 system will process data for manufacturers, distributors and retail businesses throughout the country. Input will be via punched paper tape or optical-font tape mailed to the center by subscribers to the service.

In addition to the computer room, the facility includes several classrooms for instruction in computer programming.

THE PLESSEY CO. LTD. AND BUNKER-RAMO CORP. SIGN LICENSING AGREEMENT

A licensing agreement has been signed between The Plessey Co. Ltd. of Poole, England, and Bunker-Ramo Corp., Cleveland, Ohio. Terms of the agreement permit Plessey to make and market two Bunker-Ramo continuous path systems, the 3000 and the 3100, in world markets outside North and South America, Japan and China.

Dean Freed, general manager of the Bunker-Ramo Numerical Control Systems Division, said in announcing the license agreement that Plessey intends to begin production on the 3100 system. Until production is established all units will be shipped from Cleveland.

The Plessey Co. Ltd. is the largest telecommunications manufacturer in the United Kingdom and one of the world's largest producers of electronic components. Other company interests are in the areas of systems, equipment and components for the electronic, automation, aerospace, hydraulic and related industries. The Numerical Control Systems Division of Bunker-Ramo Corp. is a major manufacturer of numerical controls used primarily in the aerospace and metalworking industries.

POTTER INSTRUMENT SIGNS MARKETING AGREEMENT WITH FACIT OF SWEDEN

Potter Instrument Company, Inc., Plainview, N.Y., and Facit AB of Sweden have concluded an agreement granting Potter the exclusive right to market Facit data system peripheral equipment in the United States, Canada and Mexico. Facit AB, based in Atvidaberg and one of the world's largest business machine manufacturers, distributes in 130 countries. The Facit product lines to be marketed by Potter cover a new range of data collection system components, including novel data input-output devices, commerical punched tape equipment and random access information storage.

Potter's existing lines will be complemented and broadened by the combination of technologies available from both companies, roudning out the total resources needed to effectively support new products which will soon become available from current development programs, according to a joint announcement by Potter president John T. Potter and Gunnar Ericsson, president of the Facit AB complex of companies.

A second agreement now being negotiated between the two companies will grant to Facit exclusive distribution rights to Potter products in Europe.

UNIVERSITY COMPUTING CO. FORMS NEW SUBSIDIARY — COMPUTER LEASING COMPANY

University Computing Company has entered the computer leasing field by forming a new subsidiary called Computer Leasing Company, with general offices established in the Washington, D.C., metropolitan area, according to Sam Wyly, president of both companies.

Computer Leasing, a wholly-owned subsidiary of University Computing Company of Dallas (Texas), purchases new and used computer systems from manufacturers and leases them to users of the systems. Both short-term and long-term leases are offered on computers ranging in price from as low as $100,000 up to several million dollars.

CONTROL DATA OPENS DATA CENTER FOR BOSTON AREA

Control Data Corporation has opened a new data processing service center in Cambridge, Mass. The new Boston Data Center is the tenth center to be established by the company.

The Boston Data Center will provide, via a data transmission system, large scale computer processing on a Control Data 3600 Computer System, and related programming service to the New England area. The Center will operate on a two-shift basis.

COMPUTING CENTERS

KIEWIT COMPUTATION CENTER

Dartmouth College (Hanover, N.H.) and the General Electric Company are collaborating in establishing a new, high-speed computer facility that will keep the college in the forefront of one of the most significant recent developments in computer technology — time sharing. The agreement with the General Electric Company was completed and approved by the Dartmouth Board of Trustees at their spring meeting.

The college's Kiewit Computation Center, now under construction, will house a new, large-scale computer system — the GE-625 — and attendant equipment worth $2.5 million when it is delivered this fall. The new installation will resemble the multiple-access computer system assembled at Dartmouth two years ago, but will be far larger and more advanced.

It is reported that Dartmouth will make some of its lines available to outside users. The College expects to offer the service to other New England colleges, universities and secondary schools on a cost basis.

AUTOMATED MEDICAL BILLING SERVICE

The First State Bank of Union, Union, N.J., has announced the introduction of an automated medical billing service for doctors and dentists in the North Jersey area. The service will be run on an IBM 1240 system in operation at the bank's data processing center.

The medical billing system is the third system currently in operation at the First State Bank data processing center. The center handles the demand depost accounting for The First State Bank and other banks in the area. In addition, an automated payroll service is offered to employers in the North Jersey area.

ITT DATA SERVICES TO OPEN LONDON COMPUTER CENTER

A new data processing and management information service is being opened in London as part of a worldwide network of data services of International Telephone and Telegraph Corporation, its divisions and subsidiaries, it was announced by Mortimer Rogoff, Group General Manager, ITT Data Systems Group. The London facility will be the first established in the United Kingdom by ITT Data Services Division of ITT Industries, Ltd.

The headquarters of the service will be at Cockforsters, 11 miles from central London. It will be connected to subscribers by permanent data links. The first link will be to the City of London for handling financial, investment and foreign exchange data. This will be a forerunner of a large time-sharing computer system having several linked subscribers.

The London service bureau, using an IBM 360/40 computer system, will offer a full line of data processing services and facilities for its customers. Analysts and programmers will prepare data processing systems that are tailored to the specific needs of all types of business, financial and scientific applications.

EDUCATION NEWS

OHIO STATE BEGINNING INFORMATION SCIENCES GRADUATE PROGRAM

Ohio State University, Columbus, Ohio, will begin a new graduate program in information sciences next fall which will be directed by Dr. Marshall C. Yovits, who now heads the Naval Analysis Group in the Office of Naval Research, Washington, D.C. He has agreed to become professor and chairman of the Division of Information Sciences in the Graduate School and director of the Center for Research in Information Sciences. All will be established under his direction.

Dr. Jackson W. Riddle, associate dean of faculties, said that Battelle Memorial Institute and Chemical Abstracts Service, both university neighbors, will cooperate in development and actual operation of the graduate program. Dr. Riddle added that the National Science Foundation has been asked for financial assistance in developing the program.

Where most other institutions stress a particular area of information sciences, Ohio State's program will be distinguished by its breadth. As an inter-disciplinary program, it will involve such areas as mathematics, psychology, biology, engineering, physics, linguistics, logic, computer sciences and systems sciences, Dr. Yovits said. Typical areas of information sciences that will be covered are computing circuits and logic, self-organization and adaptive systems, pattern and speech recognition, programming and information and communication theory. Emphasis of the program will be to turn out teachers of information sciences, researchers and individuals who can solve operational problems involving these sciences.

NEW PRODUCTS

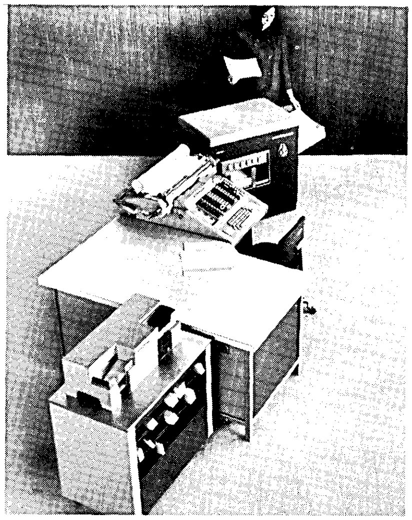
Digital

BURROUGHS ELECTRONIC SYSTEM

Ray W. Macdonald, Burroughs Corporation president, has announced the new E4000 Electronic Accounting system. This new system is intended to fill a price-performance "gap" that exists between accounting machines and computers. Burroughs took the first step toward filling this gap in 1964 with the introduction of the E2100.

The E4000 system, offering greater versatility and power, includes two basic units: an operator's control console with an alphanumeric keyboard, control keys, communications lights, and printer; and a solid-state electronic processor whose magnetic core memory will store 2400 digits of program information and data. Optional peripheral units include a punched card reader, a card or paper tape punch, and an electronic ledger card reader.

Data flows into the system through punched cards, magnetic-ink striped ledger cards, the alphanumeric keyboard, or any combination of these elements. Processed information is produced on punched cards, punched paper tape, ledger cards and journals, or any desired combination. When the



— E4000 reads and writes data coded into punched cards, reads and writes with electronic signals on magnetic ink striped business forms like the one the operator is holding, takes instructions from the operator through its control console keyboard and prints completed information in English.

E4000 is working as a "satellite" system, the punched cards or tapes it produces can be used as direct input to a large scale computer.

Programming for the E4000 system is provided by Burroughs. Operation is so simple that anyone familiar with accounting machines can learn to operate the E4000 efficiently with a few hours' practice.
(For more information, designate #43 on the Readers Service Card.)

NORTHROP NORTRONICS 28-POUND COMPUTER

A 28-pound airborne computer that offers the computational ability of large data processors at a cost comparable to the smallest commercial units has been introduced by the Nortronics Division of Northrop Corporation, Hawthorne, Calif. The high speed, general purpose digital computer, designated the NDC-1051, was designed for any use requiring high reliability and environmental tolerance, particularly where very small size, light weight, and low power consumption are primary considerations. Because of its versatility it is suitable for applications ranging from aircraft and missile guidance and control to scientific and industrial use.

The parallel arithmetic computer is less than one-half cubic foot in size. It is composed in three definable units: logic section, memory section and power supply. Incremental expansion of the random access core memory, from 2048 to 8192 instructions, can be accomplished without affecting the design integrity of the other sections by simply plugging in additional 2048-word modules. (Instruction word size is 24 bits, including sign.)

The conductively cooled NDC-1051 is a single address computer with a two microsecond read/write cycle. Typical instruction time is eight microseconds. Multiply and divide times are 72 and 180 microseconds respectively. Up to seven index registers are available for each sub-routine.
(For more information, designate #42 on the Readers Service Card.)

EMR ANNOUNCES NEW DIGITAL COMPUTER

The ASI Computer Division, Electro-Mechanical Research, Inc., Minneapolis, Minn., has announced a new digital computer system specifically intended for integrated data acquisition system and industrial applications. The computer system, designated the ADVANCE 6130, is a total monolithic integrated circuit machine incorporating a 16-bit data word. The 6130 has an exceptionally large repertoire for a 16-bit data word machine — over 100 instructions. This is accomplished with single- and double-word instruction formats for programming versatility.

One of the most significant features of this system is its bus organization, providing for simultaneous communication and control of multiple central processors, multiple I/O channels, and multiple memory modules. The 6130 is the only small scale computer to have this third generation systems organization.

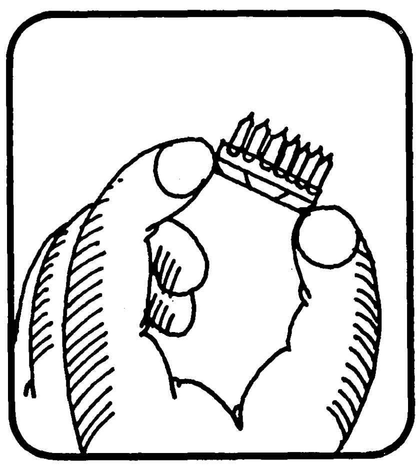
Together with the new system, the ASI Computer Division will provide a comprehensive software system including batch processing operating system, extended assembler, FORTRAN, and a real-time executive.
(For more information, designate #45 on the Readers Service Card.)

Announcing the Burroughs B 6500

A new electronic data processing system with software that is ready right now

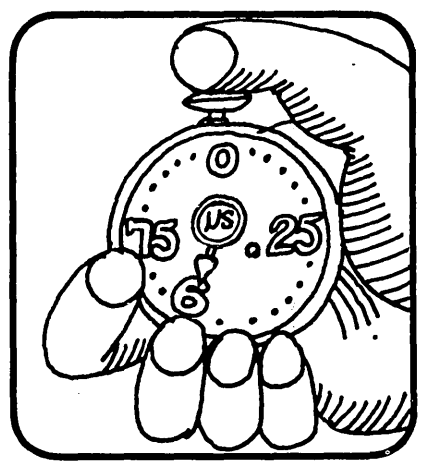
The B 6500 will have the kind of multiprocessing ability, dynamic modularity and high through-put per dollar proved in use by the B 5500.

In the B 6500, all these advantages are greatly enhanced by new hardware technology. The result: A system which is ideally suited to engineering/scientific jobs or business applications or a combination of both. A highly advanced time-sharing system which completely obsoletes the rigid time allocations for on-site vs. remote-site work. With the B 6500, numerous jobs—all completely different—can be multiprocessed at the same time, regardless of origin. And all, of course, under full software control.



High speed monolithic integrated circuits

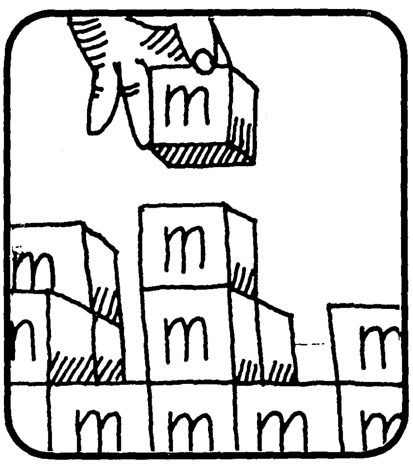
The clock rate of the B 6500 is 5 megacycles—an extremely fast speed made possible by the system's monolithic integrated circuitry.



Fast memory speed with thin film

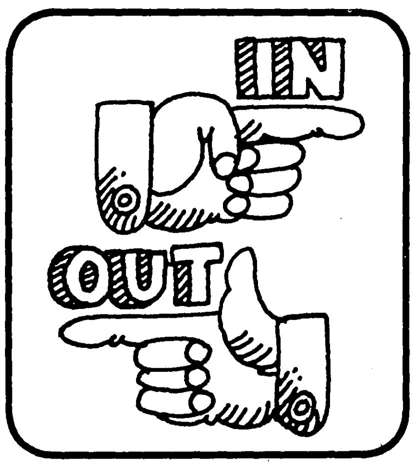
The memory cycle time of the B 6500 is 600 billionths of a second—so fast that it cannot be equalled except by giant systems at a giant cost.

Consider our accelerating success with the unique B 5500—or better still, see it demonstrated. Now, for requirements that extend beyond this already powerful computer, the new B 6500 implements that same proven software and internal organization by 5 times the processor speed, 7 times the memory speed, up to 3 times the memory capacity, and twice the I/O capability.



Large memory capacity

The B 6500 provides up to 106,496 words of thin film memory. This extensive capacity is available in functionally independent banks.



Input/Output Multiplexor

This is a device which provides up to eight high speed input/output operations simultaneous with each other and one or both processors.

We can't show you the hardware today. But we *can* demonstrate the internal organization and proven software: A comprehensive operating system that schedules and controls many jobs at once. Simultaneous COBOL, ALGOL and Fortran compilations. Even a mixture of batch and random access processing plus time-sharing.

Your local Burroughs representative will be glad to arrange such a demonstration or to discuss other Burroughs 500 Systems. Or write us at Detroit, Michigan 48232.

Burroughs Corporation

MODEL LSI 8000 — THIRD GENERATION COMPUTER

The Data and Controls Division of Lear Siegler, Inc., Melville, N.Y., has announced a new, third-generation digital processor is now in production for OEM applications. This is Model LSI 8000, a general-purpose, internally programmed digital processor. It is designed for on-line data system applications, and as an interface device to the IBM System 360.

The basic LSI 8000 digital processor is a real time byte-oriented machine with a random-access magnetic-core memory of 2048 eight-bit bytes, with 16,384 bytes accommodated within the same frame design. It is expandable to 65,536 directly addressable bytes. Full cycle speed is approximately 1.5 msec. Access time is 600 nsec.

Extensive and inexpensive input/output capability is provided through the use of a multiplexer channel with six input/output ports, expandable to 254, each with individual priority interrupt. Other features include 86 instructions, variable field length, nine addressable hardware registers, a selector channel, storage protection, TRACE (a program debugging system), and hardware bootstrap for initial program loading.
(For more information, designate #44 on the Readers Service Card.)

Software

PRIMARY OPERATING SYSTEM, FIRST OF FOUR FOR SPECTRAS

The Radio Corporation of America has made available the first of four operating systems for its third generation Spectra 70 computers. Delivery of the Primary Operating System for the three largest Spectra 70 computers — the 70/35, 70/45 and 70/55 — marks the third major programming system made available by RCA in less than nine months.

The system includes 35 programs designed to assist the user in writing, controlling, testing and executing his own software.

Two other major programming systems for the three larger Spectra 70 computers are scheduled for release later this year. They are the Tape Operating System (July delivery) and the Tape/Disc Operating System (December release). The most sophisticated Spectra 70 software — the Disc Operating System — is currently under development. In all, RCA will offer customers six Spectra 70 programming levels, the widest and most complete selection of software in its history.
(For more information, designate #48 on the Readers Service Card.)

FIVE NEW PROGRAMS FOR IBM 1130

Optical devices ranging from the photo-enlarger lens (shown below) to space-satellite telescopes can now be designed faster and more efficiently than before using IBM Corporation's lowest-priced computer. Making this possible is a set of computer instructions — one of five new programs announced by IBM for the company's desk-sized 1130 data processing system. The

other programs include automatic type composition, systems simulation, graphic data presentation, and project planning and control.

Each of the programs is stored in interchangeable magnetic disk cartridges similar to the one magnified in the picture by the enlarger lens. These cartridges will record up to one million characters of data and instructions and make them available to the computer in split seconds. A typical system using any of the programs will rent for about $1300 to $1600 a month, with a purchase price of approximately $60,000 to $77,000.
(For more information, designate #47 on the Readers Service Card.)

1108 APT PROGRAM

APT (for Automatically Programmed Tools) now is fully operational on the UNIVAC 1108 II Multi-Processor System, according to an announcement made by the Sperry Rand Corporation's UNIVAC Division. UNIVAC Systems Programming officials reported that the 1108 APT program is more than four times faster than the 1107. Complete compatibility between the UNIVAC 1108 and 1107 programs will insure production-proved reliability on the 1108, UNIVAC officials said.

APT on the UNIVAC 1108 takes advantage of the high speed magnetic drum subsystems rather than magnetic tapes for storing intermediate results.
(For more information, designate #49 on the Readers Service Card.)

HONEYWELL 200 LP SOFTWARE

A comprehensive linear programming software system now is available for the Honeywell 200 series of computers from Haverly Systems Inc., Denville, N.J. This system, based on five man years of effort, has been developed so that it can be used in many industries including the petroleum, textiles, forest products, primary metals, food, marketing, distribution, and finance industries. Systems for computers of 12K and larger are being supported.
(For more information, designate #50 on the Readers Service Card.)

NEW IBM COMPUTER TECHNIQUE TAKES WORK OUT OF PAPERWORK

Electronic "conversations" with central computers are enabling organizations to significantly reduce the time their clerical employees spend changing and updating all types of written material. This electronic communications allows users to prepare and revise text material ranging from standard form letters to complex technical manuals.

The technique — called the IBM Administrative Terminal System (ATS) — includes a central computing system, typewriter-like terminals and a computer program. The program consists of sets of instructions that speed the preparation and revision of all types of text material.

After the text has been converted to machine language and stored in the computer, a secretary or trained typist can use a terminal (either IBM 1980 or IBM 2741) to edit and revise the material. She types only the changed words or sentences and then retrieves the updated version in printed form.

ATS can be used with the IBM 1440 and 1460 computers. Up to 40 terminals, in a variety of locations, can be linked to a computer. (For more information, designate #46 on the Readers Service Card.)

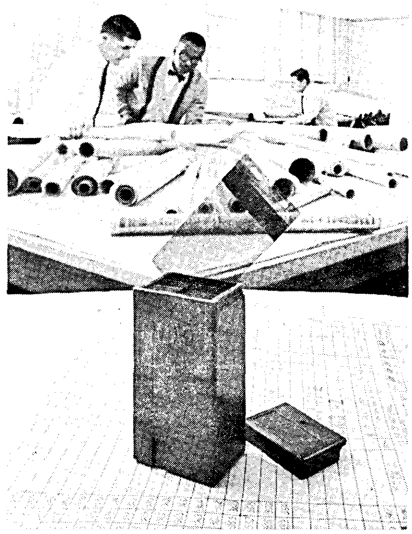
Information Retrieval

PHOTO IMAGE RETRIEVAL SYSTEM

IBM Corporation, White Plains, N.Y., has announced the development of an electronically-controlled system which can store a half-million microfilm images and — in seconds — find and produce a copy of any one of them. The new IBM 1350 photo image retrieval system can randomly locate as many as 504,000 images recorded on separate rectangles of microfilm within its storage file. In addition, the system can keep track of 2.5-million more images which can be stored in special shelf units and placed in the system when required.

Filing, retrieving and copying all are carried out automatically under control of the IBM 1350's electronic circuitry. When a specific image is requested, its address within the system is obtained from a computer-stored index or a printed directory. This address is transmitted to the system by using either a punched card, an attached computer or the system's keyboard.

Within the IBM 1350, the microfilm rectangles — called "chips" — contain both photographic images and magnetically-coded information. They are stored in plastic packs each slightly smaller than a cigarette package. These packs — known as "cells" — hold up to 32 chips, and are transported pneumatically from their storage area to and from a copying device. The copying device opens the cell, picks the desired chip, the image is copied, and the cell is returned to its assigned location.



— Small plastic container in foreground (1.5" wide and 3" high) can hold as many as 32 microfilm images of blueprints or engineering drawings like those on the table behind it.

The copying process, which takes less than two seconds, is a accomplished by printing in contact from the chip to a piece of microfilm in an aperture card under an exposure of ultra-violet light. The output aperture card is completely processed, punched, interpreted and ready for distribution. The image copy can be taken to a viewer and studied, greatly enlarged, on a screen. It also can be produced by a variety of viewer-printers as a "hard copy" document.
(For more information, designate #51 on the Readers Service Card.)

Data Transmitters and A/D Converters

ANALOG-TO-DIGITAL CONVERSION SYSTEM

A new analog/digital system for connecting computers to telemetry or other data acquisition systems "at significantly higher speeds than ever before achieved" has been developed by Stellarmetrics, Inc., Santa Barbara, Calif. The firm calls the new product its Analog-to-Digital Conversion System. The system can operate with either incoming analog or digital data, and can be adapted to any model of computer.

In operation, incoming digital data is processed directly to the computer, while incoming analog data is first digitized and then presented to the computer. In the other direction, the computer controls the ADCS, instructing the ADCS device what data or parts of data are wanted for computation, and at what rate. The ADCS operates from 1 cps to 100 Kc, the latter believed to be a significantly higher speed than ever before achieved in an analog-to-digital system of this type.

The system includes a high-speed A/D converter, analog and digital multiplexers, a multiplexer sequencer, an interrupt inhibitor, a rate generator, a calibrator, and necessary computer interface electronics.
(For more information, designate #52 on the Readers Service Card.)

AUTOMATIC ALTERNATE VOICE/DATA SYSTEM

A new communication system that uses the silent gaps in a telephone conversation to transmit data information over a single international voice circuit recently was demonstrated by Pan American World Airways, Inc., and ITT World Communications, a subsidiary of International Telephone and Telegraph Corporation. The system was developed by the ITT subsidiary for use on Pan Am's New York-San Juan, Puerto Rico, communications link.

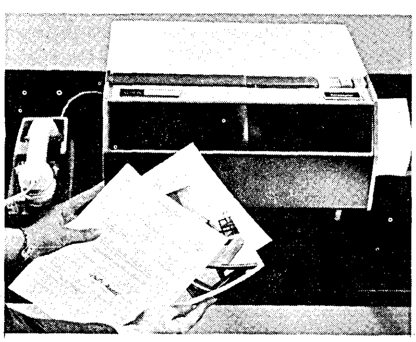
The unique data equipment — known technically as an Automatic Alternate Voice/Data System (AAVD) — uses a magnetic drum storage device that delays the transmitted speech a fraction of a second — long enough to detect pauses in a conversation and automatically fill them with data. (Studies have disclosed that the average two-way telephone conversation occupies only 36 per cent of total channel capacity.) The AAVD system will tie together a complex of low- and high-speed transmitting and receiving devices — teleprinters, telephones, and other components of a modern information system. Voice and data channels will be combined into a single, voice-conditioned 3 kc communications "pipeline" to replace the more cumbersome and costly manual method of tape transmission.

In the new system, the drum storage unit — known as IDAST (Interpolated Data and Speech Transmission) system — assigns priority to voice transmission. The data is released in short "bursts" during the silen gaps of fractions of a second or more and continuously at other times. The interpolator — a development of ITT's Standard Telecommunication Laboratories in Great Britain — is presently operating at 2000 bits per second or approximately 4000 words per minute.

In addition to slow-speed teleprinters, the AAVD system is compatible with a wide variety of input-output devices, from the telephone to cathode-ray tube. It may carry data exclusively or transmit data during the pauses of a phone conversation.
(For more information, designate #53 on the Readers Service Card.)

XEROX MAGNAFAX TELECOPIER

A portable facsimile device for transmitting and receiving documents over any distance by conventional telephone has been announced by Xerox Company, Rochester, N.Y. Known as the Xerox Magnafax Telecopier, the Telecopier was developed by The Magnavox Company, which will manufacture the equipment. Xerox will market, install and service it.



— Letters, photos, forms and a variety of documents can be transmitted and received with an ordinary telephone and the Xerox Magnafax Telecopier.

The non-xerographic device can be moved almost anywhere in a business location since it does not require wiring into telephone circuits. The only power required to operate the device is a conventional 110-volt outlet. By placing a conventional telephone receiver into the unit's acoustic coupler, an 8½" x 11" document can be transmitted in six minutes to any spot in the nation where there is an ordinary telephone and a counterpart Telecopier. The Telecopier also can be plugged into a common carrier data set for equally simple operation. Simplicity of operation enables office and field personnel to operate the equipment after brief instruction.

The Telecopier is ready to transmit copy when a document is inserted in the sender's machine and a Telecopy set, an improved carbon set, in the receiver's machine. The telephone hand-sets of both the sender and the recipient are placed in their respective units' couplers, after the pressing of a button, and transmission begins. At the completion of transmission the machines automatically stop and the recipient extracts from his unit a high-quality facsimile of the original document, and may then resume normal telephone conversation.

As with other Xerox-marketed equipment, the device initially will be leased.
(For more information, designate #54 on the Readers Service Card.)

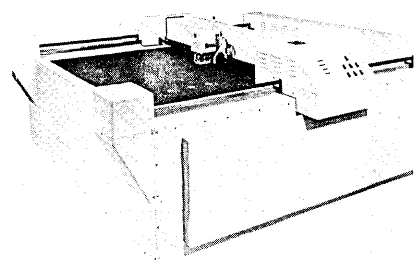
Input-Output

GERBER SERIES 2000 CONTROL SYSTEM

The Series 2000 makes a distinct departure from traditional control approaches, utilizing stored, rather than wired-in, programming and digital computer input/output approaches which offer the user complete freedom of input, computation and program control. Because it is a stored program control, basic operating capabilities can be completely changed to meet severe performance demands without costly changes in hardware configuration. Expanded computation capability makes it possible to perform linear, circular, and parabolic interpolation.

Series 2000 16-bit word length offers the programmer an efficient, straightforward instruction addressing scheme: 1024 words can be addressed by a single word instruction. (The 16-bit word is directly compatible with ASCII 8-bit character code.) In addition, users are supplied with a comprehensive program software package including FORTRAN IV, symbolic assembler, compiler, utility, and service routines.

Series 2000 input/output unit features a punched paper tape reader and I/O teletypewriter with paper tape punch. Programs can be entered for storage and plotting via the high speed punched paper tape reader, the I/O reader, or manually through the I/O unit keyboard. Program parameters such as decimal scaling, offset, symmetry switching, absolute or incremental mode selection, tool control, and symbol drawing/printing, are entered through the typewriter (or prepared input tape), rather than conventional switches. Operator control of the Series 2000 is achieved through the I/O typewriter — also allowing for printout of display data, insertion of commands, and program monitoring or modification.



Gerber Model 32 Table

A selection of graphic display tables are available to meet the user's application requirements — in terms of work area size, accuracy, and speed. Table Model 22 is a versatile, mobile, electrically tiltable falt bed unit offering basic size, speed and accuracy specifications. Model 32 is a high precision fixed horizontal table — extremely high accuracy to ±.0008 inch with exact repeatability to ±.0004 inch is guaranteed on the Gerber Model 32. Model 75 combines both speed and accuracy with large working surface advantages — area drawing capability is 5' to 24'.
(For more information, designate #55 on the Readers Service Card.)

PORT-A-WINDER

A battery operated, portable winder for quickly and easily winding punched tape segments into neat, easy-to-file or retrieve, coils has been developed by Connecticut Scientific Center, New Haven, Conn. The small, compact device helps preserve valuable tapes from excessive handling.

To operate Port-A-Winder, slip end of tape into the slotted, brass spindle, press the button, and in seconds the tape is wound ... slip coiled tape off of the spindle and secure with a paper clip for convenient filing or future reference.

Port-A-Winder is a timesaver for programmers, computer operators, analyzers and anyone who must read, scan, sort or otherwise handle quantities of segmented punched tape.
(For more information, designate #56 on the Readers Service Card.)

HIGH-SPEED STROKE WRITERS, MODEL 401 SERIES

A Model 401 series of high-speed stroke writers that can produce symbols for cathode-ray-tube displays at speeds as fast as 4 μsec per symbol has been announced by Tasker Instruments Corp., Van Nuys, Calif. A patented function-generation technique permits customizing of modular printed circuit cards to give unlimited character style and repertoire, as required by specific programs or control circuits. Adaptable to either high-speed, random-access writing systems or formatted systems, the 401 can operate from remote location (up to 50 feet) and can drive as many as 50 nonparallel displays.

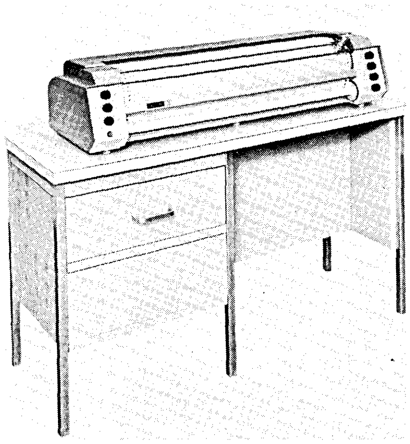
Cards can be custom-built to produce virtually any shape of symbol, figure, or character that can be made up of 20 or fewer straight line segments. Line segment length and direction are not limited. All symbols are written with continuous, connected line segments at a constant rate that assures uniform line intensity and brightness.

The basic 401 series has a 64-character repertoire: 28 special symbols as specified and 36 gothic alphanumerics conforming to Specification MIL-C-18012A. This is optionally expandable to 128 characters. Substitution of symbols is a physically simple matter, since all components unique to a particular symbol are contained on the same circuit card.
(For more information, designate #57 on the Readers Service Card.)

MODELS 665 AND 663, DIGITAL INCREMENTAL PLOTTERS

The new Models 665 and 663 drum type Digital Incremental Plotters of California Computer Products, Inc. (Anaheim, Calif.) operate at asynchronous incremental step rates up to three times the speed of standard Models 565 and 563. They are compatible with all CalComp on-line interface unites and with off-line tape unit Models 470, 750, 760, 770 and 780. Software for the 500 series plotters can be used without modification with the new 600 series models.

The new plotters provide switch selection of either .01 inch or .005 inch step size. Model 665 (shown below), with a 12 inch drum, operates at incremental speeds of



900 steps-per-second in .005 inch step size and 450 steps-per-second in the .01 inch step size. Model 663, with a 30-inch drum, operates at corresponding speeds of 700 and 350 steps-per-second.
(For more information, designate #58 on the Readers Service Card.)

DATRON SYSTEMS MODEL 610 DATA TRANSMISSION CARD READER

A new, low speed tab card reader that functions directly with the Bell System 401 series "Data Phone" data sets, is available from Datron Systems, Inc., Mountain Lakes, N.J. The new device, called the Datron Systems Model 610 Data Transmission Card Reader, consists of a manually fed serial card reader, an optional keyboard and an interface. The code transmitted, for data as well as functions, is fully compatible with most key punches used as output devices in "Data Phone" transmission systems.

The new Reader processes 80 column and 51 column cards interchangeably with no adjustment. It will transmit as much alphanumeric data as may be punched in a card up to a full 80 columns. Reading speed is 10 columns per second.

In operation, the 610 is attended and includes an answer-back loudspeaker to notify the operator through a tone pattern that the receiving station is ready to receive and that the previous transmission has been correctly received.

The optional keyboard permits transmission of variable data along with the data punched in each card. The amount of variable data which may be transmitted is limitless except that the total of characters in the card and the variable characters must not exceed the capacity of the document being generated at the receiving station.
(For more information, designate #59 on the Readers Service Card.)

Components

HUGHES OFFERNG DIE TESTER FOR FLIP-CHIP DEVICES

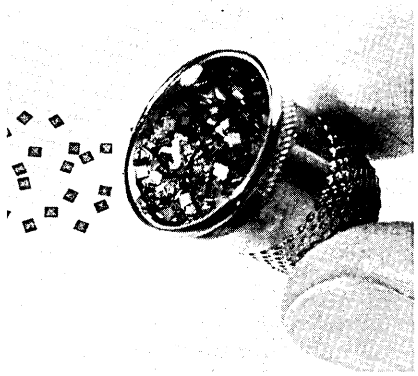
Hughes Aircraft Company's microelectronics division, Newport Beach, Calif., has introduced a new instrument for testing "flip-chip" semiconductor devices. The new tester, designated Model 2904, is designed to provide a more reliable and accurate method of electrically testing the devices than is possible using conventional needle-type probes. It offers positive contact during testing through the "pad contact" method.

In the test procedure, the semiconductor chip is lifted by means of a vacuum pickup and placed with its bumps, or metallized lands, face down, onto flexible pads. After completion of the test, an electro-mechanical push-button control allows the operator to select the proper sorting bin and counts the tested devices automatically. Standard machines are equipped with five bins and four contact pads, but special controls to handle additional multi-bump devices and automated sorting can be provided as required.

The tester measures 16½x10x10 inches, not including power supply, and weighs 20 pounds. Vacuum source, illumination and microscope are included with the standard unit. Interchangeable contact pads are available per specification, and the device may be coupled to any suitable test equipment.
(For more information, designate #60 on the Readers Service Card.)

TINY CIRCUITS MAKE DECISIONS IN FIVE BILLIONTHS OF SECOND

Integrated circuits that make logic decisions in five billionths of a second are being manufactured by Sylvania Electric Products, Inc., Woburn, Mass. Sylvania is a subsidiary of General Telephone & Electronics Corporation.



Approximately 8,000 are contained in this tiny thimble. Each has the equivalent of up to 57 components such as transistors, resistors and diodes. The circuits, produced by Sylvania's Semiconductor Division, are used in computers, missiles, space vehicles, satellites and aircraft guidance systems.
(For more information, designate #61 on the Readers Service Card.)

MODEL 19000 FREQUENCY STANDARD/TIMING SYSTEM

Teledyne Industries, Geotech Division (Texas) has developed a frequency standard and time code generator, Model 19000, designed for applications where frequency stabilities as great as 1 part in 10^9 per day and a power consumption of as low as 7 watts are required. In addition, the system can provide 115v, 60 cycle frequency-regulated power at levels of 10, 100, or 100 va.

The standard system generates the time code and calibration programs required by short-period and long-period seismographs, and the Vela Uniform code for use in magnetic tape recording applications. Alternatively, the system can be modified to generate other time programs such as those adopted by IRIG and NASA.

The system can be furnished with either a binary-coded decimal or decimal in-line readout of time in days, hours, minutes and seconds.

Model 19000 is available as a rack-mounted unit on a standard 5¼ x 19 panel or as a suitcase sized portable unit.
(For more information, designate #62 on the Readers Service Card.)

RCA ANNOUNCES TWO NEW 'OVERLAY' TRANSISTORS

Two new high-power, high-speed, and high-current overly transistors, for switching and amplifier circuits in industrial and commercial equipment applications, have been announced by RCA Electronic Components and Devices, Somerville, N.J. These new epitaxial silicon n-p-n overlay power transistors, RCA developmental types TA2669 and TA2669A, are said to be especially suited for switching-control amplifiers, power gates, switching regulators, converters, and inverters. Other recommended applications include DC to RF amplifiers and power oscillators.

Both devices employ a new overlay structure with separate emitter sites and are mounted in the popular TO-3 package. They differ in breakdown-voltage ratings, leakage-current, DC-beta, and saturation-voltage values.

The high current-handling capability of these transistors, in conjunction with their fast turn-on speeds, permits use in a wide variety of power switching applications. They will switch 15 amperes of current with a turn-on time of only 0.5 μsec maximum. Both devices have a power dissipation rating of 140 watts. Two of the devices, when used in a push-pull circuit configuration as the output of an ultrasonic amplifier will produce a power output of 250 watts, according to the company.

These devices are tested to assure freedom from second breakdown in both forward-and-reverse-bias conditions when operated within specified limits.
(For more information, designate #63 on the Readers Service Card.)

NEW LITERATURE

COBOL INFORMATION BULLETIN NOW AVAILABLE

The Data Processing Group of BEMA released the eighth in a series of COBOL Information Bulletins on June 22, 1966. This information bulletin, produced by the COBOL task group of The American Standards Association subcommittee X3.4 on common programming languages, represents the latest work of the task group and supercedes previous information bulletins.

Bulletin number 8 is a working document containing language specifications for the proposed American Standard on COBOL, including the elements of several functional modules, e.g. Mass Storage, Sort, Report Writer, Table Handling, Segmentation, etc.

Copies of this 52 page multilith document are available by writing on company letterhead to CIB Editor, Data Processing Group, BEMA, 235 East 42nd St., New York, N.Y. 10017

NEW BOOKLET DESCRIBES SCANNING TECHNOLOGY

A 16-page, color booklet providing additional information about optical scanning and related business forms technology is available from The Standard Register Company, Dayton, Ohio. The business forms company has issued the brochure, "Care and Feeding of the Optical Scanner," as a more detailed and more technically oriented companion piece to the previously released "Perspectives on Optical Scanning."

This latest booklet covers the technical principles of scanning and the place of OCR in a variety of modern data processing applications. It discusses the methods of scanning; critical areas of form design, printing tolerances and paper selection; and other aspects that determine the successful use of Optical Scanning.
(For more information, designate #65 on the Readers Service Card.)

BUSINESS NEWS

UNIVAC IN THE BLACK; SPERRY RAND EARNINGS UP 45%

Sperry Rand Corporation reports net income of $31,859,232 for the fiscal year ended March 31, 1966. This amounts to an increase of 45% over earnings of $22,016,961, in the prior year.

Sales for the year rose slightly to $1,279,768,576, compared with $1,247,621,189 for the year before.

In announcing the results, Sperry Rand officials stated, "The Univac Division reported a net profit for the fiscal year and is now solidly in the black. Furthermore, the Remington Office Equipment Division also operated at a profit for the year. These two factors contributed substantially to our fiscal 1966 results."

RCA STOCKHOLDERS TOLD OVER 1100 RCA COMPUTERS INSTALLED OR ON ORDER

RCA officials revealed at their recent Annual Meeting that over 1100 RCA computer systems are now installed or on order. In addition, deliveries of RCA's new computer line, the Spectra 70, was reported as on or ahead of schedule.

Dr. Elmer Engstrom, Chairman of RCA's Executive Committee, cited estimates of a doubling of the industry's market for EDP systems by 1970 and anticipated that RCA's share of the market "will also increase substantially".

"We see tremendous new growth opportunities for communications systems and for systems employing the most advanced circuitry," Dr. Engstrom continued. "In both areas RCA's pioneering skills should help substantially."

AUDIO DEVICES SALES UP 40% IN QUARTER

Audio Devices, a maker of magnetic computer tape, reports a 40% sales rise to $3,766,115 for the quarter ended March 31, as against $2,677,957 for the same period in 1965. Earnings rose to $233,375 for the period, compared to $224,543 a year ago.

President William Hack said at the annual meeting that computer tape now is estimated to represent 30% of the magnetic tape market. Sound tape accounts for another 30%, instrumentation tape for 25% and videotape for 15%, according to Mr. Hack.

Among the new products introduced by the company was a 3200-bpi tape designed for use with IBM's new 360 computers. However, Mr. Hack expects growing involvement for the company with the consumer market through car and home tape cartridges, and the anticipated market for videotape for home video recorders.

COLLINS RADIO EARNINGS RISE 80%

Collins Radio Company reports earnings of $5,357,000 for the nine months ended April 29, 1966. Sales were $272,062,000.

Comparative nine-month results for the previous year were earnings of $2,913,000 on sales of $197,080,000 (restated to reflect year-end tax credits).

Backlog at April 29, 1966, was $337 million, compared to $261 million a year ago and $320 million at January 28, 1966.

MAI REPORTS RECORD SIX MONTHS SALES AND EARNINGS

Management Assistance Inc., which specializes in renting and servicing data processing equipment, reports record sales and earnings for its first six months period ended March 31, 1966.

Jorge M. Gonzalez, President, announced that sales in the period increased 311% to $17,300,300 from $4,207,700 in the comparable period last year. Net earnings after provision for taxes increased 375% to $1,222,100, compared with $257,380, in the corresponding six months period a year ago.

<u>The earnings shown above reflect the accounting treatment of certain interest expense on a basis different from that previously reported</u>. MAI has heretofore followed the practice of charging interest expense, relating to loans secured by equipment rented by MAI to customers, on a straight-line basis over the term of the loan. It is expected that the American Institute of Certified Public Accountants will, in the near future, recommend that business firms similar to MAI charge interest expense to operations by applying the interest rate to the principal balance outstanding. MAI has adopted this recommendation, and it is used in calculating its current figures.

MAI officials report that the firm's business, both domestic and foreign, has continued to grow. Investment in data processing equipment at March 31, 1966, totalled $106,000,000 compared with $28,000,000 a year ago. The company's major reconditioning center, a 50,000 square foot leased structure, located in King of Prussia, Pa., was completed this month and operations have already commenced at the new location.

MONTHLY COMPUTER CENSUS

The number of electronic computers installed or in production at any one time has been increasing at a bewildering pace in the past several years. New vendors have come into the computer market, and familiar machines have gone out of production. Some new machines have been received with open arms by users — others have been given the cold shoulder.

To aid our readers in keeping up with this mushrooming activity, the editors of COMPUTERS AND AUTOMATION present this monthly report on the number of general purpose electronic computers of American-based companies which are installed or on order as of the preceding month. These figures included installations and orders outside the United States. We update this computer census monthly, so that it will serve as a "box-score" of progress for readers interested in following the growth of the American computer industry, and of the computing power it builds.

In general, manufacturers in the computer field do not officially release installation and on order figures. The figures in this census are developed through a continuing market survey conducted by associates of our magazine. This market research program develops and maintains a data bank describing current computer installations in the United States. A similar program is conducted for overseas installations.

Any additions, or corrections, from informed readers will be welcomed.

AS OF MAY 10, 1966

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
Advanced Scientific Instruments	ASI 210	Y	$3850	4/62	25	0
	ASI 2100	Y	$4200	12/63	7	0
	ADVANCE 6020	Y	$4400	4/65	9	5
	ADVANCE 6040	Y	$5600	7/65	3	6
	ADVANCE 6050	Y	$9000	2/66	2	6
	ADVANCE 6070	Y	$15,000	10/65	2	6
	ADVANCE 6130	Y	$1000	11/66	0	3
Autonetics	RECOMP II	Y	$2495	11/58	44	X
	RECOMP III	Y	$1495	6/61	10	X
Bunker-Ramo Corp.	BR-130	Y	$2000	10/61	159	5
	BR-133	Y	$2400	5/64	20	3
	BR-230	Y	$2680	8/63	15	X
	BR-300	Y	$3000	3/59	36	X
	BR-330	Y	$4000	12/60	34	X
	BR-340	Y	$7000	12/63	20	X
Burroughs	205	N	$4600	1/54	49	X
	220	N	$14,000	10/58	40	X
	E101-103	N	$875	1/56	143	X
	B100	Y	$2800	8/64	140	12
	B250	Y	$4200	11/61	95	4
	B260	Y	$3750	11/62	225	8
	B270	Y	$7000	7/62	151	12
	B280	Y	$6500	7/62	125	15
	B300	Y	$8400	7/65	75	88
	B2500	Y	$5000	1/67	0	22
	B3500	Y	$14,000	5/67	0	18
	B5500	Y	$20,000	3/63	50	10
	B8500	Y	$200,000	2/67	0	1
Clary	DE-60/DE-60M	Y	$525	7/60	355	4
Computer Control Co.	DDP-24	Y	$2500	5/63	70	8
	DDP-116	Y	$900	4/65	55	30
	DDP-124	Y	$2050	3/66	14	18
	DDP-224	Y	$3300	3/65	22	22
Control Data Corporation	G-15	N	$1600	7/55	310	X
	G-20	Y	$15,500	4/61	23	X
	LGP-21	Y	$725	12/62	125	X
	LGP-30	semi	$1300	9/56	120	X
	RPC-4000	Y	$1875	1/61	55	X
	160*/160A/160G	Y	$1750/$3400/$12,000	5/60;7/61;3/64	450	5
	924/924A	Y	$11,000	8/61	29	X
	1604/1604A	Y	$45,000	1/60	58	X
	1700	Y	$4000	5/66	0	38
	3100	Y	$7350	12/64	70	35
	3200	Y	$12,000	5/64	90	X
	3300	Y	$15,000	9/65	8	38
	3400	Y	$25,000	11/64	21	X
	3500	Y	$30,000	9/66	0	6
	3600	Y	$58,000	6/63	51	2
	3800	Y	$60,000	2/66	2	12
	6400	Y	$40,000	5/66	1	14
	6600	Y	$110,000	8/64	13	9
	6800	Y	$140,000	4/67	0	4
Data Machines, Inc.	620	Y	$900	11/65	6	32
Digital Equipment Corp.	PDP-1	Y	$3400	11/60	60	X
	PDP-4	Y	$1700	8/62	55	2
	PDP-5	Y	$900	9/63	112	1
	PDP-6	Y	$10,000	10/64	18	5
	PDP-7	Y	$1300	11/64	64	48
	PDP-8	Y	$525	4/65	250	280
El-tronics, Inc.	ALWAC IIIE	N	$1820	2/54	21	X
Electronic Associates, Inc.	8400	Y	$7000	6/65	4	6
Friden	6010	Y	$600	6/63	400	85
General Electric	115	Y	$1375	12/65	65	500
	205	Y	$2900	6/64	45	7
	210	Y	$16,000	7/59	50	X
	215	Y	$6000	9/63	56	X
	225	Y	$8000	4/61	214	X
	235	Y	$10,900	4/64	62	2
	415	Y	$7300	5/64	150	70
	425	Y	$9600	6/64	60	45
	435	Y	$14,000	10/64	25	18
	625	Y	$45,000	12/64	13	25
	635/645	Y	$55,000	12/64	8	30
Honeywell Electronic Data Processing	H-120	Y	$2600	1/66	60	300
	H-200	Y	$5700	3/64	730	100

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
Honeywell (cont'd)	H-400	Y	$8500	12/61	120	X
	H-800	Y	$22,000	12/60	86	3
	H-1200	Y	$6500	2/66	5	49
	H-1400	Y	$14,000	1/64	12	1
	H-1800	Y	$30,000	1/64	18	6
	H-2200	Y	$11,000	1/66	5	45
	H-4200	Y	$16,800	6/66	0	8
	H-8200	Y	$35,000	3/67	0	3
	DATAmatic 1000	N	$40,000	12/57	4	X
IBM	305	N	$3600	12/57	162	X
	360/20	Y	$1800	12/65	130	6400
	360/30	Y	$7500	5/65	1150	4150
	360/40	Y	$15,000	4/65	725	1700
	360/44	Y	$10,000	9/66	0	535
	360/50	Y	$26,000	8/65	40	640
	360/62	Y	$55,000	11/65	1	X
	360/65	Y	$50,000	11/65	5	105
	360/67	Y	$75,000	9/66	0	55
	360/75	Y	$78,000	2/66	3	44
	360/90 Series	Y	$140,000	6/67	0	9
	650	N	$4800	11/54	225	X
	1130	Y	$1200	11/65	200	3700
	1401	Y	$6600	9/60	6600	300
	1401-G	Y	$1900	5/64	1500	65
	1410	Y	$14,200	11/61	755	110
	1440	Y	$4800	4/63	3100	450
	1460	Y	$9000	10/63	2000	135
	1620 I, II	Y	$4000	9/60	1700	50
	1800	Y	$7600	1/66	10	270
	701	N	$5000	4/53	1	X
	7010	Y	$22,600	10/63	192	35
	702	N	$6900	2/55	7	X
	7030	Y	$160,000	5/61	6	X
	704	N	$32,000	12/55	37	X
	7040	Y	$22,000	6/63	118	14
	7044	Y	$32,000	6/63	128	20
	705	N	$38,000	11/55	60	X
	7070, 2, 4	Y	$27,000	3/60	336	X
	7080	Y	$55,000	8/61	80	X
	709	N	$40,000	8/58	11	X
	7090	Y	$63,500	11/59	45	1
	7094	Y	$72,500	9/62	126	5
	7094 II	Y	$78,500	4/64	120	12
Monroe Calculating Machine Co.	Monrobot IX	N	Sold only - $5800	3/58	145	X
	Monrobot XI	Y	$700	12/60	500	100
National Cash Register Co.	NCR - 304	Y	$14,000	1/60	26	X
	NCR - 310	Y	$2000	5/61	20	X
	NCR - 315	Y	$8500	5/62	400	40
	NCR - 315-RMC	Y	$12,000	9/65	25	25
	NCR - 390	Y	$1850	5/61	1120	25
	NCR - 500	Y	$1500	10/65	350	800
Philco	1000	Y	$7010	6/63	20	X
	2000-210, 211	Y	$40,000	10/58	18	X
	2000-212	Y	$52,000	1/63	11	X
Radio Corporation of America	Bizmac	N	$100,000	-/56	2	X
	RCA 301	Y	$7000	2/61	647	5
	RCA 3301	Y	$17,000	7/64	50	14
	RCA 501	Y	$14,000	6/59	99	2
	RCA 601	Y	$35,000	11/62	5	X
	Spectra 70/15	Y	$3500	9/65	35	100
	Spectra 70/25	Y	$5000	9/65	14	65
	Spectra 70/35	Y	$9000	11/66	0	65
	Spectra 70/45	Y	$15,000	11/65	6	125
	Spectra 70/55	Y	$30,000	7/66	0	14
Raytheon	250	Y	$1200	12/60	170	X
	440	Y	$3500	3/64	14	3
	520	Y	$3200	10/65	9	7
Scientific Control Systems	650	Y	$500	5/66	0	3
	660	Y	$2000	10/65	3	2
	670	Y	$2600	5/66	0	2
Scientific Data Systems Inc.	SDS-92	Y	$1100	4/65	42	40
	SDS-910	Y	$2000	8/62	173	12
	SDS-920	Y	$2900	9/62	116	10
	SDS-925	Y	$3000	12/64	16	20
	SDS-930	Y	$3400	6/64	110	30
	SDS-940	Y	$10,000	4/66	2	15
	SDS-9300	Y	$7000	11/64	25	8
	Sigma 7	Y	$10,000	12/66	0	16
Systems Engineering Labs	SEL-810A	Y	$1000	9/65	19	11
	SEL-840A	Y	$1400	11/65	4	2
UNIVAC	I & II	N	$25,000	3/51 & 11/57	29	X
	III	Y	$20,000	8/62	82	1
	File Computers	N	$15,000	8/56	18	X
	Solid-State 80 I, II, 90 I, II & Step	Y	$8000	8/58	270	X
	418	Y	$11,000	6/63	75	40
	490 Series	Y	$35,000	12/61	94	63
	1004	Y	$1900	2/63	3350	160
	1005	Y	$2400	4/66	50	200
	1050	Y	$8000	9/63	290	60
	1100 Series (except 1170)	N	$35,000	12/50	12	X
	1107	Y	$60,000	10/62	30	2
	1108	Y	$65,000	9/65	8	20
	LARC	Y	$135,000	5/60	2	X
				TOTALS	34278	23052

X = no longer in production.

* To avoid double counting, note that the Control Data 160 serves as the central processor of the NCR 310. Also, many of the orders for the IBM 7044, 7074, and 7094 I and II's are not for new machines but for conversion from existing 7040, 7070, and 7090 computers respectively.

NEW PATENTS

RAYMOND R. SKOLNICK,
Reg. Patent Agent Ford Instrument Co., Div. of Sperry Rand Corp. Long Island City, New York 11101

The following is a compilation of patents pertaining to computers and associated equipment from the "Official Gazette of the U. S. Patent Office," dates of issue as indicated. Each entry consists of: patent number / inventor(s) / assignee / invention. Printed copies of patents may be obtained from the U.S. Commissioner of Patents, Washington, D.C. 20231, at a cost of 50 cents each.

October 19, 1965

3,213,289 / Kenneth O. King, Torrance, and George F. Minka, Gardena, Calif. / The National Cash Register Co. / Inhibit Logic Means.

October 26, 1965

3,214,573 / Wilmer C. Anderson, Greenwich, Conn., and Michael J. Ingenito, Bronx, N. Y. / General Time Corp. / Digital Storage And Readout Device.

3,214,605 / Umberto F. Gianola, Florham Park, N. J. / Bell Telephone Laboratories / Logic Arrangements.

3,214,733 / Dana R. Spencer, Wappingers Falls, and Philip P. Cartier, Poughkeepsie, N. Y. / International Business Machines Corp. / Data Multiplexing Apparatus.

3,214,735 / John F. Reuther, Penn Hills, Pa., and Bernard R. Johnson, Champaign, Ill. / Westinghouse Electric Corp. / Double Binary Coding And Decoding System Employing Nor Logic.

3,214,737 / William M. Kahn, Brighton, and John E. Mekota, Jr., Belmont, Mass. / Honeywell Inc. / Data Processing Apparatus.

3,214,738 / Eugene F. Parrott, Jr., Coon Rapids, Minn. / Sperry Rand Corp. / Transformer Diode Shift Matrix.

November 2, 1965

3,215,819 / William V. Smith, Leende, North Brabant, Netherlands, and Harold E. Petersen, Chappaqua, N.Y. / International Business Machines Corp. / Memory System.

3,215,845 / Allen L. Solomon, Glen Cove, and Moe S. Wasserman, Massapequa, N.Y. / General Telephone and Electronics Laboratories, Inc. / Logic Circuit.

3,215,982 / Robert J. Flaherty, Pleasant Valley, and Richard C. Lamy, Poughkeepsie, N.Y. / International Business Machines Corp. / Core Matrix Control Circuit For Selection Of Cores By True And Complement Signals.

3,215,987 / John Terzian, Winchester, Mass. / Sylvania Electric Products Inc. / Electronic Data Processing.

3,215,992 / James W. Schallerer, New Shrewsbury, N.J. / by mesne assignments to Indiana General Corp. / Coincident Current Permanent Memory With Preselected Inhibits.

3,215,994 / Edward C. Dowling, Harrisburg, Pa. / AMP Inc. / Logic System Employing Multipath Magnetic Cores.

November 9, 1965

3,217,177 / Bertram Walker, Levittown, Pa. / Radio Corporation of America / Logic Circuits.

3,217,181 / Borys Zuk, Somerville, N.J. / Radio Corporation of America / Logic Switching Circuit Comprising A Plurality Of Discrete Inputs.

3,217,293 / George F. Metz, Richmond, Calif. / Beckman Instruments, Inc. / Digital Comparator.

3,217,298 / Tom Kilburn, Urmston, and Frank Hall Sumner, Manchester, England / by mesne to International Business Machines Corp. / Electronic Digital Computing Machines.

3,217,300 / Lawrence R. Smith, Phoenix, Ariz. / Motorola, Inc. / Multi-Apertured Magnetic Logic Device.

3,217,301 / Carl G. Shook, Rochester, N.Y. / General Dynamics Corp. / Memory Element.

3,217,302 / Glenn E. Hagen, Southfield, Mass. / Alwac International, Nassau, Bahamas / Magnetic Storage Device.

3,217,304 / Duane W. Baxter, Kingston, and David W. Anis, Red Hook, N.Y. / International Business Machines Corp. / Memory System.

3,217,317 / Ivan Merwin Kliman, Glen Head, N.Y. / Sperry Rand Corp. / Information Transformation System.

November 16, 1965

3,218,613 / Maurice Woolmer Gribble, Marple, and Kenneth Charles Johnson, Gatley, Cheadle, England / Ferranti, Limited, Hollinwood, Lancashire, England / Information Storage Devices.

3,218,614 / Tom Kilburn, Urmston, and David Beverley George Edwards and Michael John Lanigan, Manchester, England / by mesne assignments to International Business Machines Corp. / One-Out-Of-Many Code Storage System.

3,218,616 / Pieter Huijer and Hugo Frans Pit, Emmasingel, Eindhoven, Netherlands / North American Philips Co., Inc. / Magnetoresistive Readout Of Thin-Film Memories.

3,218,617 / Leo M. Piecha, Sierra Vista, Ariz. / Hughes Aircraft Co. / Thin Film Magnetic Memory.

November 23, 1965

3,219,908 / Steve A. Zarleng, Akron, Ohio / The Clark Controller Co. / Gate Control Circuit.

3,219,976 / Claude Hall Tucker, Jr., Sunnyvale, Calif. / General Electric Co. / Data Processing System.

3,219,978 / Henry L. Herold, Palo Alto, and Claude H. Tucker, Jr., Sunnyvale, Calif. / General Electric Co. / Data Processing System.

3,219,981 / Eugeni Estrems, Saint-Maude, France / International Business Machines Corp. / Programming Device For Data Processing Machines.

3,219,985 / Robert M. MacIntyre, Newport Beach, Calif. / by mesne assignments to Raytheon Co. / Logic System.

3,219,987 / Robert C. Kelner, Concord, Mass. / Laboratory for Electronics, Inc. / Magnetic Shift Register.

November 30, 1965

3,221,157 / Harold Fleisher, Poughkeepsie, and Robert I. Roth, Briarcliff Manor, N.Y. / International Business Machines Corp. / Associative Memory.

3,221,177 / Henri Nussbaumer, Maisons-Alfort, France / International Business Machines Corp. / Multiple Stable Generators For Majority Logical Circuits.

3,221,180 / Melvin M. Kaufman, Merchantville, N.J. / Radio Corporation of America / Memory Circuits Employing Negative Resistance Elements.

3,221,181 / Zen'iti Kiyasu and Kazuo Husimi, Tokyo, Japan / Nippon Telegraph and Telephone Public Corp. / Variable Capacitance Controlled Esaki Diode Logic Circuit.

3,221,308 / Harold E. Petersen, Chappaqua, William L. McDermid, Peekskill, and James R. Kiseda, Yorktown Heights, N.Y. / International Business Machines Corp. / Memory System.

November 30, 1965

3,221,312 / Donald Fulton Alexander MacLachlan, Hanworth, Middlesex, England / Columbia Broadcasting System Inc. / Magnetic Core Storage Devices.

3,221,313 / Umberto F. Gianola, Florham Park, N.J. / Bell Telephone Laboratories Inc. / Magnetic Memory Circuits.

December 7, 1965

3,221,755 / Malor Wright, Lexington, Mass. / Itek Corporation, Lexington, Mass. / Data Processing Apparatus.

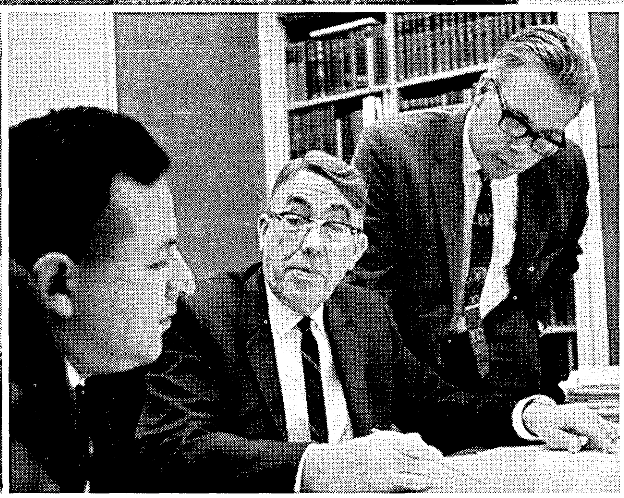
3,222,536 / John M. Witherspoon, Malvern, Pa. / Burroughs Corporation, Detroit, Mich. / Time-Controlled Logical Circuit.

3,222,544 / Tsung-Hsien Cheng, Croton-on-Hudson, N.Y. / International Business Machines Corporation, N.Y. / Superconductive, Variable Inductance Logic Circuit.

3,222,549 / Arnold S. Farber, Yorktown Heights, N.Y. / International Business Machines Corporation, N.Y. / Monostable Logic Circuit.

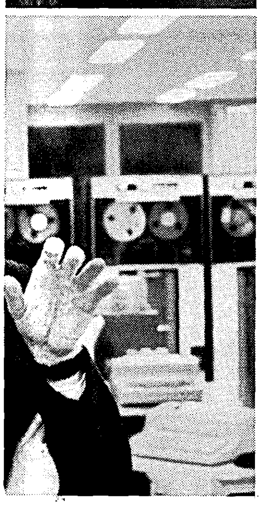
3,222,647 / Christopher Strachey, London, England / by mesne assignments to International Business Machines Corp. / Data Processing Equipment.

3,222,648 / Kenneth A. Bell and Donald S. MacLeod, Vestal, N.Y. / International Business Machines Corp. / Data Input Device.



Top: Kenneth Iverson (*A Programming Language:* Wiley, 1962; *Automatic Data Processing:* Wiley, 1963, co-author F. P. Brooks, Jr.; *Elementary Functions:* Science Research Associates, Inc., in press) has used his language in a formal description of IBM System/360. It is now being used to write a formal description of advanced software.

Left: David Sayre, left, and Robert Nelson (members of the original FORTRAN team) use a remote console of a time-sharing computer now in operation at IBM. The machine was designed specifically for programming research, with a wide variety of timing and measuring features to permit evaluation of programming performance.



BOOKS AND OTHER PUBLICATIONS

Notices

Hartley, M. G. / An Introduction to Electronic Analogue Computers / John Wiley & Sons, Inc., 605 Third Ave., New York, N. Y. 10016 / 1963, printed, 155 pp, $4.50

Klaf, A. A. / Calculus Refresher for Technical Men / Dover Publications, Inc., 180 Varick St., New York, N. Y. 10014 / 1965, printed, 431 pp, $2.00

Alfrey, G. F. / Physical Electronics / D. Van Nostrand Co., Princeton, N. J. / 1964, printed, 220 pp, cost ?

Aiken, Howard, and William F. Main, editors and 27 authors / Switching Theory in Space Technology / Stanford University Press, Stanford, Calif. / 1963, printed, 357 pp, $11.50

Prager, William / Introduction to Basic FORTRAN Programming and Numerical Methods / Blaisdell Pub. Co., 135 West 50 St., New York, N. Y. 10020 / 1965, printed, 203 pp, $6.00

Zbar, Paul B. / Electronic Instruments and Measurements: Laboratory Manual for Electronics Technicians / McGraw-Hill Book Co., Inc., 330 West 42 St., New York, N. Y. 10036 / 1965, printed, 106 pp, $3.95

Martino, R. L. / Allocating and Scheduling Resources / American Management Assn., Inc., 135 West 50 St., New York, N. Y. 10020 / 1965, printed, 143 pp, $15.00 ($10.00 to AMA members)

Meacham, Alan D., editor, and 32 authors / Data Processing Yearbook 1962-63 / American Data Processing, Inc., 22nd Floor Book Tower, Detroit 26, Mich. / 1962, printed, 300 pp, $15.00

Saxon, James A. / Programming the RCA 301, A Self-Instructional Programmed Manual / Prentice-Hall, Inc., Englewood Cliffs, N. J. / 1965, offset, 274 pp, $6.95

Desmonde, William H. / Real-Time Data Processing Systems: Introductory Concepts / Prentice-Hall, Inc., Englewood Cliffs, N. J. 07632 / 1964, printed, 186 pp, $7.95

Leondes, C. T., editor, and 6 authors / Advances in Control Systems Theory and Applications, vol. I / Academic Press, Inc., 111 Fifth Ave., New York, N. Y. 10003 / 1964, printed, 361 pp, $13.00

Miller, Raymond E. / Switching Theory, vol. I: Combinational Circuits / John Wiley & Sons, Inc., 605 Third Ave., New York, N. Y. 10016 / 1965, printed, 351 pp, $12.95

Westwater, F. L. / Electronic Computers (A "Teach Yourself" Book) / English Universities Press Ltd., 102 Newgate St., London, E. C. 1, Eng. / 1962, printed, 151 pp. $1.05

Bijleveld, W. J. / Automatic Reading of Digits / Netherlands Automatic Information Processing Research Centre, 6 Stadhouderskade, Amsterdam, The Netherlands / 1964, printed, 87 pp, cost ?

ADVERTISING INDEX

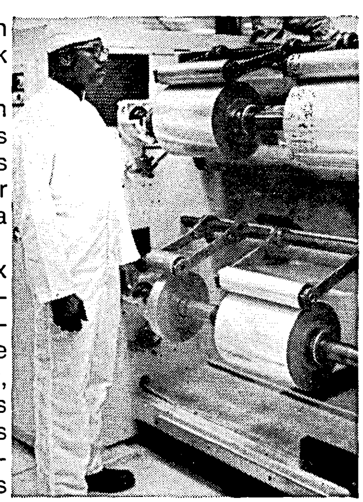
Following is the index of advertisements. Each item contains: Name and address of the advertiser / page number where the advertisement appears / name of agency if any.

Why we encourage John's Gordian Complex

John has a compulsive urge to cut through knots of red tape. Simply will have no truck with tradition.

While, for example, other polyester film comes only in *certain* roll lengths, widths and gauges, John says "nonsense" and goes right ahead supplying Celanar Polyester Film just about *any* way that's best for a particular precision tape application.

Fact is, we all have a bit of a complex about Celanar quality and service. Like insisting Celanar film be the cleanest, strongest available. Manufacturing it under "White Room" conditions at our Greer, S.C. plant, where air filtration systems trap dirt specks tiny as 0.3 micron. To assure the cleanliness that makes Celanar a better base for computer and instrumentation tapes—and gives



higher production yields in film conversion.

We go all the way to make Celanar stronger than the other polyester film. In both tensile break and tensile yield strengths. And to keep Celanar film exceptionally free of visual defects, such as cross-buckles or wrinkles.

We also guard it during shipment with temperature recording flags. Even impact recorders, when necessary. To make sure you receive Celanar film with quality as high as we produce.

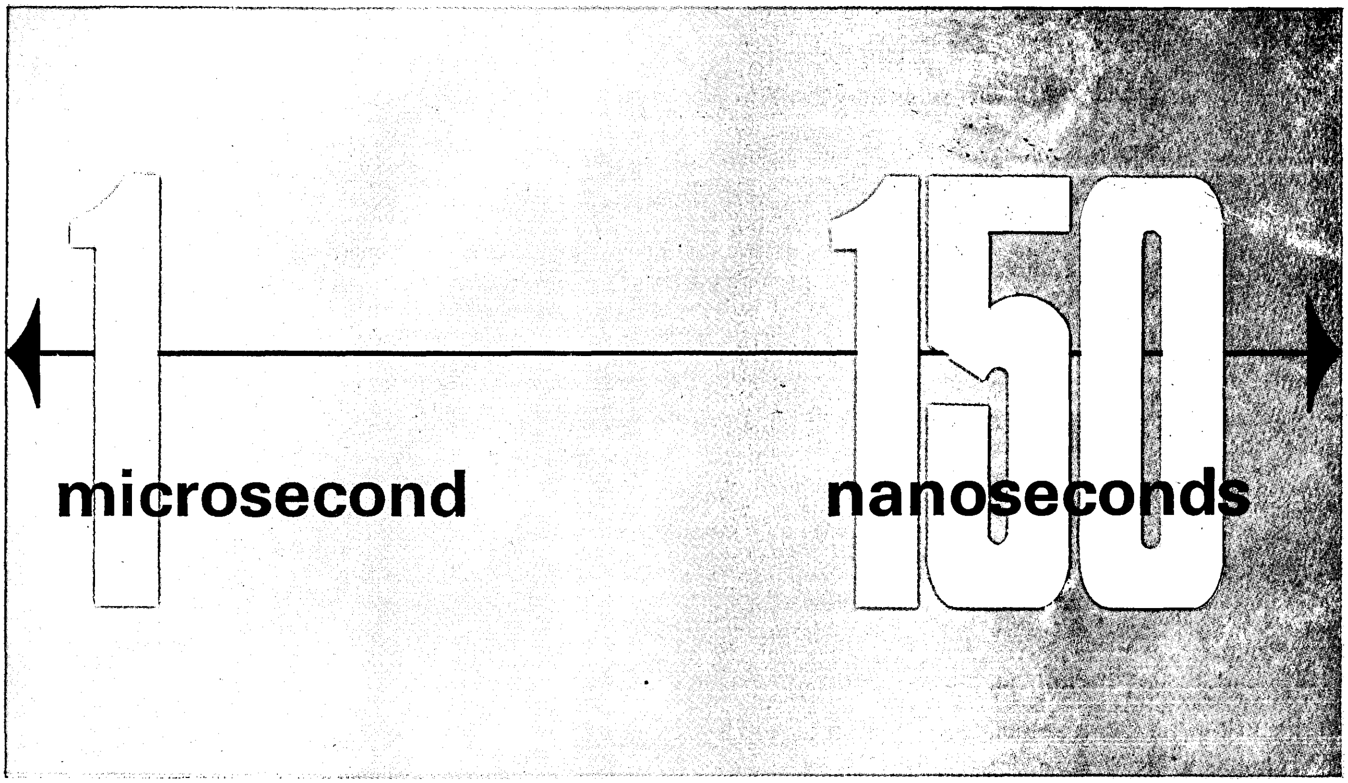
Send for complete details about Celanar Polyester Film. Celanese Plastics Company, Dept. 122-G, 744 Broad Street, Newark, New Jersey.

Celanese Plastics Company is a division of Celanese Corporation.
Celanese® Celanar®

CELANESE

Designate No. 16 on Readers Service Card

Introducing: The Fabri-Tek FAST Line concept



—a unique solution to COMPUTER MEMORY requirements in the sub-microsecond speed range!

The Fabri-Tek FAST Line concept represents a significant departure from the discrete memory speeds of equipment currently available. FAST Line provides a free selection of any memory speed between 1 usec and 150 nsec without specific incremental restrictions.

Now, you can select an optimized memory stack or system from the FAST Line spectrum which matches exactly the logical organization and internal circuit speeds of your computer design.

Here's what the Fabri-Tek FAST Line concept means to you:

1. Exact match of speed and capacity to your next computer design.
2. Value-engineered memories. You pay for only the speed required.
3. Speed-cost evaluation resulting in lowest ultimate cost to you.
4. Standardized designs and organizational techniques for reduced manufacturing costs and improved reliability.
5. All organizational modes available to match your needs (3D, 2½D and linear select).
6. . . . and a serious commitment in depth of our entire company to helping you fill your computer memory requirements.

The FAST Line memory includes core memories from 1 usec to the 375 nsec range and film memories from 500 to 150 nsec. If your present or future computer design calls for memory stack or system speeds in this spectrum, the FAST Line concept is worth your time to check out. Call: 612-935-8811, TWX: 910-576-2913 or Write: Fabri-Tek Incorporated, 5901 South County Road 18, Minneapolis, Minnesota 55436.

FTi

The Leader in Memory Technology

Designate No. 17 on Readers Service Card