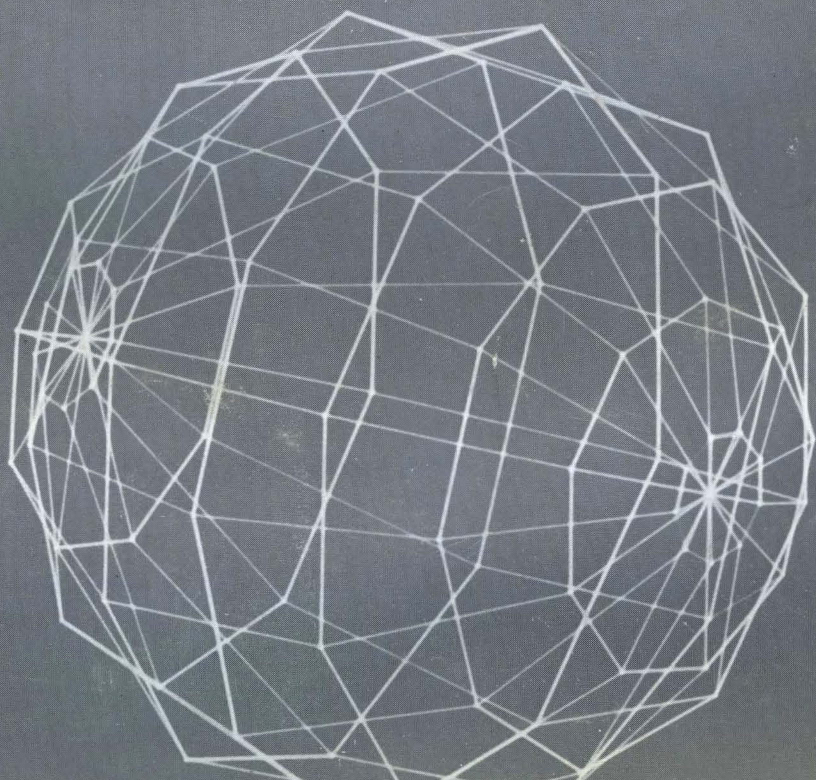
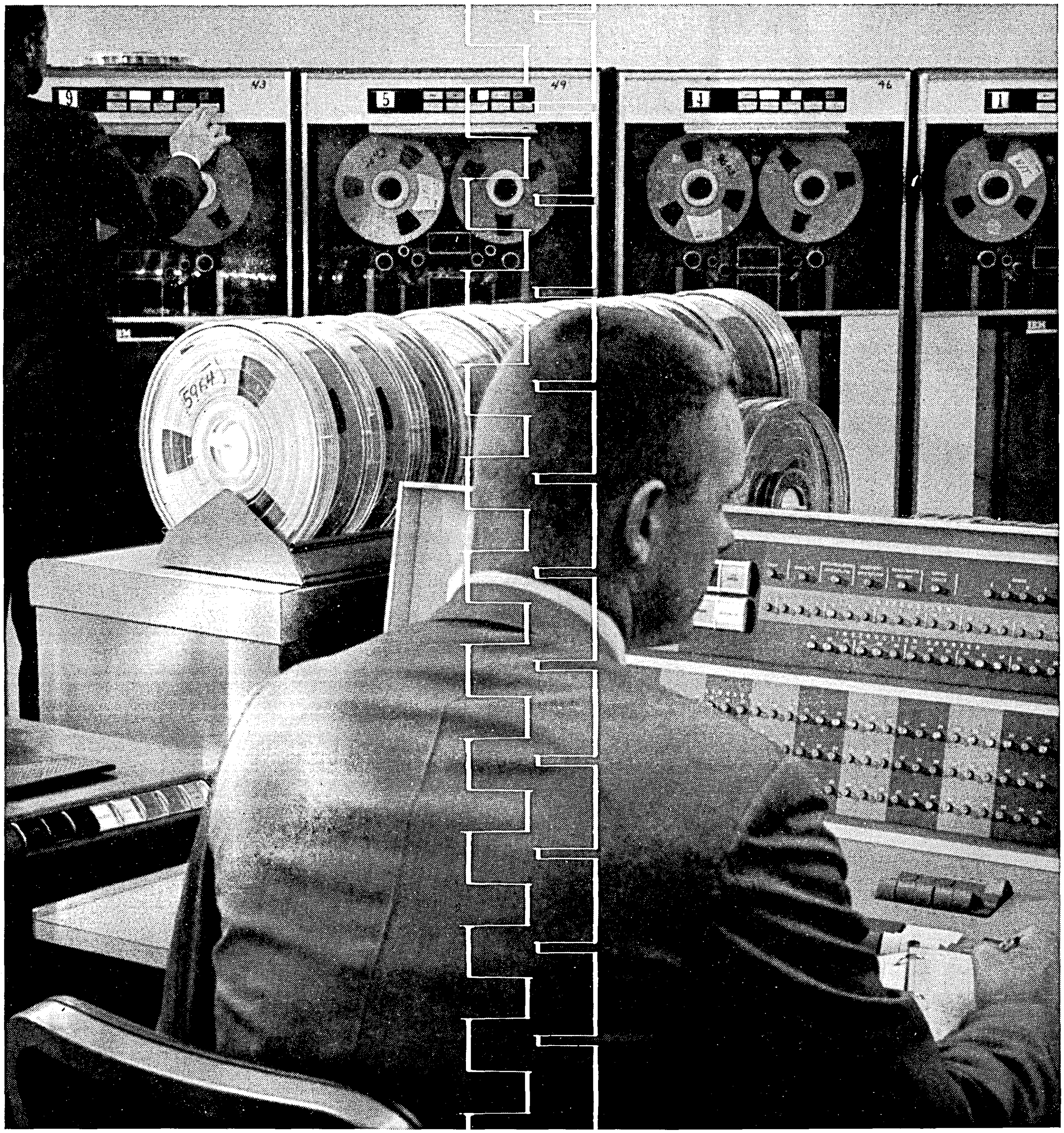
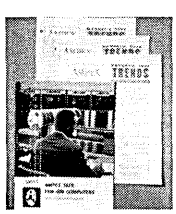
November, 1963

computers and automation

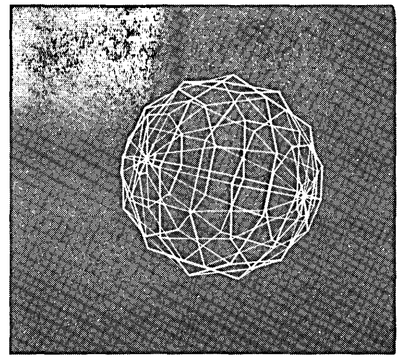






AMPEX

The front cover shows a three-dimensional drawing produced by a very-high-speed data recorder. More on this subject on page 27.



computers and automation

NOVEMBER, 1963 Vol. XII, No. 11

computers and data processors:
the design, applications,
and implications of
information processing systems.

In This Issue

In Every Issue

COMPUTERS AND AUTOMATION IS PUBLISHED MONTHLY AT 815 WASHINGTON ST., NEWTONVILLE 60, MASS., 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 $1.50 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.

POSTMASTER: PLEASE SEND ALL FORMS 3579 TO BERKELEY ENTERPRISES, INC., 815 WASHINGTON ST., NEWTONVILLE, MASS., 02160. CHANGE OF ADDRESS: IF YOUR ADDRESS CHANGES, PLEASE SEND US BOTH YOUR NEW ADDRESS AND YOUR OLD ADDRESS (AS IT APPEARS ON THE MAGAZINE ADDRESS IMPRINT), AND ALLOW THREE WEEKS FOR THE CHANGE TO BE MADE.

c & a
EDITORIAL

Computers, Automation, and Employment

"The changes coming will be so drastic and extensive that everyone will have to be informed. Thousands of white and blue-collar workers whose jobs are affected by technological change will have to think about learning a new skill. Communities will have to think about and act upon the need for setting up retraining and reemployment centers. Employers will have to think about the steps they should take to re-train some of their own labor force to take over the new jobs the machines and computers create while displacing other workers. Educators will have to think about revising vocational education in the light of the fast moving changes coming through automation and other technological developments in this new phase of the 20th century."

— William R. Baker, Jr., Chairman of the Board, Advertising Council, New York, N.Y.

"By 1970 the labor force will total some 84 million workers. If the trends that affect employment continue the same as in the 1950s, the jobs available by 1970 will be on the order of 75 million. The upshot will be unemployment of 9 million, an unemployment rate of 11%."

— "Business Week" (Sept. 23, 1963) reporting A. J. Jaffe, Director of Manpower and Population Research, Bureau of Applied Social Research, Columbia University, New York, N.Y.

The United States has a serious and enlarging problem in unemployment, in an era of more and more computers and automation.

It is of course good to inform people, as Mr. Baker advocates; and it is of course necessary to retrain and reeducate people, and to help them learn new skills. A rapidly changing society requires adaptable members.

But there is a serious arithmetical fallacy in Mr. Baker's proposals:

NO AMOUNT OF RETRAINING WILL CHANGE 75 MILLION JOBS INTO 84 MILLION

The main effect of retraining will simply be on the selection of the persons who will have the jobs. In the game of musical chairs, if 84 persons try to sit on 75 chairs, 9 of them will have no chairs.

Most of you who will read this editorial discussion during the next month have good work to do and receive a good income. You and I both have had some education in the computer field; trained computer people are in short supply.

So hardly any of us know from personal experience what it is like, month after month, to have no work to do, and to have almost no money to live on but the dole (1950 language: relief check).

We do not know what it is like while unemployed to see around us obvious economic wealth and obvious capacity to produce — even the ability to find billions of dollars in order to put a man on the moon — while over 50 million Americans are "poor".

We do not know at first hand what it is like to be condemned to economic death — like the 40,000 locomotive firemen on American railroads who will be fired from their useless jobs when the change in the railroad work rules becomes effective.

Nine million people — nine thousand thousand human beings — unemployed — in one of the richest countries on the earth! (And already, in 1963, the U.S. has six million unemployed!)

Suppose we as computer people and scientists were to report to the American people:

"We foresee a huge disaster — a great plague — a vast disease — which will make 9 million Americans null and void, as if they had never been."

Then immediately the great sympathies and energies of the American people would be aroused; they would organize to prevent any "natural" disaster. Government, business, labor, all the segments of our society would organize eagerly together to save alive 9 million people in the face of death.

But unemployment, which exists in some countries and is man-made, is not treated in our society as a disaster, a plague, a disease — real though it is, destructive though it is, wasteful though it is. Why are the people of the United States almost inactive about this? Why is there so little happening in Congress or anywhere else of a magnitude that fits the problem of retraining, education, and the ACTUAL MAKING of jobs? Why does hardly anyone in this country say "It is our social responsibility to guarantee that everyone is employed in socially useful and c & a

READERS' & EDITOR'S FORUM

ABC—ACRONYM BOUNCERS CONGREGATE

Membership in C&A's LSOAOFL (Let's Stamp Out Acronyms Over Five Letters) Club, started by a notice in our August issue, has been mounting steadily over the last several weeks. Frankly, we were both surprised and pleased to learn that there is a growing band of people who abhor with us the use of outlandish or unpronounceable acronyms to label projects and activities. We welcome additional members to our club, and we hope to be able to start a new letter to members shortly.

One of our new members pointed out how logically satisfying, LSOAOFL, the name of our club, is. For when and if we achieve our purpose, our club *should* go out of existence, and must, of course, to achieve its purpose. Another new member told us of his existing efforts to hone down the Army's acronyms to six letters. He writes:

To the Editor:

Add my name to your LSOAOFL Club.

I am the founder of a similar club, LSOAOSL, here at USAEPG (Army Electronic Proving Grounds) whose reluctant members are on Project CCIS-70 (Command-Control Information System by 1970). We found that if the field army is to be automated, they *must* limit their code words to *six* letters in human-intelligible formats made up for conversion to FIELDATA binary word lengths in their computers.

At the AHFEC-63 (Army Human Factors Engineering Conference, 1963) in Washington, D. C. (District of Columbia) next month, I will be giving a paper on the guide-lines we developed for this "brevity coding." Should your "club" have relevant data, I would appreciate it. . . .

DR. ROD E. PACKER
Star Route
Hereford, Arizona

HOUSE OF REPRESENTATIVES' COMMITTEE REPORT

I. From Representative Arnold Olsen

House of Representatives
Washington, D. C.

The Subcommittee on Census and Government Statistics of the House Post Office and Civil Service Committee has recently concluded a series of hearings on the use of electronic data processing (EDP) equipment in the Federal Government. A report summarizing the Subcommittee's findings is now in preparation and will be released soon.

In connection with the testimony presented by the Comptroller General of the United States (see enclosed copy of Part 5 of the hearings, p. 550), the excellent article titled "A Survey and Study of the Computer Field," which appeared in the January 1963 issue of **Computers and Automation,** was introduced into the hearings record by the General Accounting Office spokesman. We find this article by the Industrial Securities Committee of the Investment Bankers Association of America to be one of the best statements we have seen anywhere on the computer field.

The purpose of this letter is to request your permission to reproduce the above article in our Committee report. Appropriate credits will, of course, be given to **Computers and Automation** Magazine.

Our Subcommittee will appreciate your cooperation in this matter.

II. From the Editor

We are glad to give you permission to reprint "A Survey and Study of the Computer Field" in your Committee report. I am glad that something we published has been of use to you.

---

rewarding work"? Some countries guarantee employment to every person able and willing to work. How do they manage it? Why shouldn't the United States do so?

There are probably several reasons. First, perhaps, is the reason that most people in the United States have not awakened to the truly terrifying magnitude of the Second Industrial Revolution — call it what you choose, computers and automation, the snowballing of technological change, the bouncing upward of productivity, etc. People have not realized the enormous powers for good and evil now implied in our new avalanche of scientific technology.

But a second and much bigger reason is the sacred cows. Every society has its sacred cows. To the Hindus a cow is actually sacred, cannot be killed for any reason whatever, must be fed. In the United States a number of similar stifling ideas are sacred cows, cannot be questioned without severe punishment of the questioner, must be publicly agreed with: private property, free enterprise, the "American way of life", etc.

Yet the United States is full of compromises about private property, free enterprise, and the "American way of life" — and we need in a big way more compromises. The Port Authority of New York, a creation of the New York and New Jersey legislatures, is a most interesting

(Please turn to Page 9)

"We use Computer Audiotape in all phases of our computer operation"

says Mr. Louis L. Hodge, Director of Data Processing Operations for Government Employees Insurance Company, Chevy Chase, Maryland

"GEICO is one of the leading auto insurers in the United States. As a result, our large computer section is used to keep the individual files on almost a million policyholders constantly up to date, as well as to process thousands of claims weekly. Computer Audiotape is active in all phases of these operations. We have purchased close to 1,000 reels in less than a year. We prefer Computer Audiotape for a number of reasons. First—and most important—its quality has been very good. Second, the price is right. And third, the service we get is most satisfactory."

GEICO is just one of the many prominent companies that consistently specify Computer Audiotape. They know that each reel is manufactured with extreme care. They know that each reel is 100% checked to insure that every "bit" reproduces properly. Try Computer Audiotape in your own operation. It's available in a variety of lengths, in bit densities of 200, 556 and 800, in standard and heavy duty types. And consider Audio's new Extra Length Computer Audiotape which offers 50% more tape on the same size reel. Write for complete information to Audio Devices, Dept. CA.

AUDIO DEVICES, INC., 444 Madison Avenue, New York 22, New York

Circle No. 7 on Readers Service Card

c & a EDITOR'S SCRATCHPAD

COMPUTERS ON THE RIGHT

Up to the present, the role of the computer in politics has mainly been confined to acting as a kind of electronic Greek chorus during network television coverage of voting returns on election night. True, the Democratic party did admit to using computers in 1959 to simulate the reaction of the electorate to tentative party policy positions on sensitive issues...although the party leadership disclaimed the effort as only a matter of incidental curiosity.

However, 1964 may be the year in which the computer dons its first major political role. Already one aspiring presidential candidate, Senator Barry Goldwater, has admitted to having lined up EDP resources on his side. According to the Senator's campaign manager, a microfilm library is being prepared which will contain a complete record of Goldwater's statements on public issues, from his two books, over 700 newspaper columns, hundreds of speeches, and innumerable statements. The library will then be indexed on punched cards so that the Senator, at the push of a button, can have flashed on a screen before him a complete history of what he has said on a subject, where, and to whom. This automatic opinion retrieval system is costing the Goldwater organization $10,000.

In a further step toward computerizing the Goldwater campaign, his associates are planning to put on magnetic tape the names and addresses of everyone who ever wrote to the Senator. This tape file is envisioned as being a prime asset in organizing local action groups for Goldwater should he be a presidential candidate in '64.

COMPUTERS ON THE STREET

Computers have been making an increasing impact on Wall Street...both on the ticker tape and in the brokerage office.

On the tape, Control Data, IBM, and RCA have been very active issues on the New York Exchange in recent months, each registering impressive advances. This activity has been supported in part by a growing awareness among investors that computer applications are likely to be the greatest growth area in the industrial electronics field.

In the larger brokerage offices, computers are frequently found doing general account updating, transaction processing, billing, payroll, etc. However at least two New York groups are doing a real-time analysis of price movements on the major exchanges in order to make judicious investment moves. Their successes or failures are currently tightly held secrets. Several other organizations are selling computerized investment advisory services on a subscription basis.

A celebrated case of computer-aided investment decisions involves the small bond firm of William Morris. Using a $150,000 analog computer, analysts at the Morris firm were able to outbid a syndicate of financial giants such as the Bank of America and Bankers Trust Company for two $100 million State of California bond issues.

With the estimated $1,700,000 the Morris firm made with the aid of their small analog computer, President Morris announced that his firm was purchasing a large, new, faster computer in anticipation of increasing reliance on computer-based financial strategy.

(Continued from Page 7)

example of a compromise. So is the Tennessee Valley Authority, and also the New York State Comission on Discrimination, and others. These authorities exercise public control in the interests of all of society.

It would be good to see a Federal Automation Authority, which would exercise public control over computerization, automation, and technological change, in the interests of all of society. It must be charged with guaranteeing employment to every person able and willing to work. It must also be charged with making sure that the social and technical advances of automation are made as beneficial as possible to all members of society. The technical know-how and productive capacity of the United States could so easily do this if it were enlisted fully. And there are thousands of ways to begin — just as the Port of New York Authority provides bridges and tunnels that otherwise would only be dreams, and collects tolls from motorists who elect to use the dream bridges instead of the old ferries. There is only one essential requirement: that we Americans highly resolve to wipe out forever the scourge of unemployment — just as a hundred years ago Americans highly resolved to wipe out the scourge of slavery.

The Congress of the United States needs to take responsibility in this area — so that the people of the United States may be guaranteed to have retraining, re-education, and jobs, and so that the United States shall have full employment by 1970, or sooner. West Germany and the Soviet Union have full employment now — why shouldn't the United States have it too?

Edmund C. Berkeley

THE EDITOR

Using their new computer, the Morris firm outbid three national financial syndicates to win the $122 million bond issue for the Hanford project of the State of Washington's Supply Systems Service. Shortly thereafter, the price level on the municipal bond market took an unexpected dip, and the Morris group suffered substantial losses on the Hanford issue. And very shortly thereafter the "FOR SALE" was hung on the firm's computer, one of the first heads to roll. Said President Morris, unsentimentally, "Why shouldn't we sell our computer? We made handsome profits by using it, but right now we are in need of handsome profits by other methods."

COMPUTER OFFERS INSTANT INTERVIEW SERVICE

"Computer engineers! Programmers! Looking for a new position or better opportunities? Come datatize yourself in our computer!"

The above siren call, although fictional at present, is suggestive of the services being offered by a number of new recruiting agencies handling technical specialists.

One such group is Dyna-Search Control, Inc., a Minneapolis-based firm, which is using a CDC 160A and the Bell Systems Model 35 teletypewriter to compile, analyze, and rapidly supply head-hunting companies with data on available specialists in technical areas. The company currently has the résumés of over 2000 people on magnetic tape, and hopes to add many more, without cost to the job hunter, in the near future. To search for a desired set of applicant skills, the computer compares the job requirements with a numerically coded set of "knowledge patterns" derived from encoded résumés. A fee is paid by an inquiring company if it has employed an applicant contacted through Dyna-Search's computer selections.

According to C. B. Mjolsness, president of the firm, business potential for the service is brisk. He points out that "at any given moment, there are over 25,000 technical people either contemplating or in the process of changing positions." With such a reservoir of relocatable talent, and with the firm's communications and computer facilities, Mr. Mjolsness predicts that job requirements can be received from companies anywhere in the U.S., available personnel analyzed, and results returned "within 30 minutes." Although this personnel-searching technique is in use within many companies, the advent of computer techniques among professional recruiters, i.e., instant job service, is an event worth careful notice.

● An interesting variation on the above theme is in operation by the First Christian Church of Portland, Ore. The church has stored on punched cards the age, education, abilities, and interests of the members of the congregation. When a new Sunday School teacher, a Boy Scout leader, a volunteer typist, or such is needed, the minister has his computer ruffle through the pertinent characteristics of the faithful, and come up with some likely prospects. According to an official of the church, "the computer system enables us to give more responsibility and a more active part in the church to people who might otherwise be overlooked." So you see, brother, there is, indeed, no place to hide!

● Additional expansion of private enterprise from the use of computers in personnel work is reflected by the arrest some months ago of a clerk in the N.Y. City Dept. of Personnel on charges of secretly punching new holes in the data processing record cards of his friends who had taken the city's competitive examinations for job promotion. Through the clerk's carefully placed card punches, his friends zoomed to the top of the priority list for new positions... which reminds us, in an uncomfortable way, of the tale of a mail clerk who within three weeks of joining a major corporation was appointed as its new vice-president. When reporters investigated the makings of this Horatio Alger-like exploit, they uncovered the fact that the month before the data processing manager had accidentally stepped on the clerk's punched card qualification record while wearing golf shoes, and...

MORE ABOUT DISC FILES

Your scratchpad editor stubbed his toe last month in reporting the number of disc file installations of Data Products Corp. as being less than twenty. DPC reports that as of the end of September, 83 of their disc file units were installed; General Electric, Control Data, and System Dev. Corp. are among their principal customers. This 83 represents total value in disc files and associated electronics from DPC of approximately $7 million, making DPC a leading factor among independent suppliers of disc file systems.

WE NOTED WITH INTEREST...

a frank expression from a government agency that documentation of computer programs and data systems has not been all that it should be. The remark occurred in a recent news release from the Internal Revenue Service reporting that a library of computer tapes containing income data compiled from tax returns is now available for use by business researchers, analysts, legislators, and government officials. In setting the guidelines for the use of the tape reels in the income record library, the IRS warns that data retrieval from history tapes assembled in previous years meets with "increasing difficulties, arising out of systems changes, as knowledge and memory of former systems become dimmer."

WE NOTED WITH NOSTALGIA...

that after 12-1/2 years of faithful computing, UNIVAC I, Serial No. 1, deferred to its transistorized, thin-film sibling, the UNIVAC 1107, and retired from its job of calculating statistics at the U.S. Bureau of the Census. As the first commercial model of a data processing computer, UNIVAC I will join other distinguished, pioneering hardware at the Smithsonian Institute. R.I.P.

Conducted by Leichtlicht Schreibfeder

Circle No. 8 on Readers Service Card ⟶

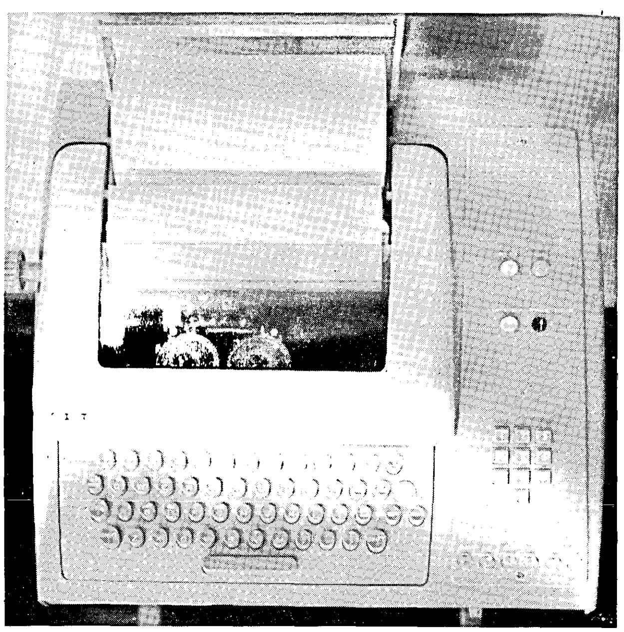
THE TIME SHARING OF COMPUTERS

Edward Fredkin
Information International, Inc.
Maynard, Mass.

Time sharing may be described as the simultaneous use or sharing of a computer by a number of users.

In a typical time-sharing system, the users may communicate with a central computer by means of a number of individual consoles (usually consisting of typewriters or teletypewriters). They may prepare and put in programs just as on an ordinary computer. For example, in one type of time-sharing system, the central computer will run each user's program, in turn, for a specified "quantum" of time (e.g., 20 milliseconds). At the end of that time the computer stores the user's program in a readily accessible peripheral memory device, such as a disc file. It reads in the next user's program from peripheral storage, processes it for 20 milliseconds, re-stores it, proceeds to the next user, and so on until, in round-robin fashion, it has returned to the first user. The first user's program will then receive a second "quantum" of processing, and the cycle will continue as before. Many other time-sharing methods besides this one are, however, now in use.

To understand time sharing and its promises for the future, let us first pay some attention to its history.



Typical input/output station for an individual user under a time sharing system.

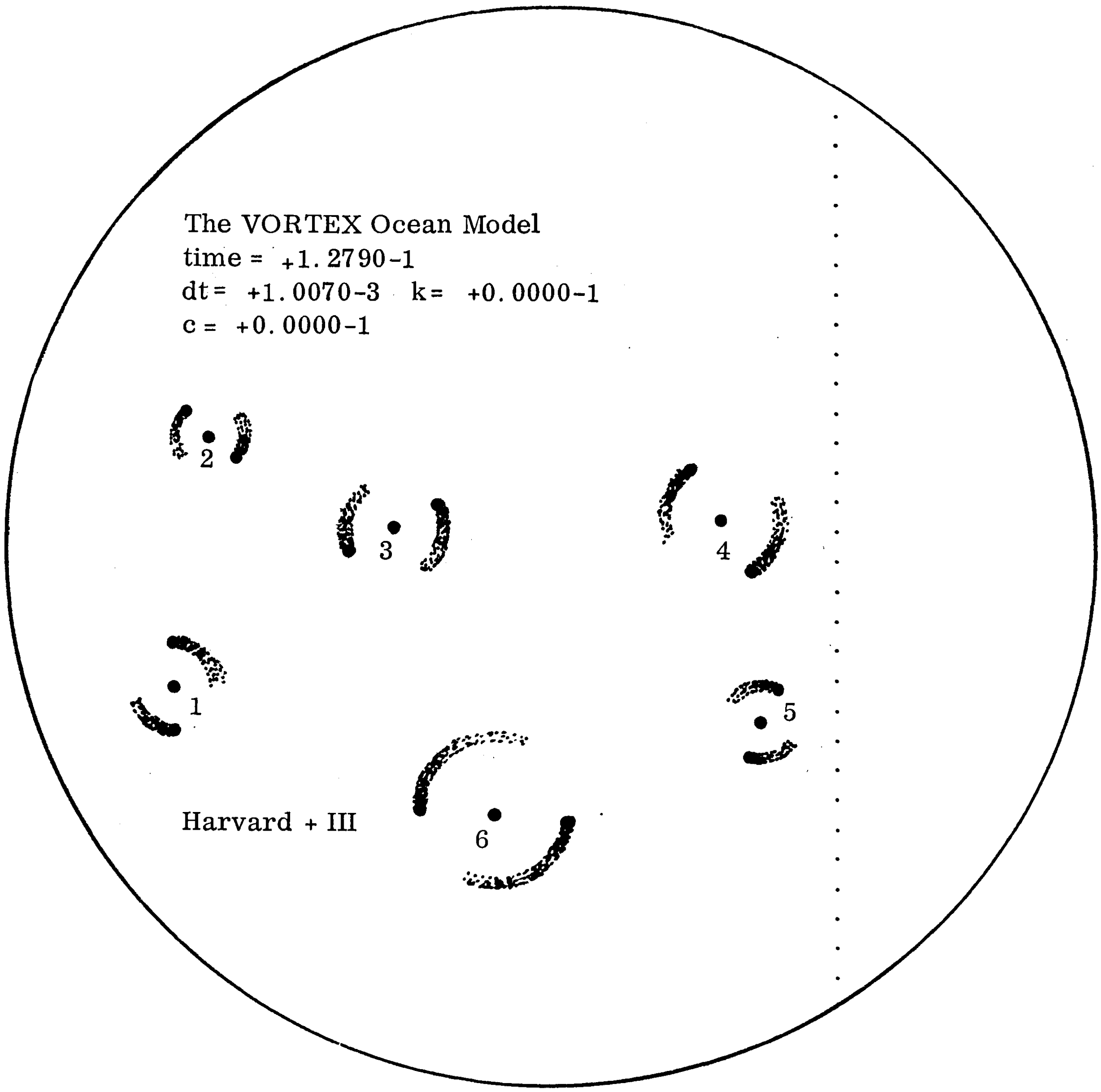
A Short History of Time Sharing

In the Fifties it was clear to many computer people that

(1) computers would eventually think,
(2) the main problems would lie in knowing what to do and how to do it,
(3) computers would help us to do it,
(4) that doing what we decided to do would be a programming task,
(5) that computers would help us do the programming tasks, and
(6) that we needed systems and languages that allowed us to use the capabilities of computers to the extent of our needs.

Our first main problem was an economic one. We could see that researchers would benefit from continuous access to the most capable (and most expensive) machines. Yet no one was about to give a new IBM 704 to each person interested in contributing to science, although there were impressive arguments to the effect that it would be worth doing this for at least some people!

Strangely enough, however, all the needs of one individual could be met by only a small part of a big machine's capabilities provided these capabilities were distributed (or shared) properly in time. This problem had been attacked and solved in the area of allowing input-output devices to share the time of the central processor—Wesley Clark of Lincoln Laboratory of Mass. Inst. of Technology not only designed a most impressive input-output interrupt system into the TX-2 computer, but he clearly specified in 1954, in a memo entitled "The Multi-Sequence Program Concept," exactly how to write a subroutine capable of simultaneous execution by many different callers. This



"Vortices" and writing shown in a scope display produced by the computer interacting with a user.

technique, called a *pure procedure* by J. C. R. Licklider,[5] is an essential ingredient of planned time-sharing systems. Basically, it is a subroutine which never modifies itself; all necessary memory modification takes place in the area specified by the calling sequence.

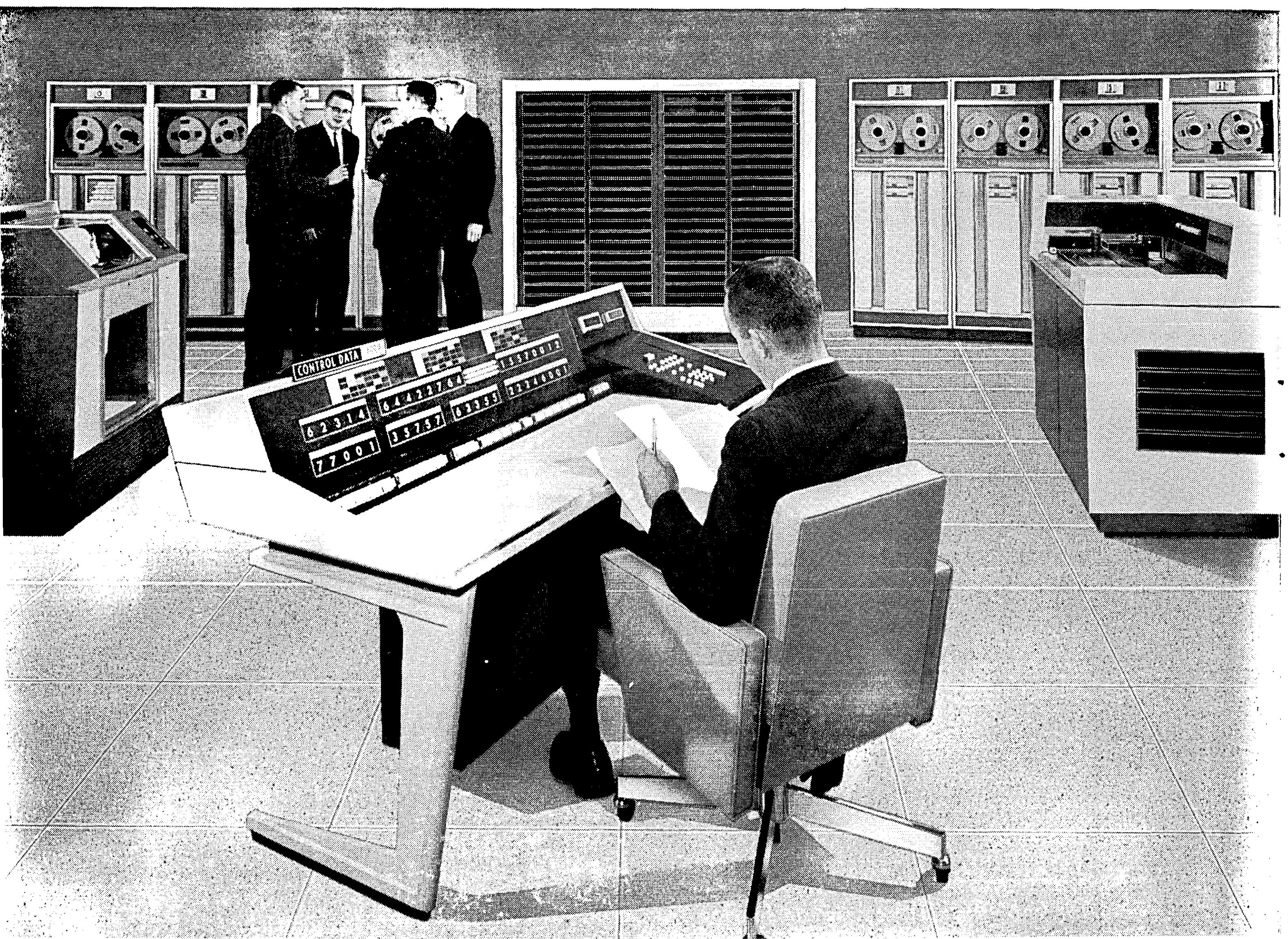
Various papers published (such as Strachey's[7]) and the machines implemented (TX-2; Gamma 60[8]) contained kernels of techniques that were to prove important to time sharing. However, I feel that Professor John McCarthy's early conception of essentially all of the basic requirements in the machine hardware and in systems programming, plus his long efforts to bring such a system into existence, deserve great recognition. Professor McCarthy, then at M.I.T, has pioneered in almost every area that will eventually make possible the creation of artificial intelligence, when "computers would eventually think."

While we are now making great progress in the implementation of time sharing, we do not today have any better ideas than those clearly enunciated by McCarthy five years ago. These ideas are today guiding our efforts.

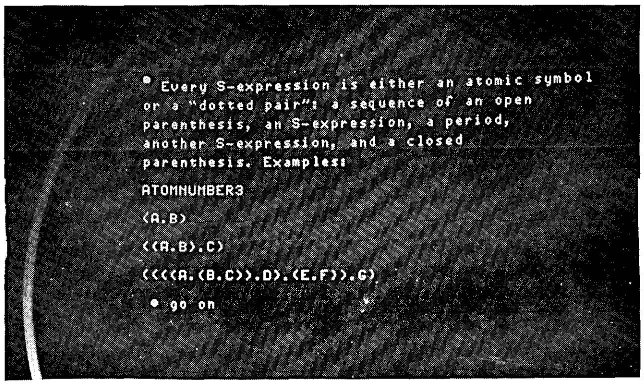
The development of the SAGE system by M.I.T.'s Lincoln Laboratory, the U. S. Air Force, and numerous contractors, illustrated many of the needs of time sharing, and solved many of the relevant problems. These problems included: display consoles, light pens, digital data communications via phone link, the interaction of many "users" with one computer, reliability, non-stop operation, computer-to-computer communications, computer-generated wall-size projected displays, the need for large memory, and most important of all, the problems of writing very large monolithic program systems. (What computer program other than SAGE has required more than 6,000 *man years* of programming effort?)

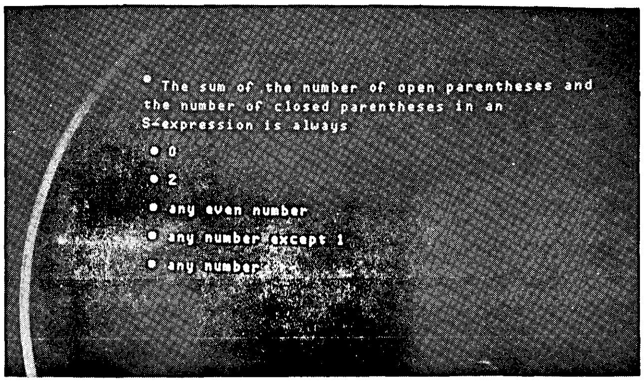
The Initial Time-Sharing Experiments

When the group of computer people of which I was part realized the importance of time sharing, we felt that the first step was to conduct an experiment in time sharing. There was no question in our minds whatsoever about the electronics or mechanical capability of accomplishing time sharing; however, we felt that there was much to be gained by some early experience with a time-sharing system. All of the systems proposed fell into two classes: (1) systems designed specifically for time sharing from the ground up; and (2) modifications to existing computers. The main distinction was that systems designed in total always included very large core memories, while modifications to computers sometimes expanded memories but due to design



CONTROL DATA





Time sharing should make feasible the use of a computer as a programmed teaching machine. Above are two sample frames as appearing on the scope of a PDP-1. If 2000 users shared a computer renting for $1 million a year and each station was used for 2000 hours a year, the hourly cost for each user would be 25 cents.

limitations the computers were unable to achieve a desirable memory size. At M.I.T. John McCarthy and Prof. Marvin Minsky were pushing for modification to the then IBM 704 computer to do time sharing for program testing. Various committees considered the question; work progressed in a variety of directions that today includes the present Compatible Time-Sharing System[3], developed under the leadership of Professor Fernando Corbató, and now in operation at M.I.T.

With the 709 and 7090 computer, many problems were present, since the computer was not designed in any way whatever for interaction with people. Early experimentation was made possible however by the development of a flexowriter control subchannel on the 709 by Professor Herbert Teager at M.I.T.

Meanwhile several of us had the notion that if we took a computer that was ideally suited for human interaction, and made just those minimum modifications necessary for time sharing, we could achieve a running system at an early date. We managed to think of a trick that allowed the PDP-1 computer to be time shared by up to approximately 20 users. The trick was the "memory swap." This was a very fast way to copy the entire core memory onto a drum field and replace the contents of core memory with information from another drum field. The total elapsed time to accomplish such a memory swap in the system design was always exactly one drum revolution regardless of the starting time; and the word rate was two word transfers per memory cycle. This meant that users could be shuttled in and out so fast that many users could operate essentially simultaneously. We viewed the memory swap as a substitute for the desired large core memory with high input-output rates. The PDP-1 was so modified, and a time-sharing system was written.[1]

The early success of the PDP-1 time sharing project, which took place at Bolt, Beranek and Newman, Inc., is mainly a credit to the design of the PDP-1 computer. This computer was designed by Benjamin Gurley at Digital Equipment Corporation and was already an outstanding machine for man-computer interaction. It is very fast and very inexpensive. Most important is the fact that the design of the machine very greatly facilitated the necessary modifications to accomplish time sharing. The initial operation of the BBN time-sharing system was successful. It emphasized the necessity for absolute hardware protection and the reliable operation of executive routine in order to prevent damaging interaction among users. Since the demand for computer time at Bolt, Beranek and Newman could be met by a normally operating PDP-1, and since the PDP-1 was already an inexpensive computer to operate, time sharing did not establish itself there as a normal mode of operation.

Modifying the IBM 7090 for Time Sharing

Meanwhile at M.I.T., the 709 computer was replaced by a 7090 and modifications continued. The basic mode of operation was very similar to the BBN system; an extra core bank in both computers held the executive routines, and users were swapped in and out of the other core bank. The 7090 system was and is greatly handicapped by the fact that no very-high-speed In-Out transfer system is available for that computer. The task of creating the Compatible Time-Sharing System for the 7090 was much greater in magnitude than the BBN time-sharing system due to the fact that a goal was to retain compatibility with existing 7090 systems and to provide very complete editing, filing, and debugging facilities for the users. Information International have used the M.I.T. compatible time-sharing system and with two exceptions we find it excellent. The exceptions are (i) delay due to the lack of high-speed transfer capability and (ii) the general problem of not enough core memory.

Other Time-Sharing Developments

In various places around the country computer people began to realize the importance of this new adventure, and various approaches and attacks on the problem were started. Again at M.I.T. under the general direction of Professor Jack Dennis, a PDP-1 was being modified in a way somewhat similar to the BBN system for a time-shared use. A major distinction however was that it was anticipated that time sharing would be a very common mode of operation in order to supply sufficient computational capabilities and interaction capabilities to the many students clamoring for time on the PDP-1.

At the Carnegie Institute of Technology under the general direction of Professor Alan Perlis, a system is being implemented on the CDC G-20 which would allow time-shared operation. In particular, what is being emphasized at Carnegie Tech is the development of languages and programming systems that allow programmers to interact with the computer in a high-level language such as ALGOL but one which includes also all levels of languages down to machine code for that computer. Two very important aspects are (i) the ability of the system to accept and modify programs written in the algebraic language and (ii) ability to most efficiently convert these to machine code. One cannot overemphasize the importance of this in time sharing, for any time-sharing user who interacts with the computer would like to continually modify his programs in symbolic form and then recompile and try again; perhaps once every few minutes. With such a system it is extremely important to minimize the time for recompiling. At Carnegie Tech techniques have been developed that in essence allow the compiler to recompile only the parts of the program that change as a consequence of the modification, leaving the rest of it alone. That part which it does compile is done quite efficiently. The net result is very fast turn-around. In addition the notion of using a single language for all aspects of communicating with the computer is good; communications with the control system, communications with a text editor, communications with a debugging system, and programming, are all accomplished in the same language and handled by the same compiler.

Professor McCarthy who is now at Stanford University is implementing a system involving a time-shared PDP-1 which will be closely tied to an IBM 7090 computer. He has already demonstrated the operation of a LISP[2] system that ties the excellent man-machine interaction capabilities of the PDP-1 to the computational power of the 7090.

System Development Corp.'s Q-32 Time-Shared Computer

By far the most ambitious hardware program yet initiated in the area of time sharing is taking place at the System Development Corporation in Santa Monica, California. There a very large, very fast computer known as the AN/FSQ-32V is being modified for time-shared operation. Modifications include the necessary protection, the addition of a peripheral PDP-1 computer to facilitate user interaction, the acquisition of additional memory, and installation of many in-out teletypewriters and consoles. The Q-32 computer, is in our opinion more ideally suited to the task of time sharing than any other operating computer. The reasons are (i) it is very fast, essentially 400,000 instructions per second, (ii) it sustains very high in-out transfer rates at approximately 400,000 48-bit words per second simultaneous with execution at the previously mentioned rate, (iii) it has a large core memory which can and will be expanded, (iv) it has a very-high-speed drum system which can effect block transfers to and from core memory at high speed, and (v) the design of the computer should eventually allow very reliable operation. A project under the direction of Jules Schwartz is rapidly approaching the goal of an operational time-sharing system. While much of the programmed systems are operational, hardware modifications are at present being made. The capabilities of the SDC system will be so great during its span of useful life (until it is superseded), that computer people must think of it as a valuable national asset.

Project MAC at M.I.T.

Perhaps the most recent significant event in the development of time sharing is the initiation of Project MAC (Machine-Aided Cognition) at M.I.T. This program, under the direction of Professor Robert Fano, is sponsored by the Advanced Research Projects Agency. The project name, MAC, is an acronym derived from two titles: Machine-Aided Cognition, expressing the chief project objective, and Multiple Access Computer, describing its major tool. One of Project MAC's major tasks is the development of a large time-shared computer system at M.I.T. MAC's initial operating system will be a duplicate of the M.I.T Compatible Time-Sharing System.[3] The CTSS includes executive, scheduling, debugging, assembler-compiler and input-output devices. The programming languages now or soon to be available in CTSS are FORTRAN, FAP, MAD, COMIT, and LISP. Others are planned for future inclusion. Project MAC has recently sponsored a six-week summer study program, at which invited participants discussed various aspects of time-sharing systems and experimented with the M.I.T. time-sharing system and the PDP-1 computer.

Within Project MAC, Professor Marvin Minsky's group is working to assemble a powerful "Mathematical Laboratory" system.[9] The goal is to invoke computer assistance for manipulation of symbolic mathematical expressions. They hope that the system will make it as convenient to apply complicated transformations to complicated expressions as it is to manipulate simple entities with pencil and paper. The system is to be able to handle the full range of ordinary informal mathematical notation; it is felt that compromise here would alienate mathematicians. It uses scope, keyboard, and console with light pens and switches.

Symbolic and numerical calculation will be done by the time-shared IBM 7094 computer, while the display, editing, and filing and retrieval systems will be managed by a PDP-1 computer (DEC). The more complex mathematical operations will use the list-processing system called LISP; the picture-language compilations will also use LISP. The system will have full facilities for use of numerical and graphical methods (when analysis fails), and these will be mediated by machine-language programs assembled by a LISP-controlled compiler.

A number of parts of the system exist now in tentative version, including a working hand-writing input system (ARGUS, written for the system by W. Teitelman), a PDP-1 mathematical-expression-picture compiler (written by P. Samson), and a system for visual examination of direction fields and singularities (written by Minsky), as well as a number of LISP functions for mathematical operations. Close cooperation is planned with McCarthy's group in Stanford.

The Significant Features of Time-Sharing Systems

Time-sharing systems have many features common to other types of real-time, on-line computer systems. For example, program interrupts are necessary to permit individual users to gain access to the central computer; an "executive" or "monitor" program is required to supervise the over-all operation of the system; and so on. The major difference is that, in a true time-sharing system, the user is not limited to the use of a central program or programs. He is, instead, free to run and debug his own program just as he would if he had direct access to his own computer.

Time sharing offers a great benefit where programs requiring a large degree of user interaction with the computer are involved. This is true, for example, in: debugging computer programs (perhaps the most common example); using computer teaching machines; heuristic computer applications such as game-playing programs; and other similar applications. Such programs are normally highly inefficient in terms of computer processing time, since the computer is continually being required to wait for the extremely slow reactions of the human user before continuing with its processing. In fact, in most cases, the computer would have ample time while it is waiting for a single user, to attend to the needs of several other users. Time sharing offers a technique or system by means of which this may, in fact, be done.

A major advantage therefore of time sharing in such situations is the economy involved. While it is normally highly expensive to utilize the full time of a non-time-shared computer for a leisurely debugging session, it becomes much more feasible under a time-sharing system.

There are, of course, many special hardware and software requirements for time sharing. We will attempt to describe some of the more important of these briefly.

Input-Output Equipment

While there may be a central set of conventional input-output equipment, such as high-speed line printers, readers and punches, tape units, and a maintenance console, users will normally gain access to a time-sharing system by means of individual-user consoles. These may consist of simply a typewriter or teletypewriter; they may be located in large numbers in individual offices. They may in some cases also include display scopes, light pens, and other similar facilities.

A user console should meet three important criteria: First, it should be relatively cheap both in purchase and installation cost. Second, it should be simple to use. Third, it must be possible to connect consoles to the computer in large numbers, if desired, without unduly restricting the computer's capabilities.

Special Memory Requirements

It is important that the central computer core memory be relatively large if many of the most important benefits of time sharing are to be realized. It may be desirable, for example, to include a major portion of the program library in core memory as a means of reducing input-output time requirements. At a minimum, an executive, a compiler, and some associated control programs should be in core. In addition, common subroutines which may be running for several users at the same time may also be included.

Fortunately, time sharing itself will tend to make large memories economically feasible. Since many users will, in effect, be sharing the cost of the computer, a larger capital investment will be justified than in the case of a conventional computer facility.

In a time-sharing system, it may be both feasible and desirable for the computer itself to serve as a place for storing data. For this purpose fast-access peripheral memories (such as disc memories) might replace punched cards and paper or magnetic tape currently used for this purpose. Use of peripheral memories for this purpose may be feasible since the cost of using the computer in a time-sharing system may well be cheaper than the cost of recording data on cards or tape. In addition, storing data in a computer will undoubtedly be more convenient than on cards or tape, not only because of the faster access time, but also because various editing, checking, and retrieval services may be available in a time-sharing system to assist the user. For these and related functions, the installation in the time-sharing computer system of an extremely large, fast-access disc memory may be highly desirable. This type of memory would be very useful, for example, for holding "bulky" programs and data which pass in and out of core fairly often.

Special Processor Requirements

The use of a very fast single central processor which shared its time among the various users would have as its main advantage a high-speed single-sequence capability. However, in a time-sharing system, it would be necessary for the central processor to alternate rapidly between the programs of the different users. Each time it switched from one user's program to another's, it would have to deposit in memory all the contents of the "active" registers—such as the accumulator—and subsequently restore them to their original positions. The loss of time resulting from this disadvantage should be measured against the advantage of a high single-sequence speed.

The problem of frequently storing and restoring information for time-sharing purposes might be lessened by the use of several central processors rather than one. Furthermore, a system consisting of several processors would have a higher collective information processing rate than would a single processor.[4] Such a system would, however, be somewhat more complex than a system based on the use of a single processor.

In some cases, a special processor may be desirable to process input and output alone. In the S.D.C. time-sharing system a PDP-1 computer will be used as a peripheral input-output processor for the Q-32. This is expected, among other things, to facilitate the complex job of accommodating the system to the demands of a large number of users.

Time-Sharing Languages and Programs

While time sharing can be accomplished without any modifications to compiler programs, this does not permit the very great potential efficiency which may result from the modification of a compiler for specific time-sharing purposes. For example, many important characteristics of a time-sharing compiler are realized in the system being implemented by the Carnegie Tech group (Alan Perlis and others) for the CDC G-20 computer. Their system includes such features as rapid compilation, disc file storage, and partial recompilation.

In addition, however, for maximum efficiency in a time-sharing system a compiler should be a "pure procedure," and should be capable of compiling programs as pure procedures. For example, a compiler such as JOVIAL could be modified to compile programs as pure procedures.

In addition to a language used to write procedures or programs, it is necessary to have a language with which users may communicate with the time-sharing system itself. This is variously called an executive, monitor, or control language. By means of the control language the user may gain access to his own programs and data stored in the computer as well as to special services which he desires to use. The control language would, in addition, serve a function similar to that of some monitor systems which are available on larger computers. These allow the user to specify that he wants his program compiled, run, dumped, etc. The monitor performs all specified operations in sequence, moving rapidly from one task to the next, under the control of a previously prepared program. Similarly, the control system used in time sharing must be able to bring specific requested programs in and out of memory and perform such operations on them. In addition, if a requested program is already in memory, the control program must ascertain this fact and not bring it in again. When a user no longer needs a program, it must check to see if any other user needs that program and, if not, remove it from memory.

Time-Sharing Services

A major argument for time sharing is that it represents a way by which a digital computer can provide useful services to many people. In particular, we have in mind the services that a computer can provide to researchers, scientists, engineers and programmers. However, these or similar services would also be applicable to the general scientific and engineering community.

Desk-Calculator Services

As a first step those services that are presently available in different types of computers could be consolidated and made available to the users of a time-sharing system. For example, on several small computers, such as the LGP-30, there exist fairly elaborate "desk-calculator" programs. These are programs that cause the computer to simulate a very sophisticated desk calculator. Very often these desk-calculator programs perform variable length arithmetic, floating point or fixed-point, and perform many other types of computation. These computations include not only standard arithmetic operations (addition, subtraction, multiplication, division) but also standard trigonometric functions such as sine, cosine, and arctangent, as well as the logarithmic and exponential functions. In such systems, numbers may be designated as integers, decimal fractions, or floating point numbers. In fact, in some systems even the exponent part of floating point numbers may be designated in any of these ways. As far as the human users can detect, most computation is performed instantaneously.

Scope Displays and Light Pens

With the availability of consoles that have scope displays and light pens, we can do much more powerful things. In general, the whole area of graphical display and the construction of pictures or drawings can be mechanized. A scientist can draw on "electronic graph paper" a function of two or more variables. The "electronic graph paper" would be, in fact, a scope display, and the drawing made with a light pen. Examples of such systems are the CDC Digigraphic System, which is a set of elaborate programs residing in a computer, which has a scope, light pen, and bulk storage device; and the sketchpad program written by Ivan Sutherland when at M.I.T., which is programmed on the TX-2 computer. In addition there is a program for constructing drawings ("Expensive Draftsman"), written by Alan Kotok and Peter Samson at M.I.T. for the PDP-1. There is also an annotation program written by Weldon Clark of Bolt Beranek and Newman. All of these programs allow users to construct drawings by putting together lines in a fairly flexible manner. They allow the user to specify precisely what he wants; often in great detail. This information may then be acted on in many different ways. For example, the data can be put into the computer in tabular form. It may be approximated by various functions. In using this service, an electrical engineer might draw the bandpass characteristics of a filter, type in other parameters, and ask the computer to type out the poles and zeroes of such a filter.

Text Editing Programs

In addition, there are available several text editing programs which aid in the writing of computer programs themselves. They allow the insertion, deletion, addition and replacement of text material. Of these general text editors, some make use of a visual scope display. They allow the display of a portion of text on the scope so that one can quickly verify that the text has been changed correctly, or as an aid to the rapid location of areas of interest.

Intercommunication

One of the benefits of a time-sharing system may be to allow a highly useful intercommunication among the users of the system. For example, it could provide general message routing and distribution. Messages would be distributed from one user to another by name, distribution list, specific user category, or other more complicated criteria. An additional advantage of a time-sharing system may lie in its ability to provide person-to-person communication on an "information retrieval" basis. For example, the system could have available information that answers questions such as "Who should I contact to find out this information?" It could accept a question and transmit it to the person mentioned. It could delay transmission until the person is present. It could accept a reply which is delayed until the receiver is present. It could, in other words, serve as a programmable delayed intercommunication net.

Memory Protection

A time-sharing computer must be able to protect areas of memory from inadvertent changes caused by users. This may be done, for example, by establishing two boundary registers changeable only by an executive routine. These would control the portion of the memory which could be changed by the operating program. All operations might be allowed into the general memory except for store operations, which change the contents of memory registers. If a store operation were attempted outside its established boundaries, an "interrupt" would be initiated which would not allow the operation to be completed.

Memory Relocation

Since many programs will be coming in and out of core memory at various times, probably from discs or drums, and since the sum of all programs will not fit into core at once, it may be necessary for the computer to relocate programs in memory from time to time. This may be accomplished by the use of a memory relocation register. For example, each program might be written with the addresses of its instructions relative to either their original location or the location of the first instruction in the program. This would allow the program to be conveniently loaded into, and operated from, any part of memory. Memory relocation may also be accomplished by the use of the program counter as an index register, or by means of relative addressing.

Priorities

Since there are many users who can tie up machines of essentially indefinitely great capacity, it is clear that an equitable system for distribution of time among various users is needed. A simple solution is to share the time evenly among users on a round-robin basis. In operation the time-sharing system will transfer control from one user to the next, allotting a certain number of milliseconds to each for operation and input and output if necessary. However, any user's program that determines that it does not need to run its allotted time will dismiss itself sooner, allowing faster circulation among the rest. In any case, programs will be put on the list on the basis of interrupts that signal the users' requests for service. The only real or important criterion as to whether the system acts fast enough is the length of time that users have to wait.

Tolerable Delays

The system should be able to respond to users without excessive or objectionable delays. Delays may result from one or more of the following causes:

(i) *Delays resulting from inability to accept input data.* Such delays may result, for example, when a maximum number of users saturate the system; in such cases, one or more users must terminate their use of the machine before the machine can become available to additional users. It should be noted in this connection that systems can be designed which can accept input data from an essentially unlimited number of users. However, this capability does not alleviate an inability to process data for all users in a reasonable time.

(ii) *Delays in reaction time.* Assuming it is possible for for the machine to accept input data, there may be a delay involved in the time required for the machine to commence processing the data.

(iii) *Delays in computation time.* Assuming the machine has commenced processing the data, there may be a delay involved in the processing time itself. Since there will always be problems that take many hours of computer time to solve, we will be most concerned with delays encountered during the use of such services as editors, compilers, debugging routines, etc.

(iv) *Delays for services which must be scheduled in advance.* It will probably be necessary for some services, such as requirements for the use of full machine memory capability, maximum computer speed, or use of special equipment, to be scheduled in advance. Delays in obtaining such services should not be excessive.

Reliability

It is extremely important that the system possess a degree of reliability sufficient to ensure adequate service to the users. Specifically, the system should possess the following characteristics:

(i) *A non-volatile memory.* All reasonable precautions shall be taken to insure against the inadvertent loss of the contents of the memory. In addition to ensuring an inherent built-in reliability of the computer in this respect, an additional safeguard might be instituted by establishing a daily dump, onto magnetic tape, of all computer memory (including disc files). This would ensure that the information entrusted to the time-sharing system by users would be available in a relatively up-to-date form in case of a catastrophic loss of computer memory.

(ii) *A minimum of computer down-time.* Availability of the computer for users of the system should be maximized by minimizing the amount of down-time resulting from scheduled and unscheduled maintenance.

Some Final Remarks

The quest for knowledge leads our intellect in various directions. The realization that numerical computation was analogous to various mechanical and electrical interactions allowed the development of ever more powerful aids to computation, culminating in the modern electronic digital computer.

Strangely enough, today's computers are often usefully employed in applications where they do little computation. Where are we going and why?

Today, computers as presently programmed have a set of capabilities that intersect those of people. People are better than computers at most things; however, computers, airplanes, refrigerators, and super-novae are better than people at such tasks as generating random numbers, flying, keeping cool, and blowing up. What is unusual about computers is that the scope of their capability is steadily encompassing more and more of an area previously limited to human intelectual activity.

The Big Picture of the Far Future

If we assume that the development of artificial intelligence will take place, how can we form a coherent picture of our place and its place in the great scheme of things?

It seems reasonable to consider that artificial intelligence is a next step in the evolutionary process. Once there was a prototype land creature that crawled out of some primeval ocean; most primitive in comparison with a more advanced creature such as a sabre-tooth tiger—and once there was a prototype intellectual creature (that's us), and we will seem most primitive in comparison with what is to come! However, instead of participating in evolution by merely serving as a runner in a genetic message relay race, we can choose the great distinction of directly employing our primitive yet unique intellectual talent to the task of evolution.

We have conceivably arrived at the notion of the "next step in evolution" by trying to fit the future development of Artificial Intelligence into the over-all scheme of things. Joshua Lederberg, a Nobel prize-winning geneticist at Stanford University, gave some attention to the problem of guessing the characteristics of that species that will evolve from mankind. He arrived at the conclusion that it would be Artificial Intelligence.

How do we proceed with this great task? J. C. R. Licklider's position in 1959 was that we should concentrate on the development of Man-Computer Symbiosis,[6] a system in which men and machines would form a close-knit intellectual team, each complementing the capabilities of the other. Then, when so equipped, we could much more effectively tackle Artificial Intelligence.

After the ascendency of A.I., it seems that mankind's intellectual skills will no longer be very useful in the solution of problems. Today, man is hardly using the intellectual capability he has. How ironic it would be to pass through our span as the dominant species in Earth's evolutionary tree, without ever realizing our true potential for intellectual creativity!

By means of a symbiotic relation with the capabilities that we now know how to implement in computers, we can not only proceed with the task of creating A.I., but we can reach for and achieve human creativity at a pace and level never before attained. We could advance all areas of science and art as partners in intellectual systems that complement and reinforce our correctable weaknesses and that make use of all our inherent creativity.

With computable wings we could soar to meet the Phoenix.

NOTES

1 "A Time-Sharing Debugging System for a Small Computer," S. Boilen, E. Fredkin, J. McCarthy, and J. C. R. Licklider, Proceedings of the Spring Joint Computer Conference, 1963.

2 "LISP" (a programming system for computing recursive functions of symbolic expressions), J. McCarthy, *et al.*, the MIT Press, Cambridge, 1962.

3 "The Compatible Time-Sharing System, A Programmer's Guide," Fernando Corbató, *et al.*, The MIT Press, Cambridge, 1963.

4 This assumes, of course, that each of the processors would be dealing separately with its own program or group of programs—as would normally be the case in a multiple-user time-sharing system. It should be noted, however, that if only one large program were involved the collective processing rate might be either slower or faster than that of a single very fast processor.

5 By "pure procedure," we mean a program in which all data applicable only to specific users has been segregated from the program itself. The "pure" program is available to all users; specific data is supplied by the user's program and is located in the user's own allocated memory areas. All parameters, variable, and modifications take place in the users' own memory area. Thus a pure procedure remains unchanged by specific users even during the course of operation.

6 "Man-Computer Symbiosis," by J. C. R. Licklider, in IRE Transactions on Human Factors in Electronics, March, 1960.

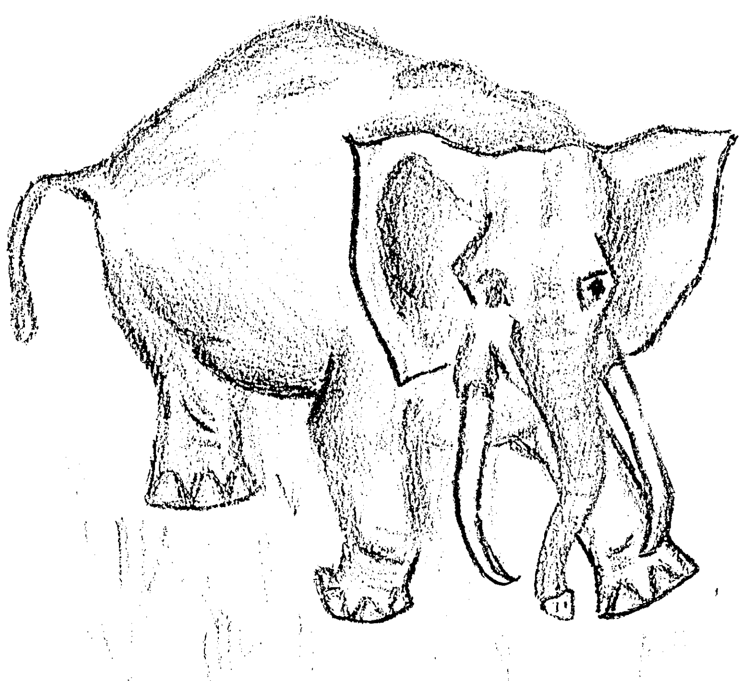
7 "Time Sharing in Large, Fast Computers," C. Strachey, Proceedings of the International Conference on Information Processing, UNESCO, Paris, 15-20 June, 1959.

8 "Sur certains aspects de la conception logique du Gamma 60," by J. Bosset, ibid.

9 Marvin Minsky and the author, one evening in 1961 in Pasadena, California, called on Richard Feynman, physicist at California Institute of Technology. We had a far-ranging discussion that evening—settling on how computers could be better than pencil and paper in aiding mathematicians in symbolic manipulation. We all felt that this was a good idea, and in the course of the evening (and early morning) developed in some detail the concept of the Mathematical Laboratory. Since that time, the three of us have actively pursued this goal. Feynman has worked with Glenn Culler, of the University of California at Santa Barbara, in areas associated with numerical and graphical techniques. And our organization, Information International, has developed a wide range of techniques in the field of number theory. See "Computer Aids to Number Theory," by Malcolm Pivar (to be published in the Fall 1963 Proceedings of the DECUS users group).

(Note: This article is based in part on research in time sharing done at Information International, Inc., and supported by the Advanced Research Projects Agency of the U. S. Department of Defense.)

CONSIDERATIONS IN COMPUTER DESIGN
—Leading up to a Computer Performing over 3,000,000 Instructions a Second



virus : elephant = abacus : ?

James E. Thornton
Chippewa Laboratory
Control Data Corporation
Chippewa Falls, Wisc.

NO APOLOGY INTENDED

Someone has said that the elephant can grow no larger because of the ratio of its volume to the surface area of its digestive system. On the theory that simplest reasons are best, this certainly ranks high on the list. I don't suppose that this explanation of an elephant's size is entirely accurate. However, it illustrates the idea of an ultimate limit.

Perhaps the steps can be traced in the evolution of the elephant which most affected its final limitation. I can imagine some steps aiding and some reducing the eventual size. Since the evolutionary model states that natural selection controls each step, the short-term corrections predominate. I have no idea what caused the elephant's tusks, for example. The first rudimentary tusks must have satisfied some early need. They evidently helped and were useful; therefore, they were selected. The tusks have no obvious connection with the elephant's maximum size, at least by the above theory. However, they may have been evolved in favor of another set of molars which could improve digestion. Or perhaps the roots of the tusks further limit the intake of food and internally displace the digestive tract, with a net reduction of the eventual size. This little fantasy follows the lines of the natural selection model, by which we attempt to explain what is going on. It may be that this model, invented by man, is most accurate when applied to man's machines, in which a similar situation is developing. I'm not really interested in larger elephants, but rather in faster computers.

The quick fix

The factors influencing the evolution of the computer are economic (what isn't), logistic, comfort, convenience, and any number of other conflicting preferences. Designers have moved through a series of "safe" improvements without seriously tampering with the original idea. The significance of each innovation is largely masked by the mystery and confusion surrounding complex machinery. Actually, a great deal can be accomplished by taking each obstacle and applying a short term correction to circumvent it. Really startling improvements in speed have come from the most innocent and deceptively simple corrections. Ingenuity of computer designers has made the "quick fix" the rule of the industry. The ability to do so much with the simple computer circuits leaves little excuse for attempting almost any new combination. The net effect is computers with superficially similar outward appearance (speed specification, special features, standard features) but fundamentally different internal methods.

There can be no argument with the desire for faster operation or more effective operation. Our principle of natural selection serves to weed out the weak ideas. A strong feature is easily accepted, copied, and re-copied without much change. Probably a good rule of thumb for measuring success is the number of suggested changes — the fewer the better. On the other hand, following this rule obviously leads to including *every* desirable feature ever mentioned. Lacking economic or electronic reasons for rejecting a new addition, there may be another kind of reason. It has to do with the ultimate limits (something like the elephant) and leads to a wholly different approach to computer design.

From the beginning, there was something clean and straightforward about the digital computer idea. One could visualize enormous potentialities of such machines. The extension of our brainpower was a clear possibility; indeed, very shortly a clear reality. It was easy to think of machines doing every routine computational job, large or small. The very principle of using numbers, with their almost unlimited resources, as the fundamental internal controls further opened the possibilities. However, it was psychologically a little too much to take at once. The temptation to plunge off without careful deliberation was countered with the reaction to do nothing really different. It was a choice of being a fool or a coward. Under the circumstances, the "safe" improvements looked rather good. We were encouraged to go on.

Elementary, my dear

The numerical instructions — the programs — were originally intended to provide desirable deviations in the computation quickly and easily. The computer designer could then concentrate on making the most of the fundamental computer parts without fear of these deviations. The original thought was to . . . "make the machine elementary. The program will provide for the complex needs." The history of the computing machine has recorded some failure in this direction. The first special relief granted to a group who suffered from this elementary phase began a series of evolutionary phases.

It is basic to the computer idea that a problem planner conceive the solution in terms of a sequence of elementary operations. He orders these elementary operations in the amount, sequence, and combination necessary to the solution. A major portion of the utility of the computer is the use of repeatable sets of these instructions, the repetitions or iterations of these sets themselves computable. The successful programmer seeks these iterative loops for a maximum amount of the solution, knowing this to be faster, less wasteful, or otherwise more effective. Now, it is precisely in this area of maximum utility of the computer that the superficial likenesses between machines belie the internal differences to the detriment of the results. A particular repetition on one machine fits its internal methods more exactly (and therefore more effectively) than the same repetition on another machine. The second would prefer a variation in the sequence or combination of the elementary operations making up the iteration. Plainly, the program should correct for this problem, leaving the designer freedom to devise the most effective machine possible. Again, the industry history has recorded some failure in this approach.

The most important area of failure in choosing between what is to be elementary (or wired) and what is to be programmed lies in machine compatibility. If there were only one machine and one set of elementary operations, and if the designer merely reproduced the machine, making it faster each time, there would be very little compatibility problem. The original program deviations and the original optimum iterations would hold. This overlooks, of course, the whole dimension of improvement available at the elementary level. Even if one wanted this simplicity, the psychological atmosphere is against it. Programs must be made compatible by whatever means available. Here the idea of developing common language was most successful. The program was split into two levels, the original with sequences and combinations, and a second one with common language compatibility. Methods devised to transpose between the two levels could be adjusted to optimize for the specific internal needs of each machine. This was the original idea in an evolved form. This should have released the elementary operations for a more effective result. However, a movement to upgrade the machine to fit the new languages bids fair to neutralize this method.

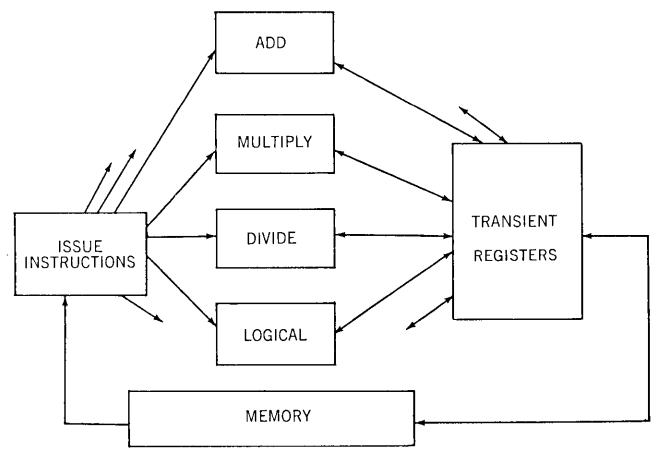
This sort of discussion of elementary versus "special effect" operations runs the risk of being lost in specific argument. Almost any kind of operation can attract support for a time. Only history can select the good from the bad in the absence of specific economic, logistic, or other argument for or against. Therefore, it is not with any specific operation that argument can be successful. What remains to be done now is to clear away *some* of the growth and debris, leaving only those operations which are truly fundamental or for which considerable potential can be demonstrated. The dependence on several levels of language should aid in this effort rather than trigger a series of new corrections to fit. In short, the original idea was so good and so simple that we ought to start again with our experience as a guide. The time is fast approaching when a really serious upper limit will be reached, a direct result of the speed of light limit of electrical signals on wires.

What can be gained by simplicity? I know, of course, there remains the lingering doubt that simplicity is the answer. The computer must be effective, not merely fast. Without attempting to remove that doubt, let me discuss some effects of simplicity. The elementary level (wired-in operation) that I will consider fundamental includes floating point arithmetic as well as the logical and fixed point manipulative operations. Something over one hundred distinct operations can be edited down to about half that number for the machine's elementary set of operations. From this set, it must be possible to construct the most complicated operation. It is obvious that some, if not the majority, of such complicated operations can be made faster by wiring them in. I propose to show how they cause other delays which may result in a net loss.

A significant portion of the time of most elementary operations is absorbed in obtaining and identifying what to do. For two reasons, the simple instruction set is desirable. The fewer instructions require a smaller instruction word, allowing more to be obtained at once from memory (a normally slow operation). The simplicity of *all* instructions allows quick and simple evaluation of status to begin execution. Both reasons add up to faster instruction acquisition. Notice that this applies to *all* instructions. Adding complication to a special operation, therefore, degrades all the others. Particularly in the newest computers with a high degree of parallel operation, this instruction fetch and interpret time becomes a very significant percentage.

Concurrently sequential

Looking further into parallel operation, it is reasonable that more and more of the sequential operations will give way to parallel. As a consequence, more and more circuits are included in the computer. Full utilization of the extra hardware demands that instructions be *issued* quickly and efficiently to the free areas for execution. In order to get several areas in operation concurrently, the time for issuing must be substantially faster than the time for executing. This is precisely the area of fetch and interpret time.



For the repetitive iterations, mentioned earlier, which make up a large part of the computer's utility, this high speed *issuing* of instructions can be augmented by a high speed supply of instructions. Since the very simple instructions can also be made efficient of instruction bits, more can be held at once. Holding complete iterations without need to reference memory offers a significant speed advantage, distinctly improved by simplicity in the instruction set.

It is part of the theory of use of special wired instructions that many normally sequential operations need not operate in sequence. The special instructions remove all but the essential sequential operations from the time sequence. The extras are performed in separate hardware not influencing the total time. This valuable technique can be applied to whole sets of instructions if separate arithmetic and functional units are included in the computer. Assume about ten functional units, such as those in the central processor of the **Control Data®** 6600. Next, assume that these units contain completely independent controls. Further, assume an over-all control system which can issue instructions to these units, maintaining the necessary sequence but allowing the "extra" operations to go forward without influencing the total time. It is feasible with such a system to construct a more complex special instruction by programming its parts without sacrificing the special ability of the wired-in special instructions. To the degree that this technique is available in *all* program sequences, not just the special combinations, the entire program is speeded up. Let me continue to point out that the special instructions are first given up in order to obtain this very desirable effect. The extra hardware is merely distributed in a more general way.

I mentioned the difference in internal methods from computer to computer. These methods, of course, are of little interest to the user except as they influence the final effectiveness of each program. In view of impending limits to speed, it may be fruitful to discuss some of the detailed methods. First, a look at the speed of light limit is in order. Among the several ways to interconnect the computer logic circuits, none exceeds about three-quarters of the speed of light. This translates to about 9 inches per nanosecond. A typical present-day computer wastes over ten per cent of its time traversing these interconnecting wires. Assuming factors of circuit improvement, in the future, of two to four times the present rates, one can see the dominating influence of these wires. This is a kind of reverse situation from our friend elephant. In order to reduce the wire length, the total volume must come down at a much higher rate. Some reduction is possible, but the volume-to-area-to-linear dimensions are almost self-defeating. It should be very clear that no really startling speed improvements can be made on these wire transmissions. Furthermore, each such improvement shortens the time when wire speed is a really difficult limit.

Psychological barriers

Computer circuits employ an intricate variety of methods. Such mechanisms as synchronism, sequences of steps, static combinations, storage, etc., depend, at least partly, on the accuracy of the clock. To the waste of time on wires mentioned above can be added the tolerance of the clock, the ratio of longest untimed paths to the shortest, and a host of unnecessary periods of circuits waiting for completion in other circuits. Ingenuity and brute force can occasionally improve on these wastes. Separating these into circuit wastes and logic organization waste, some guides can be drawn. Circuit waste can be classified in electrical terms and, in turn, in terms of available components and techniques. Circuit waste can be minimized by careful test and good design judgment. However, logic and organization waste is a somewhat different thing. The designer crosses a kind of psychological barrier between the circuits and their logic. The logic carries with it no intrinsic waste. The questions of design begin with economics and markets; they end with the engineer's ingenuity. The pressure to reduce wastes due to the logic is compromised by the availability of outstanding circuit performance. New computers have been begun almost exclusively on the prospect of circuits of greater performance. As a result, the waste due to logical organization has not received equal attention. Consider what is in prospect when the circuit performance well runs dry and the kind of relativistic friction of the wiring can no longer be ignored. What is needed is a plan for removing the logical waste.

Remember

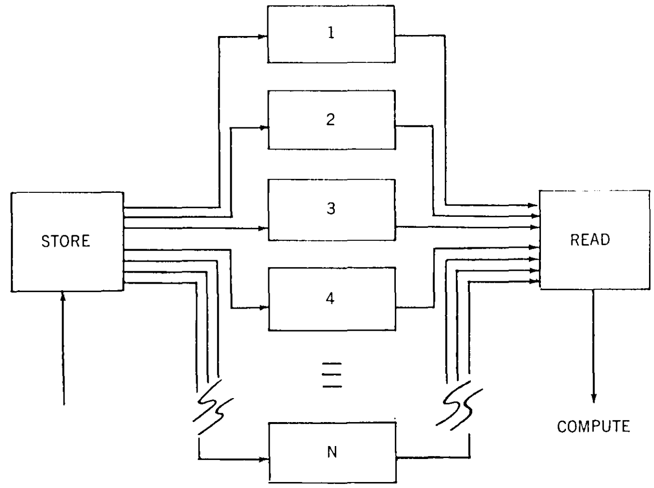
The subject of computer memories jogs my own memory a bit. The usefulness of memory has evolved from a secondary role in the earliest computers to a present primary role. This early role was probably undeserved and unwanted. The fact is, there wasn't much to work with at first. Memory circuits then (and now) were more cantankerous and frustrating than any other. Practical engineers chose those which offered some degree of quick success. Delay lines provided basically serial memory — that is, information was put away, and recovered, one digit at a time. Around this delay line memory grew a serial arithmetic system together with serial control sequences. Logical complexity of these machines was confined to the sequences, and otherwise time-oriented steps, performed on the data flowing to and from memory. Many in those days said that with a rather unlimited fast memory (say several thousand words) a huge improvement could be had. The obvious advantage of parallel memories (all bits of the word at once) broke down any economic obstacles.

The feeling that unlimited high speed memory would give advantages has persisted even with enormous increases in size. The idea of primary and secondary memories, a kind of conscious and sub-conscious, allowed for magnetic drums and tapes. However, it remained for the magnetic ferrite cores to provide a really satisfactory parallel primary memory. The key advantage was parallel operation with no penalty for referencing in odd order (random access). The ferrite memories have become most successful and reliable and provide high-speed memory measured in hundreds of thousands of words. It is nonetheless interesting that the problems to be solved by computers continue to far out-strip this explosive growth.

The matter of primary and secondary memories, of course, offers a variety itself. They take the form of temporary and fixed stores, index stores, in-out buffers, and so on. They range nowadays from transistor registers, small temporary stores of film and ferrite, modular ferrite memories of large size, magnetic drums, magnetic disks, magnetic tapes, magnetic cards, optical stores — an endless array. The continuing success of ferrite memories has led to some intrinsically different methods of use, of which the coincident-current and word-organized memories are the leaders.

With the logic circuit performance keeping just one jump ahead, the memories continued to represent a large part of the time spent in operations. An admittedly brute force improvement in large memories was the separation into several banks of memory, with overlapping of cycles. Truly parallel banks of memory evolved to give an added dimension to the term parallel computer. Through all this, the original concept of primary and secondary holds with its one major problem: the somewhat untidy shuffling back and forth of data between the two. The very necessary data are naturally kept in primary memory, and the little used files in secondary. It is the in-between ground which seems to defy any order.

Some attempts have been made to make sense of this problem. There are schemes of addressing all data, primary and secondary, with somewhat automatic transferring when necessary. Other schemes use direct block transferring at very high speed. It would seem that more parallel trunks for these transfers would help. One trunk could load and another empty large chunks of primary memory not presently in use. In fact, several sets of these might be worthwhile. A fundamental assumption is made, however. If the trunks are to be usable, they must be separate; and there must be a comparable ability to compute on other primary memory at the same time. In fact, in the worst case a meshing of all these operations must be possible by parallel trunks, time-sharing, random ordering under an over-all control. To obtain this final effect, much more than the memory must be considered.



What is described above could be called another step of parallelism, i.e., parallel-by-function, to be added to the bit parallel, word parallel, and memory bank parallel schemes. It is simply the idea of more things being done at the same time.

Illogical Waste

The computing is done on the data at a point in its trip from memory and back to memory. Most computers contain at least one place outside of memory for holding intermediate or partial results, usually an accumulator. Data to be carried over from one operation to the next can be placed in this accumulator and recovered from it. In fact, it forms a one word high-speed memory attached to the arithmetic and must have a path to the main memory as well.

A good many sequences of operations contain several cases of cumulative results. More than one carry-over register would be attractive for these cases, especially if a net speed improvement were possible. On the premise that transistor register storage is substantially faster than magnetic memory (say ten to one), a number of registers would allow good isolation from memory. These registers would require refilling from memory for incoming data and emptying to memory for final results. Otherwise, the partial results would arise from the computing activity. Thus, it can be seen that memory access is a secondary process as far as time is concerned and is mostly masked by computing time (more on this later).

Typical computer instructions contain memory addresses for the incoming data and the results. By removing memory to a secondary role, most of the computing instructions can refer to the transient registers. A considerable instruction word

(Please turn to Page 59)

ACROSS THE EDITOR'S DESK

AT THE LAST MINUTE

OUTPUT AT 220,000 POINTS PER SECOND

The front cover of "Computers and Automation" for the November issue shows a three-dimensional drawing produced by a very-high-speed data recorder. The machine will print tabular characters at 110,000 characters per second; it will draw vectors at a rate per second ranging from 170,000 short vectors to 30,000 long vectors; and it will plot points at a speed of 220,000 points per second.

The machine, called the dd80, is developed and produced by Data Display, Inc., St. Paul, Minn. It is able to produce output at a speed that fits with the internal computing capabilities of modern large-scale computing systems.

The dd80 records information photographically onto 35mm film from a 5-inch cathode ray tube. The film is positioned under computer control. Each character or vector end point may be positioned to a resolution of any one of 1024 positions in each of the X and Y axes on the "page" of 35mm film (about 5/1000 of an inch). The characters are then traced on the CRT, much as a character is drawn with a pencil. This method of character generation results in a combination of high character brightness and definition together with high writing rates. The dd80 has a repertoire of 123 characters, typically including the Greek alphabet, mathematical symbols, and any other special symbols that may be useful or desired.

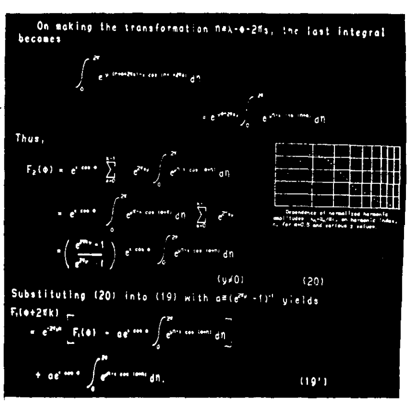


Figure 1

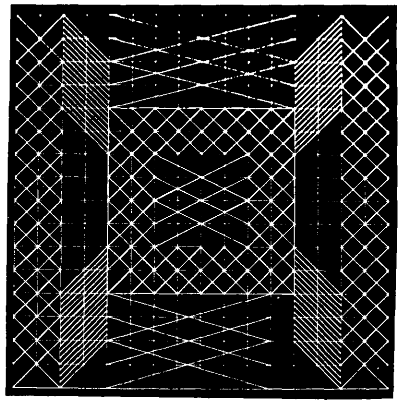


Figure 2

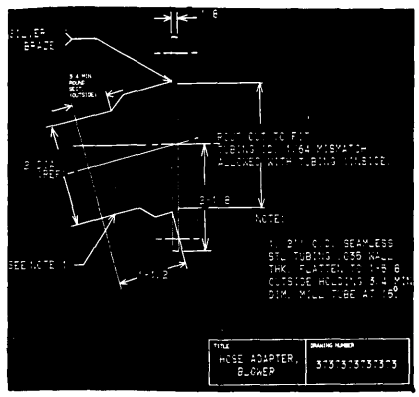


Figure 3

The vectors are drawn as straight lines between any pair of the 1024 X and 1024 Y positions. Vectors are specified by the computer by a sequence of X-Y position pairs.

The front cover and the accompanying figures illustrate the variety of outputs obtainable from the machine. Figure 1 shows mathematical symbols and four symbol sizes; it is a section of mathematical text printed on the dd80 via computer control. This figure contains a small graph illustrating the freedom of format. Figure 2 illustrates the vector drawing capabilities of the machine when it is used to generate a pattern. Although this is a vector testing pattern, it might well be an entry for "Computers and Automation's" Computer Art contest. Figure 3 shows a combination of blue print drawing and text.

The machine also has a conventional 16-inch cathode ray tube in parallel with the 5-inch one. The 16-inch tube provides a view for the human operator, and is useful for interacting presentations to human operators and programmers; in this way a human being may judge a proposed display and then release it for photographing.

To date the dd80 has been associated with IBM 7094, 7074 and CDC 3600 computers for on-line operation, and with IBM 729 II, IV and VI tape units for off-line operation.
(For more information, circle 76 on the Readers Service Card.)

COMPUTER MEETING (DECUS) LIVERMORE, CALIF., NOVEMBER 18-20, 1963

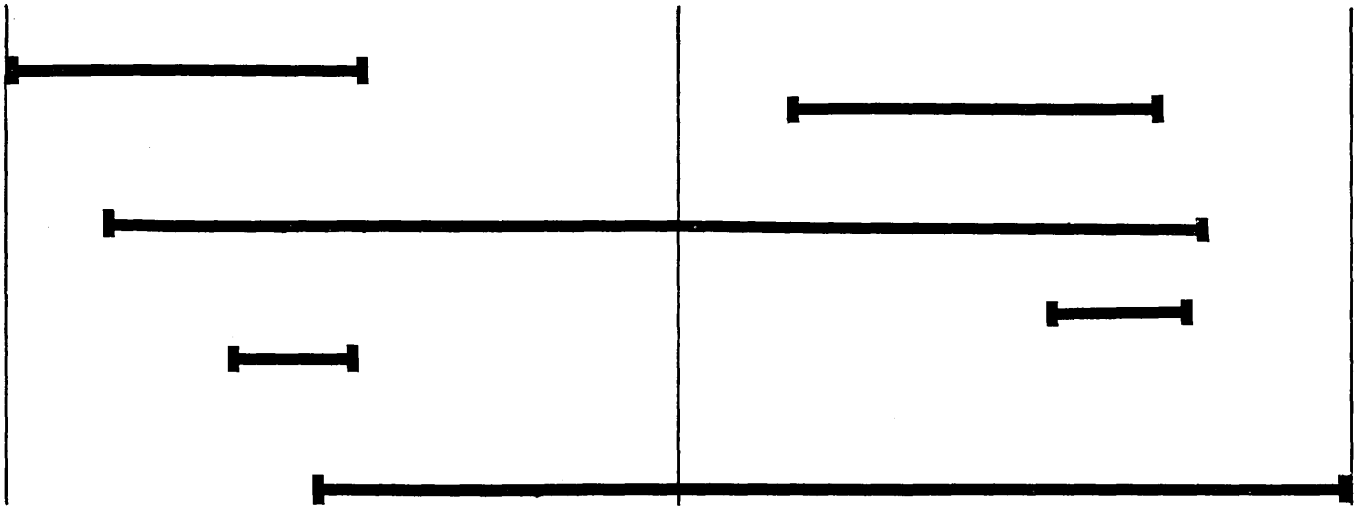
The annual meeting of the users group (DECUS) of Digital Equipment Corp. (Maynard, Mass.) computers, which includes the PDP-1, will take place at the Computation Center, Lawrence Radiation Laboratory, Livermore, California, Monday and Tuesday, November 17 and 18, 1963.

The program contains 15 papers and reports including:

- Stanford Time-Sharing System, by Dr. J. McCarthy, Stanford Univ.
- Report on SDC Time-Sharing System, by Jules Schwartz, System Development Corp.
- An Integrated Display System, by J. Gilmore, Adams Associates
- On-Line Input of Graphical Data, by W. Fletcher, Bolt, Beranek & Newman, Inc.
- New Developments in On-Line Debugging, by Prof. M. Minsky, M.I.T.
- Computer Aids to Number Theory, by M. Pivar, Information International, Inc.
- The Hybrid Computation Facility at United Aircraft Research Laboratories, by R. Belluardo and others, UAC
- Steps Towards Computer Stimulation of Small Group Behavior, by T. Roby & R. Nickerson, Air Force Systems Command

For more information, contact Mrs. Elsa Newman, Digital Equipment Corp.

(More "Across the Editor's Desk" starts on Page 43)



THE CASE FOR DATA PROCESSING STANDARDS

Dick H. Brandon
Frederick Kirch
The Diebold Group, Inc.
New York, N. Y.

Introduction

The use of computers to solve business or engineering problems is now almost commonplace. Largely because of the spectacular growth of this field, the data processing industry has reached economic maturity without developing proper working methods, procedures, and disciplines. Serious operating problems have arisen as a result, characterized by a *loss of management control* over the data processing function.

The data processing profession now has the responsibility for restoring this control function to management where it rightfully belongs. To accomplish this restoration of control, each computer installation must adopt an internal set of rules and procedures—management control standards—for the data processing function.

Lack of Standardization

Lack of standardization can make data processing a haphazard and costly business. Certainly, no architect would set a crew of carpenters to work building an apartment house without blueprints. No football coach would operate a team without a full repertoire of well-practiced plays. Yet, nearly every data processing installation approaches the issue of planned analysis and programming on a catch-as-catch-can basis.

From the time a contract is signed for a computing system, the implementation is regularly underestimated and underbudgeted in terms of dollars, time and people. This is particularly true in programming. Management gives only passing attention to the long-term desirability of insisting upon standards for systems analysis, operation, and programming. Measures necessary to correct damage after it is done can be very expensive; the inevitable shortcomings on crash installation projects are all too painfully apparent.

In many computer acquisitions, as work progresses on the implementation, the schedule fails to be met. So the schedule is adjusted. Since the completion date is "firmly" established in advance, the adjustment generally involves deleting items scheduled nearest the completion date. Testing and documentation often are left to be completed after the computer has been delivered. Once the machine has been installed, however, pressure from management to justify the cost forces the data processing department into a crash program to complete testing. Documentation is not done.

As a result of poor scheduling, most computer installations miss their target dates and cost much more than their projected budgets. The programmers who developed the keystone programs without documentation become indispensable. They are the only ones who can change the programs they wrote. Many installations never overcome these handicaps.

Standards for an Installation

These problems can be avoided through the development and use of a set of standards for the installation. Two types of standards are necessary: methods standards and performance standards. Methods standards call for the establish-

Computers and Automation is pleased to begin an important series of articles on the subject of user standards for automatic data processing. This series is being written by Dick H. Brandon, Director, Data Processing Services, and Frederick Kirch of The Diebold Group, Inc.

The Diebold Group, Inc., an international management consulting firm specializing in automation and automatic data processing, has pioneered in the development of data processing standards. The Group has presented numerous courses in this field, and has established standards for many prominent client organizations. Out of this work came the book *Management Standards for Data Processing* by Dick H. Brandon*, parts of which have been abstracted for this series.

Permission to reproduce illustrations and material has been given by Dick H. Brandon, The Diebold Group, Inc., and D. Van Nostrand Company, Inc.

The series consists of six articles.

The first, "The Case for Data Processing Standards," follows.

The others, "Systems Analysis Standards," "Programming Standards" (in two parts), "Computer Operation Standards," and "ADP Performance Standards" will appear in forthcoming issues of **Computers and Automation.**

**Management Standards for Data Processing,* Dick H. Brandon, 1963, D. Van Nostrand Company, Inc., Princeton, New Jersey.

ment of *uniform practices or common techniques;* they are applicable to systems analysis, programming, and operations. Performance standards provide *yardsticks* for measuring data processing performance; they make it possible to review personnel and equipment performance. The value of a methods standard becomes very evident when a programmer is observed trying to change a program that he did not write. The absence of language uniformity, proper documentation and limited program organization make the program impenetrable to investigation.

The importance of performance standards is illustrated daily by those installations whose system development budgets and production schedules continually exceed original estimates.

Costs

Because of the imbalance in data processing personnel supply and demand, salaries in the field have risen dramatically. The average annual salary of programmers has increased 50% since 1958. The turnover rate in the field has increased correspondingly, presenting a continuing personnel problem to management.

Early computer installations often were made on an experimental basis with costs charged to research and development. More recently, the computer has been expected to pay its own way. However, over-all installation costs have increased twenty to twenty-five per cent with the cost of personnel as the single largest cost.

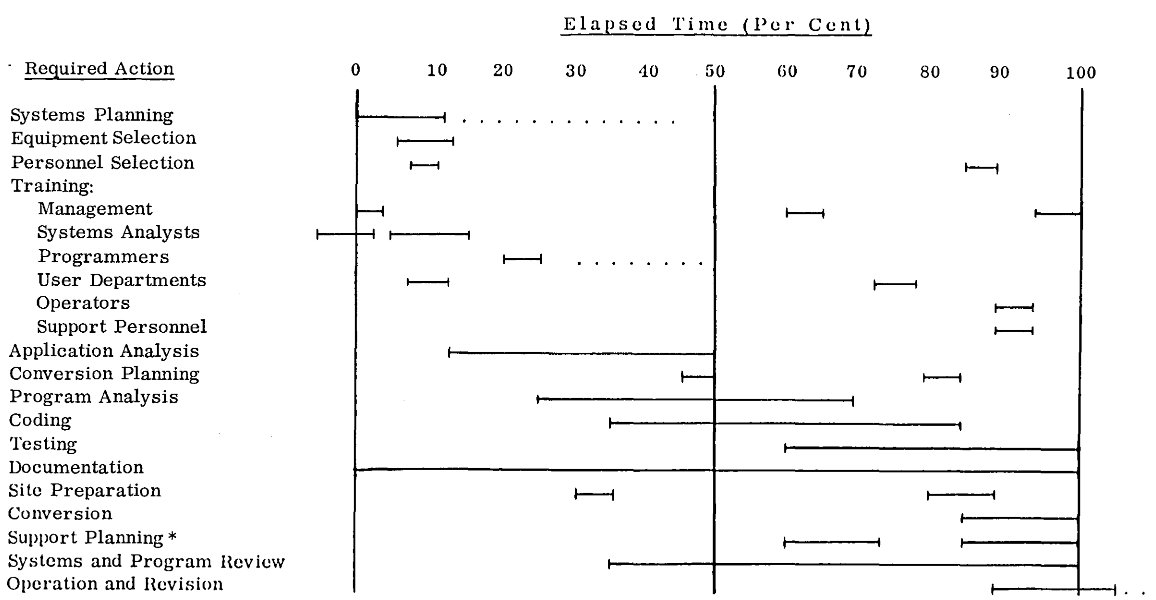
This increase and the equivalent increase in installation operating costs have made management more and more aware of computer costs. Accordingly, management demands a return for its investment that can only be realized through complete control of the data processing function. Computer costs have been taken out of research and placed under operations. The costs therefore must be subjected to the same management control used in other operations.

The major requirement for this management control is a system of appropriate standards. The first standard of course, is a definition of data processing and its tasks.

Implementation Tasks

Installation of a computer requires a precise definition of implementation tasks. Unfortunately, too many computers

CHART 1



* Program Library, Tape Library, EAM, Quality Control, Supply, and Production Control

are installed with only a limited understanding of objectives and without a definition of the tasks to be performed to accomplish installation. The first step in establishing a set of standards or in planning an installation therefore must be to define the steps required in implementation. The list below indicates the tasks to be performed:

Definition of Objectives
Preliminary Study
Feasibility Analysis
Equipment Selection
Section of Personnel
Personnel Training
Establishment of Standards
Scheduling
Systems Planning and Design
Program Logic Design
Coding
Testing
Documentation
Conversion
Parallel Operation
Audit of the Installation
General Organization of the ADP Department
Physical Organization of the ADP Department
Site Preparation

Chart 1 correlates the tasks of planning and design with the over-all installation schedule. It shows the relationships of tasks and emphasizes the importance of scheduling their performance according to their relationships.

Methods Standards

Methods standards require programmers to create programs in a uniform manner, understandable to others and with a basic amount of documentation produced during the programming effort, not afterwards.

If the methods are allowed to vary from programmer to programmer, output cannot be compared. The programmer who does not make block diagrams will complete more pages of coding in a given period of time than the programmer who first creates a detailed logical diagram as documentation, prior to coding. The fact that the quality of the latter program will be better and that testing is simplified will not affect measurements if they are made based simply on the number of coded pages.

Reasons for the development of methods standards are:

- To enable program review by another programmer. It has been demonstrated that the time required for a detailed review can be reduced by more than half if programming methods are standardized.
- The effect of programmer turnover will be reduced. Programs written using standard methodology can be taken over quickly by another programmer trained to use this methodology.
- Conversion of systems to the computer can be planned adequately.
- Performance standards for measuring data processing performance can be established when methods are standardized.
- To allow program segmentation without problems of communication between programmers. Uniform methods make it possible to divide work among a group of programmers without concern about duplication of labels or memory use.

Reasons for Standards

There are a number of other compelling reasons for the use of methods standards:

- To allow segmentation of programs.
- To enable review of programs.
- To reduct the effects of personnel turnover.
- To allow adequate planning for conversion.
- To allow for functional specialization.
- To allow the development and use of performance standards.

The reasons for performance standards are equally as compelling:

- To allow the development of realistic schedules.
- To allow the development of realistic budgets.
- To allow for equitable review of personnel and the development of standards for hiring.

An experienced data processing manager will readily testify to the difficulties encountered and the costs incurred in taking over inherited programs after the resignation of a programmer. The language used may be highly individualized, using non-standard symbology and abbreviations and incomprehensible mnemonics. Such was the case of the programmer who wrote all of his comments and mnemonics in French! Many programs have been completely redone when the original author has left the company.

Performance Standards

By using performance standards, the following can be achieved:

- Management Control—It becomes possible for management to estimate development time and costs, the costs to change a system, and costs to establish controls. Management will be able to evaluate programming performance, program performance, and department performance against a standard of productivity.
- Scheduling of the Development Program—Without performance standards it is almost impossible to accurately estimate time and manpower required to develop a system.
- Costing the Development Program—Management must be able to determine well in advance costs for the development program and costs for making changes to existing systems. If management is aware of costs of systems changes, it may be possible to avoid causes which force expensive changes.
- Personnel Evaluation—It is necessary to make periodic equitable adjustments to salaries of operating and programming personnel. The data processing market is sufficiently competitive to force management to consider salary adjustment carefully. The loss of an experienced programmer can represent the loss of a large investment and a heavy program takeover cost.
- Compensation—It is good business to compensate each staff member in accordance with his contribution. The difficulty has been that it is hard to recognize the exact relationships between the outputs of different programmers.
- Hiring—Performance Standards are also necessary for hiring experienced personnel and training inexperienced personnel. In the former case, it is necessary to evaluate the extent of experience and the level of productivity which can be expected for this experience.
- Long-Range Planning and Economic Analysis of Systems—Conversion costs can be calculated more easily and more accurately.
- Functional Specialization—By reviewing performance by tasks, it is possible to assign different tasks to individuals with specific abilities.
- Budgeting—Accurate costs lead to accurate budgets.

Sources of Standards

It is difficult to develop standards for data processing without recognizing the many differences which have grown up among machine manufacturers and industries. Within machine types for example, distinctions are made (among others), between scientific and business computers, analog and digital computers, large and small computers, and tape and card systems.

Major differences exist:

- Across machine lines
- Across manufacturer lines
- Across industry lines
- Across user lines
- Across departmental lines for a given user.

Other influences affect standards. A specific template may be established as official symbology for block diagramming. Templates have undergone changes over the years. The use of an aged template has become a status symbol which identified the programmer as one of the old-timers. Similarly, the hiring of experienced programmers from outside the organization introduces a new set of experiences, practices and rules into the organization. An installation exists, for example, where among the twenty programmers there are three different methods of writing the alphabetic character O.

Standards sources therefore vary. They include:

- The U. S. Government
- American Standards Association
- Business Equipment Manufacturers Association
- Computer Manufacturers
- Consultants

The Manual of Standards

A compilation of methods standards and rules necessary to establish meaningful performance standards is required for each installation. This compilation should be made and enforced in each installation by the use of a Manual of Standards. The Manual of Standards should include the following:

- Systems Analysis Standards
- Programming Standards
- Operating Standards.
- Performance Standards

The function of the manual is to:

- serve as a compilation of rules and procedures governing data processing department operation
- serve as a policy manual for all employees
- serve as a training manual for new employees
- settle disputes concerning standards

The Manual of Standards must include all of the procedures to be followed and methods to be used. It should enforce rules and regulations and at the same time ensure uniformity of output.

Conclusion

Good standards enforce themselves. Once the programmer, analyst or operator recognizes that his performance has improved through methods standards he becomes a proponent of standards. When he suddenly recognizes that he is capable of understanding a program written by someone else, he is convinced forever.

Future articles in this series will discuss methods standards for systems analysis, programming, program documentation and computer practices. The final article in the series will discuss standards for performance measurement.

"Our problem was to find a 'satellite' computer that could handle FORTRAN efficiently."

"We really searched, but nothing could touch General Electric's Compatibles." He liked the idea of a manufacturer designing a FORTRAN compiler from the ground up. No warmed over competitor's program this. ■ GE-FORTRAN incorporates the very latest compiler techniques, and that's why it is far and away the fastest available for any medium price computer. For example, it has a monitor that performs both control and chaining functions. Only the very largest systems provide such a comprehensive FORTRAN listing with diagnostics. ■ The GE-FORTRAN compiler enables any of The Compatibles to accept most FORTRAN II programs, with little or no changes. And GE-FORTRAN programs can be compiled as is on most large-scale scientific computers. ■ There is also a one-pass FORTRAN that requires only an 8192-word central processor, card reader and punch. ■ Sound good? Write for "FORTRAN Capabilities of the Compatibles." General Electric Computer Department, Section P-11, Phoenix, Arizona.

Progress Is Our Most Important Product

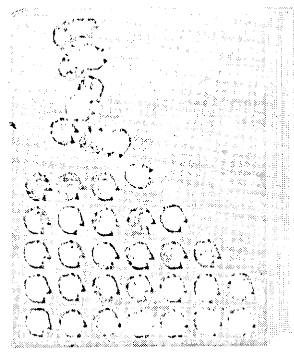
GENERAL ELECTRIC

Circle No. 14 on Readers Service Card

here it is!

who's who in the computer field -'63/'64

A new comprehensive edition of the **WHO'S WHO IN THE COMPUTER FIELD** is available. This is the first edition in over five years. All entries are complete and accurate as of January, 1963. This handsome, clothbound book is the standard biographical reference on over 5000 leaders in **computer applications/ design/ education/ logic/ mathematics/ marketing/ programming/ systems analysis**

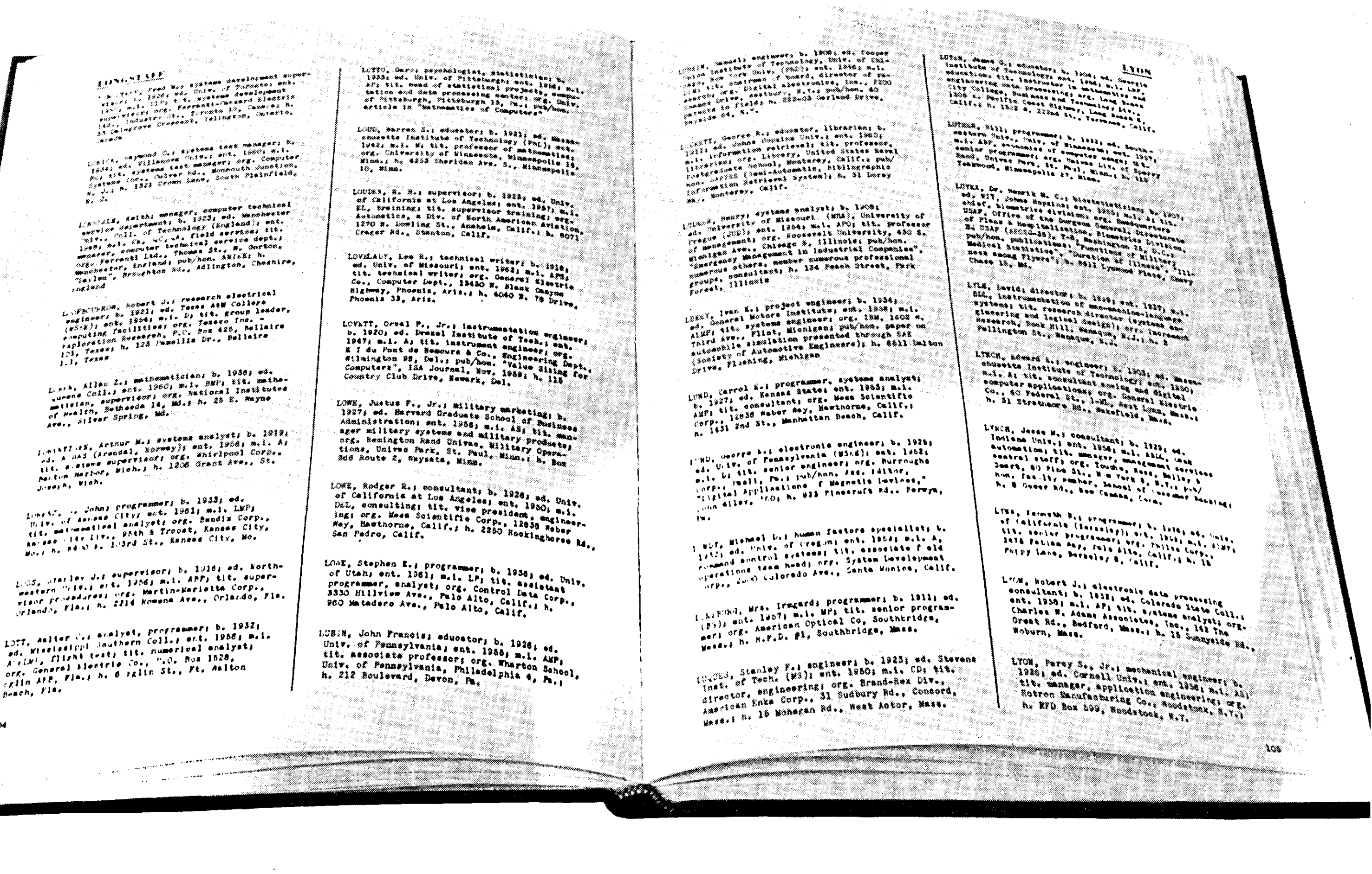


This is the answer book for such questions as:

Where did he get his degree?
How do you spell his name?
What is his home address?
Where is he working?
What is his job title?
What are his interests in the computer field?
What papers has he given?
What books has he written or edited?
To what societies does he belong?
In what year was he born?

Regular price: $24.95. Price to subscribers to Computers and Automation: $18.75. Full refund within ten days if not completely satisfied with the usefulness of this volume. To order your copy, send a check or purchase order to:

Who's Who in the Computer Field, Attn: Order Section
815 Washington Street, Newtonville 60, Mass.



A SURVEY OF NEW WEST-EUROPEAN DIGITAL COMPUTERS (Part 3—Conclusion)

Joseph L. F. De Kerf
Research Laboratories
Gevaert Photo-Producten N.V.
Mortsel, Belgium

(Continued from the October Issue of **Computers and Automation,** Page 29)

Store: magnetic cores. Capacity: 1,024 words. Access time: 0.5 microsec. Auxiliary store: magnetic cores. Capacity: up to 8 units of 8,192 words (maximum capacity: 65,536 words). Access time 2 microsec. External store: Elliott magnetic film or Decca 4000 magnetic tape units. Specifications not yet published.

Input/output: punched tape readers (Elliott: 1,000 char. per sec.), tape punches (Teletype: 100 char. per sec.), direct connection to all forms of measuring and transmission equipment.

Operation speeds (access time included): 2.5 microsec for addition and subtraction, 18 microsec for multiplication and division.

Components: all-transistorized. Price: according to system. Rent: by negotiation.

ELLIOTT 503

Control: stored program. Operation mode: parallel. Number base: binary. Alphanumeric representation: 7 bits per character. Word length: 39 bits (plus parity and tag bit). Point working: fixed and floating. Floating point representation: 30 bit mantissa + 9 bit exponent. Instructions: 1 address type (½ word). Number of operations: 64 (including double precision). Index registers: each store cell.

Store: magnetic cores. Capacity: 8,192 words. Cycle time: 3.5 microsec. Auxiliary store: magnetic cores. Capacity: up to 131,072 words. Access time: 15 microsec. External store: up to 4 Elliott magnetic film units per controller. Film width: 35 mm. Film length: 1,000 feet. Capacity: 262,144 words per film. Read/write speed: 833 words per sec. Block length: 64 words. Up to 8 Ampex TM4 magnetic tape units per controller may be used (compatible with IBM systems). Simultaneous read/write speed: 15,000 or 41,000 characters per sec. Block length: variable.

Input/output: electric typewriter (Flexowriter: 10 char. per sec.), punched tape readers (Elliott: 1,000 char. per sec.), tape punches (Teletype: 100 char. per sec.), punched card readers (Elliott: 400 cards per min.), card reader/punches (Bull: 300 cards per min.), and line printers (Anelex: 1,000 lines per min.). Any number of input and output devices may be used.

Fixed point operation speeds: 7 microsec for addition and subtraction, 38 to 55 microsec for multiplication, and 81 microsec for division. Floating point operation speeds: 20 microsec for addition and subtraction, 38 to 51 microsec for multiplication, and 71 microsec for division. Access time included.

Power consumption: 5 kVA and up. Components: all-transistorized. Price: about $168,000 and up (UK). Not leased.

NCR 315

Control: stored program. Operation mode: serial parallel. Number base: binary decimal. Code: slabs of 12 bits + parity bit (3 decimal digits or 2 alphanumeric characters). Word length: variable (up to 8 slabs). Point working: fixed. Instructions: 1 or 2 address type (2 or 4 slabs). Number of operations: about 150. Number of index registers: 32 (plus 32 jump registers).

Store: magnetic cores. Capacity: from 2,000 to 40,000 slabs. Cycle time: 6 microsec. Auxiliary store: up to 16 Card Random Access Memory units (removable cartridges of 256 plastic cards per unit). Capacity: 2,777,600 slabs per CRAM. Access time: up to 200 ms (reaccess time: 23ms). External store: up to 8 magnetic tape units. Tape width: ½ inch. Tape length: 3,600 feet. Capacity: 4.280, 7.088 or 10.060 million slabs per reel. Read/write speed: 12,000, 20,000 or 30,000 slabs per sec.

Input/output: punched tape readers (1,000 char. per sec.), tape punches (110 char. per sec.), punched card readers (400 or 2,000 cards per min.), card punches (100 or 250 cards per min.), line printers (680 alphanumeric or 900 lines of 120 char. per min.), E-13B document sorters (1620 documents per min.), and optical readers (520 char. per sec.). Up to 128 keyboard inquiry stations may be connected. Polysynchronous operation with demand interrupt permits simultaneous operation of a number of peripherical units.

Operation speeds: 36 to 84 microsec for addition and subtraction, 900 microsec for multiplication (average), and 1,020 microsec for division (minimum).

Power consumption: 27 kVA (varying with different installations). Pulse rate frequency: 166.7 kc/s. Components: all-transistorized. Price: about $225,000 and up.

VERDAN

Control: stored program. Operation mode: serial. Number base: binary. Word length: 26 bits (including sign, spare and synchronizing bit). Point working: fixed. Instructions: one plus one half address type (1 word).

Store: magnetic disc. Speed: 6,000 rpm. Capacity: 13 channels of 128 words (1,644 words). Eight channels (1,024 words) are used to store instructions and data. Minimum word access time: 160 microsec. The remaining five channels (640 words) are utilized by the incremental section to form 128 incremental elements: integrators, servos or decision elements.

Input: keyboard, punched tape reader (800 char. per sec.), up to 16 voltage inputs (processed 100 times/sec.), 3 ternary and 3 binary coded resolvers, up to 48 binary shaft to digital encoders (sampled 100 times/sec.). Output: electric typewriter or tape punch, up to 15 voltage outputs (100 times/sec.), up to 16 shaft output devices, 4 ternary and 4 binary coded incremental outputs, words from the store at the computer clock rate.

Operation speeds (access time not included): 160 microsec for addition and subtraction, 2 ms for multiplication and division. The 128 incremental elements are processed at 100 iterations per sec.

Power consumption: about 320 VA. Pulse rate frequency: 332.8 kc/s. Components: transistor circuits and packaging techniques. Price: not made available. Not leased.

Forty DEUCE computers have been installed by the Data Processing and Control Systems Division of THE ENGLISH ELECTRIC COMPANY Limited. Last deliveries were performed in 1960 but a transistorized medium to large high-speed commercial data processing system, named KDP 10 and based on the RCA 501, was introduced the same year (description: cf. Comp. & Aut., Vol. 9, No. 12, p. 41). Five KDP-10 systems were installed during 1962. A low-cost general-purpose computer for small scale work in commerce, industry and research, was marketed by the ENGLISH ELECTRIC in the meantime. Two computers of this type, called KDN 2, have been in-

stalled; another 5 were on order in October, 1962. An extremely fast, versatile, and expansible system designed for general purpose computing and data processing work, known as the KDF 9, was announced in 1962. Thirteen KDF 9 systems are on order and the first deliveries are expected in the course of 1963. A small-scale business computer, specifically designed to use magnetic tape storage, has been announced by ENGLISH ELECTRIC recently as the KDF 6. The description given below must be considered as provisional.

KDN 2

Control: stored program. Operation mode: serial. Number base: binary. Alphanumeric representation: 6 bits per character. Word length: 18 bits. Point working: fixed. Instructions: 1 address type (1 word). Number of operations: 64. Number of index registers: 3.

Store: magnetic cores. Capacity: up to 8 units of 512 words (maximum capacity: 4,096 words). Cycle time: 15 microsec. External store: up to 4 English Electric magnetic tape units. Tape width: ¾ inch. Tape length: 2,400 feet. Density: 333⅓ char. per inch. Capacity: up to 8.64 million char. per reel. Read/write speed: 33,333 char. per sec. Block length: variable. Dual recording.

Input/output (basic computer): electric typewriter (IBM: 10 char. per sec.), punched tape reader (20 char. per sec.), and tape punch (20 char. per sec.). Faster punched tape equipment or alternative input and output devices may be used (including keyboards, punched card equipment, line printers, analog-to-digital and digital-to-analog converters).

Operation speeds: 175 microsec for addition and subtraction, 2.75 ms (average) for multiplication, and 5 ms (average) for division. Access time included.

Power consumption: 1.6 kVA. Pulse rate frequency: 140 kc/s. Components: diodes and transistors (+ 252 Datapac plug-in packages). Price (basic machine): about $70,000. May be leased.

KDF 9

Control: stored program (optional automatic time-sharing: up to four programs concurrently). Operation mode: parallel. Number base: binary. Alphanumeric representation: six bits per character. Word length: 48 bits. Point working: fixed and floating. Floating point representation: 40 bit mantissa + 8 bit exponent. Instructions: 0 and 1 address type (2 to 6 instructions per word). Number of operations: over 200 (including half-word and double-word operations). Number of index registers: 15.

Store: magnetic cores. Capacity: up to 8 units of 4,096 words (maximum capacity: 32,768 words). Cycle time: 6 microsec. External store: any number of English Electric magnetic tape units. Tape width: ¾ inch. Tape length: 2,400 feet. Density: 333⅓ char. per inch. Capacity: up to 8.64 million char. per reel. Read/write speed: 33,333 char. per sec. Block length: variable. Dual recording.

Input/output: punched tape readers (English Electric: 1,000 char. per sec.), tape punches (Teletype/Creed: 110/300 char. per sec.), punched card readers (English Electric: 400 cards per min.), card punches (English Electric: 150 cards per min.), on-line printers (English Electric: 600 lines of 120 char. per min.), off-line printers (English Electric: 600 to 900 lines of 120 char. per min.), off-line xerographic printers (Rank: 3,000 lines per min.). Maximum number of units: any number subject to maximum theoretical instantaneous transfer rate of 1.33 million char. per sec.

Operation speeds: 1 microsec (fixed point) or 6 to 10 microsec (floating point) for addition and subtraction, 14 to 18 microsec (fixed and floating) for multiplication, 30 to 35 microsec (fixed and floating) for division. Access time excluded.

Pulse rate frequency: 2,000 kc/s. Components: diodes and transistors (+ magnetic core circuits). Price: about $350,000 and up. May be leased.

KDF 6

Control: stored program. Operation mode: serial. Number base: alphanumeric (6 bits per character). Word length: 1 triad of 3 characters (grouped in data areas). Point working: fixed. Instructions: 1 address type (1 word). Number of operations: 64. Number of registers: 4 (3 of them may be used as index registers).

Store: magnetic cores. Capacity: 24,576 characters (8,192 individually addressable triads or groups of 3 characters). Access time: 7 microsec. External store: up to 4 English Electric magnetic tape units. Tape width: ¾ inch. Tape length: 2,400 feet. Density: 333⅓ char. per inch. Capacity: up to 8.64 million char. per reel. Read/write speed: 33,333 char. per sec. Block length: variable. Dual recording.

Input/output: 1 monitor typewriter (10 char. per sec.), 1 punched tape reader (English Electric: 1,000 char. per sec.), and 1 tape punch (Teletype: 110 char. per sec.). Optional: 1 line printer (English Electric: 600 to 900 lines of 120 char. per min.). Other peripherical devices, such as punched card equipment, may be added if required by the user.

Operation speeds: 175 microsec for addition and subtraction, 2.75 ms (average) for multiplication, and 5 ms (average) for division. Access time included.

Power consumption (basic installation): 3 kVA. Pulse rate frequency: 140 kc/s. Components: diodes and transistors (no tubes). Price (central processor, control console, monitor typewriter, punched tape reader and tape punch): about $126,000. May be leased.

The Computer Department of FERRANTI Limited has installed 85 computers, while 24 were on order in June, 1962. In addition to these, a large number of computers have been ordered for military applications. ORION, a time-shared transistorized computing system for business or scientific uses, and ATLAS, a high-speed transistorized scientific computer, have been described in this journal (cf. Comp. & Aut., Vol. 9, No. 12, pp. 41 & 42). As more details about ATLAS are available now, its description is given again. A transistorized process control computer, called ARGUS, has been installed by FERRANTI at the Fleetwood Chemical Industries Ltd. in 1961, where it will take over the functions of about 100 conventional control devices. Two ARGUS are on order. The first will be used by Babcock & Wilcox Ltd. to control the start-up and shut-down of a large boiler-turbine set which they are building for the Central Electricity Generating Board. The second will be used by the C.E.G.B. in grid system control experiments. The process control computer is marketed as the ARGUS 200, while a slower but less expensive version is known as the ARGUS 100. The first ARGUS 100 has now been ordered to control a new radio-telescope at Jodrell Bank. The installation of APOLLO, a special purpose computer for air-traffic control data processing, in the Scottish Air Traffic Control Centre at Prestwick, was announced by FERRANTI in the course of 1961. It is used there by the Ministry of Aviation for experiments in automatic processing of data for air-traffic control on the North Atlantic routes. The results of the trans-oceanic experiments are expected to prove valuable for use in other areas. POSEIDON, a high-speed real time control computer, designed in close collaboration with the Admiralty Surface Weapons Establishment, has been announced by FERRANTI recently. The fixed program store consists of open or closed patterns of copper rings on interchangeable cards (developed by Mullard Ltd.). These cards are clamped into magnetic sensing heads which detect by magnetic induction which rings are open and which are closed. The system has been designed to accommodate multi-computer operation with data being transferred between machines at 6 microsecond intervals. A system of priority routines has been designed into the computer to provide any required lower speed of transfer. The first POSEIDON was installed at the A.S.W.E. in January, 1962. FERRANTI Limited is represented in the USA by Ferranti Electric Inc. (Industrial Park No. 1, Plainview, L. I., New York) and in Canada by the Ferranti-Packard Electric Ltd. (Industry Street, Toronto 15, Ontario).

ATLAS

Control: stored program (time-sharing: concurrent operation of any number of programs). Operation mode: parallel. Number base: binary. Alphanumeric representation: 6 bits per character. Word length: 48 bits (sign bit included). Point working: fixed and floating. Floating point representation: 39 bit mantissa + 7 bit exponent (both with sign). Instructions: 1 main address + 2 index addresses (1 word). Number of operations: 300 (including subroutine instructions). Index registers: 128 half words (access time: 0.35 microsec).

Main store: magnetic cores. Capacity: 16,384 words upwards. Access time: 2 microsec. A fixed store, constructed of ferrite rods, is used for holding subroutines. Capacity: 8,192 words. Access time: 0.3 microsec. A further block of 1,024 words core store is used as wording store for the routines. Auxiliary store: 4 or more magnetic drums. Capacity: 24,576 words per drum. Block length: 512 words. Read/write time: 2 ms per block. Revolution time: 12 ms. External store (standard provision): up to 32 Ampex TM2 magnetic tape units. Tape width: 1 inch. Tape length: 3,600 feet. Density: 375 char. per inch. Capacity: 20 million char. per reel. Read/write speed: 90,000 char. per sec. Block length: 512 words. IBM half inch magnetic tape units can be supplied for input and output (not as part of the main tape system).

Input/output (standard provision): 1 clock, up to 16 Flexowriters and Teleprinters (10 char. per sec.), up to 12 punched tape readers (Ferranti TR5: 300 char. per sec.), up to 4 high-speed punched tape readers (Ferranti TR7: 1,000 char. per sec.), up to 12 tape punches (Teletype: 110 char. per sec.), up to 4 fast tape punches (Creed 3000: 300 char. per sec.), up to 4 punched card readers (ICT: 600 cards per min.), 1 or 2 card punches (ICT: 100 cards per min.), 1 or 2 line printers (ICT: 600 lines of 120 char. per min.), and 1 or 2 xerographic printers (Rank: 3,000 lines per min.). Additional equipment may be incorporated but requires additional hardware.

Average operation speeds (fixed and floating): 1.1 microsec for addition and subtraction, 3.5 microsec for multiplication, and 6 microsec for division. Access time to the main store included.

Power consumption (typical installation): about 200 kVA. Pulse rate frequency: 10,000 kc/s. Components: all-transistorized. Price (average): approximately $5,600,000. May be leased.

ARGUS

Control: by pegboards. Operation mode: serial parallel. Number base: binary. Word length: 12 bits (parity checking, double precision). Point working: fixed. Instructions: 1 address type (2 words). Number of operations: 54. Number of index registers: 7 (2 of which are double length).

Fixed program store: pegboards (up to 64 trays). Capacity: up to 4 units of 1,024 instructions or 2,048 twelve bit constants. Working store: magnetic cores. Capacity: up to 8 units of 1,024 words (maximum capacity: 8,192 words). Access time: 6 microsec. Auxiliary store (optional): magnetic drum. Capacity: 50,000 words. Access time: 12 ms. External store (optional): magnetic tape units.

Input/output: electric typewriter, digital inputs and outputs, up to several hundred analog units (including analog-to-digital and digital-to-analog converters if required). Optional equipment: teleprinters, punched tape readers, tape punches, and line printers. No standard devices: system to meet each application.

Single precision operation speeds: 20 microsec for addition and subtraction, 100 microsec for multiplication, and 200 microsec for division. Double precision operation speeds: 40 microsec for addition and subtraction, 200 microsec for multiplication, and 400 microsec for division. Access time included.

Power consumption (basic computer): 0.6 kVA. Pulse rate frequency: 500 kc/s. Components: about 20,000 diodes and 4,000 transistors (15 types of printed circuit plates). Price: about $112,000 for a small to $420,000 for a large system. May be leased.

APOLLO

Control: stored program. Operation mode: parallel. Number base: binary. Word length: 24 bits. Point working: fixed. Instructions: 1 address type (1 word). Number of operations: 96. Number of index registers: 3.

Store: magnetic cores. Capacity: up to 8 units of 4,096 words (maximum capacity: 32,768 words). Access time: 6 microsec. Auxiliary store: magnetic drum (optional). External store: magnetic tape units (optional).

Input/output: electric typewriters (Creed: 7 or 10 char. per sec.), punched tape readers (Ferranti TR5: 300 char. per sec.), tape punches (Creed: 25 char. per sec.), and cathode-ray tube displays. Multi-channel input and output using interrupt technique.

Operation speeds (access time included): 6 microsec for addition and subtraction, 60 microsec for multiplication and division.

Power consumption: 0.5 kVA. Pulse rate frequency: 500 kc/s. Components: about 18,000 diodes and 5,000 transistors. Price (minimum installation): approximately $210,000. May be leased.

POSEIDON

Control: fixed and variable program store (multi-computer working with priority routing). Operation mode: parallel. Number base: binary. Word length: 24 bits. Point working: fixed. Instructions: 3 address type (1 word). Number of operations: 512 (plus 256 subroutine entry instructions). Number of index registers: 5.

Fixed program store: Mullard cards. Capacity: 4,096 words and up (maximum capacity: 16,384 words). Access time: 2 microsec. Optional program store: magnetic cores. Capacity: 4,096 words. Access time: 6 microsec. Data store: magnetic cores. Capacity: two units of 4,096 words. Access time: 6 microsec. Working store: transistor-circuit registers. Capacity: 12 words. Access: immediate. The larger access to the data store does not limit the computing speed: the instructions are overlapped in time to some extent.

Input/output: punched tape reader (Ferranti TR5: 300 char. per sec.), tape punch (Creed 25: 33 char. per sec.), and magnetic tape (1,000 char. per sec.).

Operation speeds: 2 microsec for addition and subtraction, 28 microsec for multiplication, and 58 microsec for division.

Power consumption: 1.2 kVA. Pulse rate frequency: 500 kc/s. Components: about 30,000 diodes and 7,000 transistors. Price (minimum installation): approximately $280,000. May be leased.

INTERNATIONAL COMPUTERS AND TABULATORS Ltd., the largest manufacturer and distributor of punched card and electronic data processing equipment in the United Kingdom, has more than 15 subsidiary and associated companies. The company employs over 22,000 people and operates in more than 50 countries. ICT had about 100 computers of the type 1201 and 1202 delivered or on order in August, 1962. A new medium-size computer, known as the 1301 data processing system, was introduced by ICT in the course of 1960. The ICT 1301 was designed and developed by Computer Developments Ltd., a company formed and owned jointly since November, 1956 by ICT and The General Electric Company of England. The first ICT 1301 was installed in March, 1961 at the ICT Computing Centre (Putney Bridge House, London SW6). Four ICT 1301's have been delivered. In 1961 ICT concluded an agreement with the Radio Corporation of America for the exchange of technical information and patents in the field of data processing. ICT arranged to purchase fifty RCA 301 computers, which are marketed in Europe as the 1500 data processing system. The computers may be equipped with ICT punched card input and output units. An ICT 1500 has been in operation since January, 1962 at the ICT Computing Centre of London. Another was installed in June, 1962 at the ICT Computer Centre of Dusseldorf. So far, five ICT 1500's have been delivered. ICT expects to receive delivery of all fifty systems by the end of 1963. ICT and Electric & Musical Industries Ltd., announced that agreement had been reached whereby, as from July, 1962, the data processing activities of EMI Electronics Ltd. are merged with the ICT Ltd. organization. A 4096-word one microsecond magnetic film store and a magnetic tape tester were shown by ICT at the INTERDATA Exhibition of the IFIP Congress 62. The Tapetester Type 536 is a design of DRI (Data Recording Instrument Co. Ltd., 33 Woodthorpe Road, Ashford, Middlesex). In the meantime, DRI became a subsidiary of ICT Ltd.

ICT 1301

Control: stored program. Operation mode: serial parallel. Number base: binary decimal (1-2-4-8 code). Alphanumeric representation: 2 digits per character. Word length: 12 decimal digits (including sign). Point working: fixed. Instructions: 1 address (½ word). Number of operations: 51. Automatic sterling processing.

Store: magnetic cores. Capacity: up to 5 units of 400 words (maximum capacity: 2,000 words). Access time: 4 microsec. Auxiliary store: up to 8 magnetic drums. Capacity: 12,000 words per drum (60 channels of 200 words). Speed: 5,240 rpm. Average access time: 5.7 ms. Average access time for full channel transfers: 0.28 ms. External store: up to 8 magnetic tape units (Ampex TM 2 or FR 400). Tape width: 1 or ½ inch. Tape length: 3,600 feet. Density: 600 or 300 decimal digits per inch. Read/write speed: 90,000 or 22,500 decimal digits per sec. Automatic correction of single bit errors, detection of double bit errors. Checking: two parity bits per word on core store and one check digit per word length on drum store.

Input/output: one punched card reader (ICT 590/0: 600 cards per min.), one card punch (ICT 600/0: 100 cards per min.), and one line printer (ICT 660/0: 600 lines of 120 char. per min.).

Operation speeds: (access time included) 21 or 25 microsec for addition and subtraction, 175 microsec per multiplier digit for multiplication (division by subroutine).

Power consumption: from 7 to 28 kVA. Technical data: 1,000 kc/s prf, printed circuit boards, all-transistorized, wrapped connections. Price: from $182,000 to $840,000. Rent: from $3,920 to $19,600 per month.

ICT 1500

Control: stored program (simultaneous input/output and processing). Operation mode: serial parallel. Number base: alphanumeric (7 bits per character, parity bit included). Word length: variable. Point working: fixed (floating point can be specified). Instruction type: 2 address. Instruction length: 10 characters. Number of operations: 48. Indirect addressing.

Store: magnetic cores. Capacity: 10,000, 20,000 or 40,000 characters. Access time: 7 microsec. Auxiliary store I: 1 or 2 Data Disc Files. Capacity: more than 88 million characters per unit (supplied in modules of about 22 million characters on six discs). Speed: 1,200 rpm. Average access time: 0.1 sec. Transfer rate: 32,000 char. per sec. Auxiliary store II: up to 6 Data Record Files (128 interchangeable records per unit). Capacity: about 4.6 million characters per unit (maximum capacity: more than 27 million characters). Average access time: 4.25 sec. Transfer rate: 2,500 char. per sec. External store I: 1 or 2 groups of 6 magnetic tape units. Tape width: ½ inch. Tape length: 1,200 feet. Density: 333⅓ char. per inch. Capacity: more than 3 million characters per reel. Read/write speed: 10,000 char. per sec. External store II/III: up to 14 high-speed magnetic tape units. Tape width: ¾ inch. Tape length: 2,400 feet. Density: 333⅓ or 666⅔ char. per inch. Capacity: about 8.5 or 14 million characters per reel. Read/write speed: 33,333 or 66,666 char. per sec. Any combination of the three types of magnetic tape units may be included in the same system, provided the total number of decks does not exceed 14.

Input/output: 1 console typewriter (10 char. per sec.), 1 inquiry station (10 char. per sec.), 1 punched tape reader (1,000 char. per sec.), 1 tape punch (100 char. per sec.), 1 punched card reader (600 cards per min.), 1 card punch (100 cards per min.), 1 or 2 line printers (Anelex: 1,000 lines of 120 or 160 char. per min.).

Operation speeds: 189 microsec for addition and subtraction (5 digit terms), 8.8 ms for multiplication (10 digit factors), and 15 ms for division (10 digit dividend and divider). Mode of operation of the arithmetic unit: table look-up system. Multiplication and division by subroutines.

Power consumption: 19 kVA. Pulse rate frequency: 200 kc/s. Components: transistorized. Price: about $200,000 and up. May be leased.

Eleven LEO II's have been installed by LEO Computers Limited. This model is no longer manufactured but a transistorized and improved version with automatic time-sharing, called LEO III, was announced by the company during 1960. Two have been installed, one at the LEO Service Bureaus of London and one at the LEO Service Bureaus of Johannesburg. More than 10 LEO III computers are on order (September, 1962).

LEO III

Control: stored program (automatic time-sharing, interruption facility to permit concurrent running of 2 or more programs). Operation mode: serial parallel. Number base: binary decimal. Alphanumeric representation: 2 digits per character. Word length: 5 (short) or 10 (long) digits, plus sign and parity bit. Point working: fixed and floating. Floating point representation: 40 bit mantissa + 20 bit exponent. Instructions: 1 address type (1 short word). Number of operations: 110. Number of index registers: up to 12. Automatic sterling processing.

Store: magnetic cores. Capacity: 1 to 3 units of 1,024 long words and/or up to 8 units of 4,096 long words (subject to maximum capacity of 32,768 long words). Access time: 6 microsec. External store: Ampex magnetic tape units (linked to the computer through assemblers, with a capacity of up to 8 desks each). Tape width: ½ or 1 inch. Tape length: 3,600 feet. Density: 375 or 750 char. per inch. Capacity: more than 10 or 20 million char. per reel. Peak speed: 22,500, 45,000 or 90,000 char. per sec. Effective speed: 17,500, 30,000 or 45,000 char. per sec. (with blocks of 1,000 characters). Block length: variable, maximum 5,000 characters.

Input/output: electric typewriters (10 char. per sec.), punched tape readers (Elliott: 1,000 char. per sec.), tape punches (Teletype: 110 char. per sec.), punched card readers (ITC: 600 cards per min./Elliott: 400 cards per min.), card punches (ICT: 100 cards per min.), and line printers (Anelex: up to 1,000 of 120 or 160 char. per min.). Five types of assemblers may be used. Up to 8 assemblers, magnetic tape assemblers included, may be connected.

Fixed point operation speeds: 31 microsec for addition and subtraction (48 microsec if modified), 251 to 501 microsec for multiplication (170 to 347 microsec if repeated with the same multiplier), 1,200 microsec for division. Floating point operation speeds: 180 to 330 microsec for addition and subtraction, 560 to 738 microsec for multiplication (division not yet fixed, special microplane under construction).

Power consumption: 10 kVA for computer and 20 kVA for ancillary equipment. Technical data: asynchronous, printed circuits, all-transistorized. Price: about $365,000 and up. Not leased.

The Integrated Electronic Systems Division of STANDARD TELEPHONES & CABLES Limited has installed 39 STANTEC ZEBRA computers. One of them was used as central unit of an aircraft weight and baggage control system, delivered by Standard Elektrik Lorenz AG to the Scandinavian Airlines Systems in the course of 1961 (SEL-KA 21). A contract was placed the same year by the British Overseas Airways Corporation with STC for the supply of an Electronic Seat Reservation System (SEL-DB 40). It provides ticket-selling offices throughout the United Kingdom and Europe with up-to-minute information on the availability of airlines seats on all flights operated by BOAC. The system will also give information on the flights of other airlines associated with BOAC. In the meantime STC introduced the STANTEC COMPUTING SYSTEM, the central processor of which is a fully transistorized and improved version of the STANTEC ZEBRA. Seven STANTEC COMPUTING SYSTEM's had been installed by September, 1962. No data were then available about the number on order.

STANTEC COMPUTING SYSTEM

Control: stored program. Operation mode: serial. Number base: binary. Alphanumeric representation: 6 bits per character. Word length: 33 bits (sign bit included). Point working: fixed. Instructions: 1 + 1 address and 2 address type (1 word). Operations: externally microprogrammed (multiple word operations). Number of index registers: 12 (i.e. fast access registers can be used as index register).

Main store: magnetic drum. Capacity: 8,192 words (with parity checking). Speed: 6,000 rpm. Average access time: 5 ms. Additional quick access store: magnetic cores. Capacity: up to 8 units of 1,024 words (maximum capacity: 8,192 words). Access time: 312 microsec. External store: magnetic tape units (supplied to customer requirements).

Input/output: 1 teleprinter (Creed: 10 char. per sec.), 1 or 2 punched tape readers (Elliott: 300 or 800 char. per sec.), 1 or 2 tape punches (Teletype: 100 char. per sec./Creed: 300 char. per sec.).

Operation speeds: 312 microsec for addition and subtraction, 11 ms for multiplication, and 35 ms for division. The multiplication time may be reduced to 624 microsec by an optional fast multiplier.

Power consumption: 2.5 kVA (basic machine). Pulse rate frequency: 128 kc/s. Components: fully transistorized. Price: from $85,000 to $250,000. May be leased.

COMPUTER ENGINEERING Limited (52 Wilbury Way, Hitchin, Hertfordshire) is a newcomer in the field. A small general-purpose digital computer, known as the CE102, was introduced by this company at the Olympia Electronic Computer Exhibition (London, October, 1961). According to the manufacturer, the CE102 has been specially designed with the needs of the teacher in mind and its modest price places it within the budget of the Technical College or small industrial firm. As a solid-state computer, its power consumption is low and running costs very small. Cooling requirements are reduced to a bare minimum. No data are available about the number installed or on order.

CE 102

Control: stored program. Operation mode: serial. Number base: binary. Word length: 32 bits. Point working: fixed. Instructions: 1 address type (1 word). Number of operations: 13. Every address can be B-modified.

Store: magnetic drum. Capacity: 4,096 words (128 tracks of 32 words). Speed: 5,000 rpm. Average access time: 12 ms. One track is used for fixed instructions and constants.

Input: punched tape reader (20 char. per sec.). Output: electric typewriter or teleprinter with tape punch (10 char. per sec.). Alternative input and output systems can be provided for customer's special requirements.

Operation speeds (access time not included): 350 microsec for addition and subtraction, 12 ms for multiplication. Division bij subroutine.

Power consumption: 1 kVA. Pulse rate frequency: 100 kc/s. Components: about 1,000 diodes and 600 transistors (no tubes). Price: about $27,000. Not leased.

CALENDAR OF COMING EVENTS

Nov. 4-6, 1963: NEREM (Northeast Research and Eng. Meeting), Boston, Mass.; contact NEREM-IRE Boston Office, 313 Washington St., Newton, Mass.

Nov. 4-8, 1963: 10th Institute on Electronics in Management, The American University, 1901 F St., N.W., Washington 6, D. C.; contact Marvin M. Wofsey, Asst. Director, Center for Technology and Administration, The American University, Washington 6, D. C.

Nov. 10-15, 1963: 9th Annual Conference on Magnetism and Magnetic Materials, Chalfonte-Haddon Hall, Atlantic City, N. J.; contact Mr. C. J. Kriessman, Physics, Materials and Processes Sec., Box 500, Blue Bell, Pa.

Nov. 11-13, 1963: 1963 Radio Fall Meeting, Manger Hotel, Rochester, N. Y.; contact EIA Engineering Dept., Room 2260, 11 W. 42 St., New York 36, N. Y.

Nov. 12-14, 1963: Fall Joint Computer Conference, Las Vegas Convention Center, Las Vegas, Nev.; contact Mr. J. D. Madden, System Development Corp., Santa Monica, Calif.

Nov. 18-20, 1963: 11th Annual Electronics Seminar, Pick-Congress Hotel, Chicago, Ill.; contact S. M. Salvino, Chairman, EDP Committee, The Peoples Gas Light & Coke Co., 122 So. Michigan Ave., Chicago 3, Ill.

Nov. 18-19, 1963: DECUS (Digital Equipment Computer Users Society) Annual Meeting, Lawrence, Radiation Laboratory Computation Center, Livermore, Calif.; contact Elsa Newman, Secretary, DECUS, Digital Equipment Corp., Maynard, Mass.

Nov. 18-20, 1963: 16th Annual Conference on Engineering in Medicine and Biology, Lord Baltimore Hotel, Baltimore, Md.; contact Richard Rimbach Associates, 933 Ridge Ave., Pittsburgh 12, Pa.

Nov. 18-22, 1963: Institute on Patent Incentives, The American University, 1901 F St., N.W., Washington 6, D. C.; contact Marvin M. Wofsey, Asst. Director, Center for Technology and Administration, The American University, Washington 6, D. C.

Nov. 19-21, 1963: Fifth International Automation Congress and Exposition, Sheraton Hotel, Philadelphia, Pa.; contact International Automation Congress & Exposition, Richard Rimbach Associates, Management, 933 Ridge Ave., Pittsburgh 12, Pa.

Dec. 5-6, 1963: 14th Nat'l Conference on Vehicular Communications, Dallas, Tex.; contact A. C. Simmons, Comm. Industries, Inc., 511 N. Akard, Dallas, Tex.

Jan. 30-31, 1964: Annual Computer Applications Symposium, LaSalle Hotel, Chicago, Ill.; contact Milton M. Gutterman, IIT Research Inst., 10 W. 35th St., Chicago, Ill. 60616.

Feb. 3-7, 1964: ASTM International Conference on Materials, Sheraton Hotel, Philadelphia, Pa.; contact H. H. Hamilton, American Society for Testing and Materials, 1916 Race St., Philadelphia 3, Pa.

Feb. 5-7, 1964: 5th Winter Conv. on Military Electronics (MILECON), Ambassador Hotel, Los Angeles, Calif.; contact IEEE L. A. Office, 3600 Wilshire Blvd., Los Angeles, Calif.

"ACROSS THE EDITOR'S DESK"

Computing and Data Processing Newsletter

TABLE OF CONTENTS

NEW APPLICATIONS

CHARTING METEORITE PATTERNS BY COMPUTER PLANNED

One of the nation's foremost geochemists, Dr. Harrison Brown of the California Institute of Technology, Pasadena, Calif., is making a new study of meteorite records going back 260 years. While about 560 falling stars, or meteorites, hit the earth each year, there are, over the 260 year period, only some 526 on which there is enough data for scientific inferences. Age-dating by observation of the extent of radioactive decay indicates they were all created about four and a half billion years ago, about the time the earth was. The biggest one known is a 60-ton one, which landed in South Africa. Most are too small to do damage, and there is no record of anyone ever having been killed by one. They fall at a rate of about 360 to 650 miles an hour -- the speed range of current jet planes.

The study will use electronic computers, which can produce mathematical patterns of meteorite characteristics that previously required an inordinate amount of arithmetic. Dr. Brown wants to see what can be deduced from the frequency of their occurrence and other characteristics. Mrs. Irene Goddard, a Cal Tech chemist, is collaborating in the study, which is supported by the National Aeronautics and Space Administration.

COMPUTERS AID DESIGN OF SHELL STRUCTURES

Three Purdue University engineers, John E. Goldberg, professor of civil engineering, John L. Bogdanoff, professor, and Dale W. Alspaugh, instructor in aeronautical and engineering sciences, have developed a computer method which makes the design of shell structures both practical and relatively inexpensive. Shell structures are the domed or vaulted buildings that have no interior supports.

Problems in building shell structures are caused by climate and weathering. For example, reinforced concrete, of which many thin-shelled structures are composed, is likely to shrink. Both the reinforcing steel and the concrete react to differences in temperature; more heat inside the shell than outside, or vice versa, imposes a stress. Wind, snow, or unusual loadings may upset the balance of membrane action and bending stress, by which a shell structure, without the support of inside ribs, supports itself.

The computer method was reported in September to the meeting of the International Association for Shell Structures, in Warsaw, Poland. The method is expressed in differential equations for stress and deformation. The new computer technique gives shell structure engineers a more complete and more accurate method than previously available for determining how such stresses will affect their structures.

COMPUTER AS A MANAGERIAL TOOL

Last year, management at Citizens & Southern National Bank, Columbia, S.C., made a new decision: to eliminate all service charges on regular personal checking accounts with a $100 minimum balance. Behind this decision lay thought, study, and the electronic computer. The computer made it possible to estimate in advance the results of such a move.

C & S had previously eliminated service charges on regular checking accounts with a $400 minimum balance. As soon as this had been effected and observed in actual operation, the $100 minimum was considered.

A survey was made of customer lists to pinpoint areas of greatest checking activity. Then, using customer data stored on magnetic tape, volume within various minimum balance categories was determined. In the case of the $100 minimum balance, it became predictable that dropping charges on accounts above this figure would have relatively little impact on bank income, and that any loss which might result could be expected to be offset by new accounts generated through establishment of the new minimum.

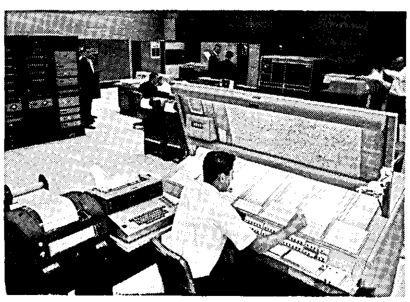
In fact, upon announcement of the new minimum, new customers began opening checking accounts. Also, existing smaller accounts were increased to take advantage

of the savings in service charges. It is reported that regular checking accounts have increased by more than 17 per cent.
(For more information, circle 26 on the Readers Service Card.)

CONTROL SYSTEM OF AIR TRAFFIC IN FLIGHT

At the Federal Aviation Agnecy's New York Air Route Traffic Control Center (ARTCC), MacArthur Airport, N.Y., a data processing system acts as a high-speed organizer of the basic information against which the controller develops an accurate picture of the changing pattern of moving aircraft in his sector of responsibility.

Built into each of the Center's 22 sector control positions, with their radar scopes and two-way communications channels, is a printer, keyboard, and visual display linking the controller with an IBM computer. In the computer are filed and updated all flight plans within 41,000 square miles of land area and 1.5 million square miles of ocean area. The system operates in the real-time framework of the air traffic environment. It provides all controllers with a continuous flow of flight data, and at once accepts from any of them, changes in aircraft status which will alter that data.



-- Assistant controller, Edmund Barrett, at one of the eight Flight Data Positions (Flidaps). The IBM 1410 data processing system is shown along rear wall. Flight plans from adjacent ARTCCs are transmitted directly into the computer through special Teletype lines, with a copy of the message printed out simultaneously (left foreground). Flight plans transmitted by voice telephone from other points are taken down over headset and entered into the computer through the keyboard of the IBM 1052 printer, which Mr. Barrett is shown operating.

An IBM 1410 data processing system, together with a smaller 1401, matches incoming flight plans against airspace geography stored in an associated 1301 disk file. Flight plans for the New York control area come into the FAA Center from a number of sources. They are entered into the computer manually by keyboard, based on a telephone or teletype message -- or automatically through special teletype lines connecting the MacArthur Airport Center's computer to the computers of FAA Centers with which it has common boundaries (Cleveland, Boston and Washington, D.C.).

The end-product is a series of flight progress reports for each aircraft, which the computer automatically breaks down by sector and selectively disseminates to the appropriate control board printers.

As an aircraft enters a new sector, its pilot is required to contact the sector controller. If his position report, obtained by voice communication and radar fix, indicates a different arrival time over a navigational check-point than had been originally estimated, the controller is responsible for alerting the other controllers along the flight path of the change.

The men of the New York ARTCC direct the flow of up to 3000 flights in and out of the Mid-Atlantic area on a normal busy day.
(For more information, circle 27 on the Readers Service Card.)

THE ROLE OF COMPUTERS IN AGRICULTURE

Agricultural experts from government, universities, and major farm enterprises, recently attended an agricultural symposium, at IBM Corporation, Endicott, N.Y., to review the role of computers in agriculture. Talks and demonstrations explained how computers can increase farm profits by: (1) scheduling the use of equipment; (2) planning when to plant and cut trees in a forestry program; (3) determining least-cost rations for beef cattle; (4) indicating when to shift crops and invest capital; and (5) improving record-keeping.

As part of a new computer-conducted farm management game, agricultural experts were able to run a successful farm without plowing, planting or harvesting. They did it on an IBM 1620 computer. The computer exercise presents a typical farm in operation. It demands of the players decisions on the allocation of land, selection of crops and livestock, the purchase and sale of produce and the use of capital. These decisions are fed to the computer, which delivers the results of a full year's operation in one minute.

The farm management game was developed by Dr. Ludwig M. Eisgruber at Purdue University's Department of Agricultural Economics. It is based on farm management research, historic price movement and trends in yields as well as personal observation. Essentially, it is a mathematical model which attempts to duplicate the world of the modern American farmer.
(For more information, circle 28 on the Readers Service Card.)

COMPUTERS DETECT FASHION TRENDS

Oreck's, a women's specialty store in Duluth, Minn., is relying on its data processing equipment to keep ahead of the shopper's fashion preference. In order to waste no time in spotting customer reaction to a new style, IBM data processing equipment monitors daily transactions on the sales floors. The flow of sales information is analyzed, and before noon of the following day, a comprehensive report on the styles, colors, and sizes the shoppers are choosing is given to the buyers.

A special 4-part price ticket is the key to this inventory control system. The ticket is attached to each garment and item before it moves up to the selling floor. Coded information on the ticket includes style, color, size, season, source of supply, etc. When the item is sold, one portion of the ticket is removed and sent to the IBM department. Here the machines "read" the coded data, punch out IBM cards, then sort, tally and print out reports for management. From these reports, Oreck's buyers are better able to balance merchandise stocks to customer taste, and to maintain adequate inventories to meet the demand.
(For more information, circle 29 on the Readers Service Card.)

NEW CONTRACTS

STUDY WILL PROJECT STATE OF COMPUTER ART FOR YEARS 1975 TO 1985

The U.S. Army has awarded a $133,000 contract to the National Cash Register Company, Military Development Dept., Dayton, Ohio, for a study of what types of computers and related equipment will be available for military use between the years 1975 and 1985. Information from the NCR study program and other studies will result in the development of what has been designated the MILDATA system, which will eventually replace the Army's present FIELDATA system.

The NCR study program will develop and determine the suitability of advanced computer concepts applicable to the Army's Command Control Information System of that future period. This program is bringing about many new electronic approaches to tactical operations control, fire control, intelligence, and logistics.
(For more information, circle 30 on the Readers Service Card.)

CONTRACT FOR PRODUCTION OF META-ASSEMBLY PROGRAM

Programmatics Incorporated, Palos Verdes Estates, Calif., has been awarded a contract by Scientific Data Systems Inc. involving the production of an advanced programming language processor called a "meta-assembly program". The current award calls for the production of assembly systems for the SDS 920 and SDS 9300 computers, including one to generate 9300 programs on the 920.

The function of a meta-assembly program is to produce conventional symbolic assembly programs. David E. Ferguson, president of Programmatics and developer of the meta-assembly concept, said that in less than a day Programmatics can change a meta-assembler into an assembler for a new computer. The process involves writing the assembler's description in the meta-language.
(For more information, circle 31 on the Readers Service Card.)

UNIVAC ORDERS HIGH SPEED ELECTRONIC DATA PRINTERS

A contract for high speed electronic data printers has been awarded to SCM Corporation, New York, N.Y., by the Univac Division of Sperry Rand Corporation. The machines will be used as remote strip printers. They will handle output data from Univac computers in the Federal Aviation Agency's new air traffic control centers in Washington, Indianapolis, Cleveland, and Boston. The initial installation of the SCM printers (Model 311) will be made at the Washington air route traffic control center, Leesburg, Va.
(For more information, circle 32 on the Readers Service Card.)

TRW AWARDED FOLLOW-ON CONTRACT BY AIR FORCE SYSTEMS COMMAND

The Electronic Systems Division, Air Force Systems Command, has awarded a fixed-price $1 million follow-on contract to TRW's Computer Division, Canoga Park, Calif., to fabricate highly advanced man-machine communication equipment for use in three major USAF commands. They are the Hq., USAF; Hq., Military Air Transport Service, Scott AFB, Ill.; and Hq., Tactical Air Command, Langley AFB, Va.

The contract calls for five TRW Computer Communication Consoles (CCC) and two TRW-88 Projection Units. Two CCC's and one projection unit will be supplied to Hq. MATS and Hq. TAC; and one TRW-88 projection unit to each of the major command Hq's. Under the initial contract, TRW supplied two CCC's, presently in use in the 473L system at the USAF Headquarters Command Post.
(For more information, circle 33 on the Readers Service Card.)

ENGLISH COMPANY ORDERS $1½ MILLION OF TAPE MEMORY SYSTEMS

Ampex Corporation, Redwood City, Calif., has received an order amounting to more than $1½ million for tape memory systems from English Electric-Leo Computers Ltd., London. The recording equipment includes Ampex TM-2100 and TM-4100 tape memory systems for use in standard and high-speed Leo III computers. The equipment will be partially manufactured at Ampex facilities in Culver City, Calif., and will be finally assembled by Ampex Electronics, Ltd., subsidiary of the corporation in Reading, England.
(For more information, circle 34 on the Readers Service Card.)

EXTENSION TO BURROUGHS ON U.S. AIR FORCE CONTRACT

Burroughs Corporation, Detroit, Mich., has been given an extension on an existing U.S. Air Force contract to provide 17 additional D825 electronic modular data processing systems at a cost of $12½ million. The systems are for the Air Force Back-Up Interceptor Control (BUIC) program. The extension increases the total contract to $37,015,000 and the number of D825 systems to 34. The initial contract was granted Burroughs Corporation in October, 1962. BUIC will provide emergency back-up control capabilities to the SAGE continental air defense system.
(For more information, circle 35 on the Readers Service Card.)

AUERBACH NAMED RELIABILITY CONTRACTOR FOR AUTODIN PROGRAM

The Defense Communications Agency (DCA) has awarded a $224,000 contract to the Auerbach Corporation, Philadelphia, Pa., for reliability-engineering services in the AUTODIN program. The contract designates the company as Reliability Contractor for AUTODIN (Defense Communications System Automatic Digital Network), a modern data-communications network being implemented to link U.S. forces throughout the world.

As reliability contractor to the DCA, Auerbach will be responsible for the reliability aspects of AUTODIN switching centers overseas and in the continental U.S. This work will encompass both the hardware and software required to perform the switching and interface functions of the AUTODIN network. The work will be carried out at the company's headquarters in Philadelphia and its technical facility in Arlingtaon, Virginia.
(For more information, circle 36 on the Readers Service Card.)

CONSULTING SERVICES CONTRACT

A contract from the Space and Information Systems of North American Aviation has been awarded to

Informatics Inc., Culver City, Calif., for consulting services in support of the computer-centered checkout systems for the Saturn State II booster rocket under design by North American Aviation for NASA.

Informatics Inc. personnel will assist in the design of the digital computer programming system that provides control for an intricate array of test equipment. (For more information, circle 39 on the Readers Service Card.)

AUTOMATIC ELECTRIC RECEIVES $17 MILLION CONTRACT FROM U.S. AIR FORCE

A $17 million U.S. Air Force contract has been awarded to Automatic Electric Company, manufacturing subsidiary of General Telephone and Electronics Corporation. The award was made following a formally advertised procurement by the Air Force's Electronic Systems Division, which is administering the program for the Defense Communications Agency (DCA).

The contract calls for the ultimate establishment of a series of switching centers throughout the world. It is part of a project designated "490L", which will provide a "modernized, global, compatible defense communications system fully responsive to government communications requirements under cold war, limited war, and general war conditions".

The switching centers to be developed for the communications system employ advanced electronic techniques and components. The centers will be located in three network areas -- European-Mediterranean, Pacific, and Caribbean. Initial plans provide for installation of 23 switching centers in 15 countries. They will be capable of interconnecting with all existing military and commercial telephone networks. The system is capable of future adaptation to add the "broadband" channels required for data transmission. (For more information, circle 75 on the Readers Service Card.)

OMEGA CONTRACT EXTENSION IN EXCESS OF $1 MILLION

Technical Operations Research, Burlington, Mass., has been awarded a contract extension in excess of one million dollars for OMEGA (Operations Model Evaluation Group Air Force). The new contract, extending the technical assistance which Tech/Ops has been providing to the Air Force Air Battle Analysis Center since 1957, provides for continued development and applications of operations research and computer techniques for the study of global air war. The Tech/Ops OMEGA technical group is located in Washington, D.C. and comprises a 40-man staff, headed by John A. Pond, Director. (For more information, circle 38 on the Readers Service Card.)

COMPUTER PROGRAMMING CONTRACT

Computer Sciences Corporation, El Segundo, Calif., has received a major contract for computer programming support from the Lockheed Missiles and Space Company, Sunnyvale, Calif.

Computer programming will be accomplished by CSC for such large scale equipment as the IBM 7090/7094 computers. Programs will be part of an Automatic Data Accumulation system for Lockheed's Sunnyvale facilities. (For more information, circle 40 on the Readers Service Card.)

OAKLAND BANK PLANS $500,000 EDP CENTER

Central Valley National Bank, Oakland, Calif., has started on an extensive automation program with the ordering of a $500,000 computer system under a lease-purchase agreement with National Cash Register Company. Installation of the new equipment is expected by mid-1964. Commercial deposit accounting for the bank's offices in central and northern California will be "phased in".

The bank will establish a new EDP Center in Oakland, where the computer, an NCR 315 with CRAM (Card Random Access Memory) units, will also process payroll, mortgage service, money order, and general ledger items. (For more information, circle 41 on the Readers Service Card.)

USN AWARDS $14.2 MILLION CONTRACT TO SPERRY FOR INERTIAL NAVIGATORS

Sperry Gyroscope Company, a division of Sperry Rand Corp., Great Neck, N.Y., has received a $14.2 million award from the U.S. Navy for production of new Ship's Inertial Navigation Systems (SINS) for attack submarines, aircraft carriers and a missile tracking ship. A SINS will go aboard each of 21 vessels.

The equipment will be able to measure with increased precision and reliability the changing positions of the ships as they cruise on, or under, the surface of the sea. SINS senses and measures every turn and movement from the speed of the ships to the rotation of the earth over which they sail. (For more information, circle 42 on the Readers Service Card.)

METROPOLITAN LIFE CONTRACTS FOR DATA COMMUNICATIONS SYSTEM

Metropolitan Life Insurance Company, New York, N.Y., has contracted for the development of a data communications system which will eventually link its headquarters with more than 800 district offices. The contemplated system is expected to consist of a centrally-located Honeywell 1800 computer and a communications console located in each district office.

-- Multi-purpose console. Honeywell secretary Freda Tomaris examines a model of the Metropolitan Life Insurance Company's district office data communications console. Consoles similar to the above will be installed by Metropolitan Life at each of its more than 800 district offices.

The data communications console located in a district office, will be the key element in the system. It will be equipped with an optical scanning unit capable of reading premium notices and will automatically transmit the data over long distance telephone lines to the central Honeywell 1800 system.

The data communications system is being developed by Honey-

well Electronic Data Processing, Wellesley Hills, Mass.
(For more information, circle 43 on the Readers Service Card.)

CONTRACT FOR LARGE COMPUTING SYSTEM

A contract for one of the largest single commercial computer systems ever installed has been received by the Univac Division of Sperry Rand Corporation from The Travelers Insurance Companies of Hartford, Conn. The Travelers is purchasing multiple Univac 490 Real-Time computers, which will be the heart of a system for additional data processing operations in a new center planned for downtown Hartford. The new Univac system will be used to process casualty and fire insurance.

The new installation will be a message-handling as well as a data-processing system, and will be installed over a period of several years. Eventually all Travelers' reporting offices will be connected to the computer site.
(For more information, circle 44 on the Readers Service Card.)

COLLINS RADIO ORDERS 16 MORE DISC FILES

Bryant Computer Products, Walled Lake, Mich., has received a $1 million follow-on contract from the Communications and Data Systems Division of Collins Radio Company for the purchase of sixteen Series 4080B Disc Files. All sixteen files will be used in conjunction with Collins' C-8400 Communications and Data Processing System.
(For more information, circle 45 on the Readers Service Card.)

NEW INSTALLATIONS

BANK OF AMERICA TO INSTALL BURROUGHS B200'S

The Bank of America has ordered four B200 electronic data processing systems from the Burroughs Corporation. Two of the systems are to be installed at the Bank of America in San Francisco, Calif., while the other two will be installed in bank facilities in Los Angeles, Calif. Each of the computer systems includes a central processor, document sorter-reader, a card reader and a card punch, and a six-tape listing printer. The systems will be used in bank transit applications.
(For more information, circle 46 on the Readers Service Card.)

DRESS MANUFACTURER INSTALLS UNIVAC PROCESSOR

Kay Windsor. Inc., New Bedford, Mass., a volume manufacturer of dresses in the popular price range, has installed a UNIVAC 1004 Card Processor at its New Bedford headquarters. It will be used to enable the company to keep ahead of the fast changing trends in the dress business (forecasting) as well as for business accounting functions.
(For more information, circle 47 on the Readers Service Card.)

"ON-LINE" COMPUTER SYSTEM PLANNED BY DAYTON BANK

Citizens Federal Savings & Loan Association, Dayton, Ohio, has announced plans to install an "on-line" electronic computer system. The system, an NCR 315 computer system, will be installed early in 1965. It is capable of handling over 10,000 transactions an hour. In addition to processing savings and mortgage loan accounts, the computer system will also provide daily, monthly, quarterly, and annual financial reports.
(For more information, circle 48 on the Readers Service Card.)

ITT 7300 ADX INSTALLED AT MARSHALL SPACE FLIGHT CENTER

A high speed automatic data switching system has been installed at the National Aeronautics and Space Administration Marshall Space Flight Center (MSFC), Huntsville, Alabama. The central feature of the data switching system is an ITT 7300 ADX Automatic Data Exchange System supplied by the ITT Corporation's Data and Information Systems Division, Paramus, N.J.

The ITT 7300 ADX machine will act as a traffic director for the huge volume of information and data that is processed at Huntsville in support of the nation's space flight activities. Initially activities will be confined to operations in Huntsville, but it is anticipated that the ADX System later will handle switching of traffic to and from other NASA installations.
(For more information, circle 49 on the Readers Service Card.)

ORGANIZATION NEWS

AUDIO DEVICES, INC. PURCHASES ASSETS OF SOUND CORPORATION OF AMERICA

Audio Devices, Inc., Stamford, Conn., has concluded arrangements to buy the assets of Sound Corporation of America, Worcester, Mass. Stockholders of Sound Corporation have approved the purchase. All facilities of the former company will be moved to the magnetic tape plant in Stamford, Conn. The former company were producers of endless-loop cartridges, transports, and playback units. Audio Devices, Inc. is a major manufacturer of magnetic recording tapes.
(For more information, circle 50 on the Readers Service Card.)

NEW NAME CHOSEN

The name "Orchard-Hays & Company, Inc." has been chosen as the new name for the organization formerly known as Systems Programming Incorporated of Arlington, Va. William Orchard-Hays is president of the organization; he explained that the objective of the change was to give the organization a more distinctive name at a time when an increasing number of new companies with closely similar names are entering the computing and data processing fields.

Orchard-Hays & Company provides a wide range of specialized services in computer software for linear programming, statistical analysis, mathematical problems, and the development of specialized compilers, assemblers, and other processors.
(For more information, circle 51 on the Readers Service Card.)

Newsletter

COMPUTING CENTERS

CPM DATA PROCESSING SERVICE OFFERED BY MAUCHLY ASSOCIATES

A new low-cost Critical-Path-Method data-processing service has been announced by Mauchly Associates, Inc., Fort Washington, Pa., which will enable engineers and project managers to utilize certain proprietary computer programs. The service is available to those engineers able to generate their own CPM schedules and arrow diagrams. Mauchly Associates have supervised the planning and scheduling of over 2 billion dollars in construction projects.

Mauchly's computer center, Fort Washington, Pa., can supply services for Critical-Path Method (CPM), Resources Planning and Scheduling Method (RPSM), and Minimum-Cost Expediting (MCX).

For Normal-Time CPM work, the data processing service is offered at 20 cents per arrow with a minimum charge of $25. A person using the service completes forms provided by Mauchly Associates, and receives by return mail six copies of each of two computer listings based on the Normal-Time CPM solution. The first list (an i, j sort) arranges jobs in the ascending order of their identifying numbers. The second list (an early-start, total-float sort) presents jobs chronologically. Persons who know how to apply CPM can now process their scheduling data on the most advanced computer programs available at the Mauchly Computation Center. The center will be staffed by professionals in EDP and network analysis with experience in the maintenance and construction fields.
(For more information, circle 52 on the Readers Service Card.)

BANK-OWNED EDP COOPERATIVE

Five small northwestern Ohio banks have joined to form a bank-owned electronic data processing cooperative. Incorporated under revisions to the National Banking Act and the Banking Laws of Ohio, the complete stock of the Financial Computer Services, Inc., is owned by the member banks. The five member banks, with combined assets of $75 million, are Croghan Colonial Bank of Fremont, Tri-County National Bank of Fostoria, Union Bank & Savings Co. and First National Bank of Bellevue, and Bowling Green Banking Co. of Bowling Green.

Both the equipment and the center will be leased. Operating expenses will be shared in proportion to the number of hours each bank uses the center's facilities.

A $50,000 data processing center is under construction in Fremont, Ohio. A Burroughs B270 financial computer system is scheduled to be installed in February 1964. The system includes the B270 central processor, 1560 item-per-minute sorter, 700 line-per-minute printer, 200 card-per-minute reader, and three high-speed magnetic-tape units.

The center will operate a daily pick-up and delivery service for each bank (all are within a 30-mile radius of the center).

Services of the data processing center will be offered on a service fee basis to businesses which are customers of the member banks, thereby defraying part of the cost of the center.
(For more information, circle 53 on the Readers Service Card.)

EDUCATION NEWS

LINK 727 SIMULATOR TO BE USED IN FLIGHT TRAINING SCHOOL

Eastern Air Lines has accepted the Link 727 Simulator for use at their flight training school in Miami, Florida. The Link 727, manufactured by Link Division-Simulation & Control Group, General Precision, Inc., has complete digital computation. It duplicates every flight aspect of the Boeing 727 tri-engine jets.

Approximately six hundred of Eastern's veteran airline crewmen will be trained in the simulator. From engine start to cutoff, practically all sounds and sensations associated with actual flight will be experienced. The crew will sit in an exact replica of a Boeing 727 cabin, operate the controls, and perceive the corresponding changes of instruments and aircraft attitude. The instructor can introduce emergency situations and check the student's ability to make the necessary adjustments.

A vital part of the 727 Simulator is the Mark I digital computer which contains a memory drum that has recorded on it all Boeing 727 performance characteristics. Each control movement within the cabin is interpreted by Link's Mark I and the proper instrument readings and aircraft attitudes are introduced into the simulator. Navigation problems can be flown using the three hundred and fifty radio facilities programmed into the computer.
(For more information, circle 54 on the Readers Service Card.)

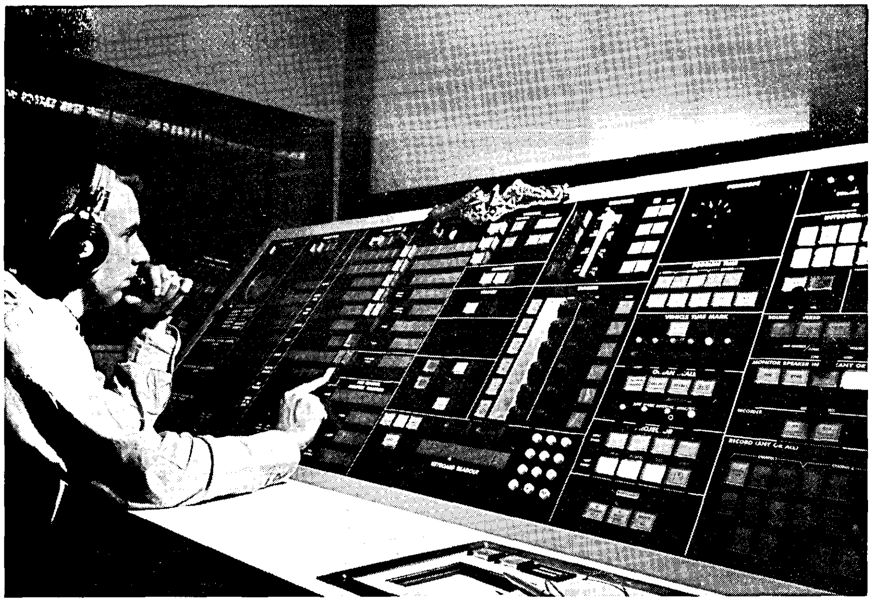
BUSINESS COMPUTER HELPS TRAIN POLARIS SUB CREWS

A business computer has been applied to wage imaginary sea battles on dry land with the U.S. Navy's Polaris submarines. The computer, a Honeywell 800, is located at the U.S. Naval Base, Fleet Ballistic Missile (FBM) Submarine Training Center, Charleston, S.C. The training center has been established to provide operational, refresher, and precommissioning training to submarine "off crews". Within the center, all offensive and defensive weapon systems and communication systems aboard an SSBN 616 class submarine are simulated or duplicated.

The submarine attack center is one of the major sections of this new training facility; it is used to train crews in defensive torpedo tactics. The Honeywell 800 is the heart of the attack center. Within its memory are stored and classified all pertinent characteristics of: (1) an SSBN 616 class submarine; (2) the great variety of conventional and nuclear weapons at the submarine's disposal; and (3) a number of imaginary but possible targets, including other submarines, freighters, destroyers, cruisers and aircraft carriers.

The computer is connected through distribution, multiplexing, and real-time control units to the attack center, where the crew is trained, and to the program operator's (instructor's) room. That contains a program operator's console and a problem critique and evaluation screen.

The program operator establishes the problem to be solved.



-- Program operator's console enables instructor to tell Honeywell 800 computer which vehicles will be used to train attack center crew. Critique and evaluation screen in background records all vehicle movements.

By punching buttons on his console, he tells the H-800 which vehicles will be used, where they are on the "ocean", and the initial movement of "own ship" and "targets". From then on, the program operator controls the movements of own ship according to orders received from the crew commander (approach officer) and controls the movements of targets according to the problem the crew is trying to solve.

The program operator can simultaneously control up to six targets, which may travel independently or in convoy. Information on the movement of all vehicles through the water is projected under the control of the computer on the critique and evaluation screen. At the end of a problem, all maneuvers have been recorded in color, for review by approach officer, crew, and program operator. The training system can conduct problems on any of four different ocean scales: 8 x 16 miles; 32 x 64 miles; 128 x 256 miles; or 511 x 1023 miles.

Training devices such as the attack center enable officers and men of the Polaris missile-launching submarines to maintain their readiness by conducting more frequent and complete practice sessions than they can aboard ship.
(For more information, circle 55 on the Readers Service Card.)

NEW PRODUCTS

Digital

NEW B200 PROCESSOR

Burroughs Corporation, Detroit, Mich., has announced more powerful central processors for punched card and magnetic tape computers in its B200 series. The new Burroughs B200 processors have a 43% faster clock rate than standard B200 processors and cut down on the time required for memory cycle -- from the standard ten microseconds to seven in the new equipment. The new equipment will be available with either 4800 or 9600 characters of memory. Software designed specifically for the new processors will be available when first deliveries begin in February 1964.
(For more information, circle 56 on the Readers Service Card.)

Data Collection

DATA SYSTEMS ASSEMBLED FROM 12 BASIC LOGIC CARDS

Digital data systems of the new 2000 Series are being assembled for industrial applications from standard components by Fischer & Porter Company, Warminster, Pa. The twelve basic logic cards involved, can be combined in logical arrangements for a wide range of specific industrial needs.

Basic design of the 2000 Series systems permits the selection of as many as 999 inputs without modification. Other functions can be expanded in the field to meet subsequent needs for increased logging, scanning, or alarming capacity.

The new systems' typical performance characteristics include an accuracy of ±0.1 per cent of 40mv; readouts in engineering units with up to 4 decimal digits resolution; speed of 100 points per second (or limited by the readout device); and a temperature limitation of 135°F ambient.
(For more information, circle 57 on the Readers Service Card.)

Information Retrieval

BANKING SYSTEM USING NEW CHECK SORTING APPROACH

A low-cost electronic banking system, with a new approach to magnetic ink check sorting, has been announced by IBM Corp., White Plains, N.Y. The new IBM 1240 bank data processing system controls document sorting by a series of instructions programmed in the computer. It offers the same Magnetic Ink Character Recognition (MICR) and remote-teller terminal capabilities that up to now have been practicable only for larger banks.

To lower the cost of installation and operation of the 1240, a number of specialized banking programs have been developed. These are available from IBM at no charge to users of the new system. This support includes programs for demand deposit accounting, mortgage loan and savings accounting, as well as the document sort program.
(For more information, circle 58 on the Readers Service Card.)

Newsletter

Software

PROGRAM FOR SIMULATION OF STEEL MILLS, RAILROADS, COMPUTER SYSTEMS, ETC.

New techniques for simulating "real-life" processes and systems within a computer have been outlined by IBM Corporation. Simulation, a method of mathematically representing the operation of anything from a steel mill to another computer, allows the testing of the facilities before they are built.

A new computer program, the IBM 7090 General Purpose Systems Simulator II, enables engineers to: (1) simulate the flow of raw metal, and its accompanying paperwork, through a steel mill; (2) vary traffic conditions on a mathematical model of a highway network; and (3) evaluate a proposed quality control procedure for a manufacturing company. The GPSS II program also can simulate such systems as railroads, communication networks, checkout counters and mail order procedures.

GPSS II, designed for use by working engineers, requires no knowledge of computer programming. The engineer's block diagram of the system to be simulated is the key to its use. The block diagram information is punched into cards and loaded together with the GPSS II series of instructions, into the computer. Under control of these instructions, the computer creates within its magnetic core memory a numeric model of the system. Specifications of the system to be simulated, including capacity, traffic flow and other data, are provided by the user in his block diagram.

The General Purpose Systems Simulator II is available without charge to users of the IBM 7090, 7094, and 7094 II data processing systems.
(For more information, circle 59 on the Readers Service Card.)

PROGRAM FOR CONTROLLING OPERATIONS OF MACHINE TOOLS

General Electric's Computer Department, Phoenix, Ariz., has developed a new computer program for controlling operations of machine tools. The new program, known as GE-ADAPT, permits the GE-200 line of medium-range computers to prepare perforated tapes for automatically controlling such machine tools as drills, presses and horizontal mills.

Basically, GE-ADAPT comprises two parts; the main processor and the post processor. The main processor translates required machine tool operations into computer language. It also provides a variety of checks, performs geometric calculations, and prepares a magnetic tape link for the post processor. The post processor translates computer-oriented language into codes for operating a specific machine tool, provides accuracy checks, and prepares perforated tapes for controlling movements of the machine tool.

GE-ADAPT can be used to prepare control tapes for two- and three-axis, two-dimensional position tools; two-dimensional continuous-path tools; and a limited number of three-dimensional continuous-path tools.

GE-ADAPT is a simplified version of APT (Automatic Programmed Tools), developed four years ago for use with large-scale computers. Under Air Force direction, ADAPT was developed to permit use of medium-scale computers.
(For more information, circle 60 on the Readers Service Card.)

COMPUTER PLANNING AIDED BY NEW HONEYWELL SOFTWARE

A new software package, developed by Honeywell EDP, Wellesley Hills, Mass., can accurately and automatically determine time, equipment, and manpower requirements for specific electronic data processing applications. The package is comprised of the AUTOTIMER and COMPACT programs, and is available to all Honeywell EDP customers as an aid in planning new computer installations or new applications for existing installations. Although both programs are designed to run only on Honeywell 400 or 1400 computers, they can be used to plan any EDP installation -- whether produced by Honeywell or any of its competitors.

AUTOTIMER performs all computational tasks associated with timing a given job; it works from an input of English-language statements. The program can produce complete estimates for a job of about 200 computer runs in less than 10 minutes. AUTOTIMER eliminates the manual computation involved in timing computer runs, provides a simple means of investigating many alternative techniques and equipment, and produces a concise printed report for evaluation and documentation of proposed system configurations.

COMPACT is a PERT-like program designed to aid a customer in planning his installation. Input consists of the various system considerations pertinent to installing a computer, including: system design, programming and testing; the number of programmers assigned; their experience; the complexity of various programs; and the number of days in the work week. Like PERT, COMPACT allows frequent status reports and can adjust a projected schedule on the basis of actual achievement.
(For more information, circle 61 on the Readers Service Card.)

LINEAR PROGRAMMING BEING DEVELOPED FOR HONEYWELL 1800

Honeywell Electronic Data Processing, Wellesley Hills, Mass., is developing a linear programming package for use with large scale Honeywell 800 and 1800 data processing systems. The new package is capable of handling up to 700 constraints and an unlimited number of variables on Honeywell 800 or 1800 computers with a minimum of 16,000 words of memory. With a 32,000 word memory, the new linear programming system can handle up to 1000 constraints.

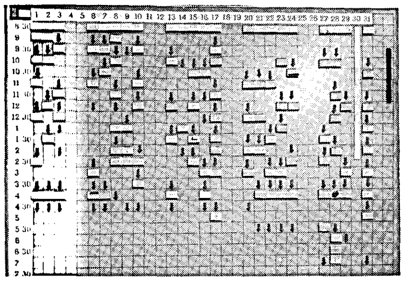
The package uses a Simplex Algorithm method of problem solution. Control is accomplished by means of cards which permit the user to control the sequence and number of tasks to be performed.

The minimum configuration for using the system is a central processor with 16,000 words of memory, six magnetic tape drives, floating-point arithmetic, a card reader, a printer and programmed clock.
(For more information, circle 62 on the Readers Service Card.)

MAGNETIC SCHEDULING BOARD

A manual non-computer magnetic scheduling device for computer control has been produced by the Methods Research Corp., Staten Island, New York.

The picture below shows an actual installation of the Magnetic Scheduling Board in a research company in New Jersey. This board visually controls a computer for a thirty-one day



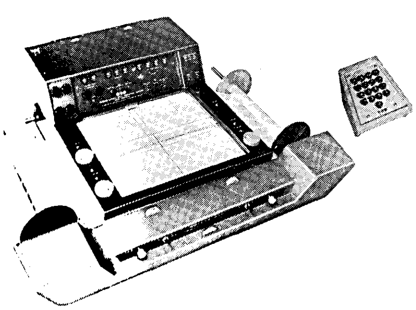
period, on a one-half hour scheduling cycle. In other cases, the scheduling cycle may be in quarter hours or tenths of an hour.

The board markers are all magnetic. Changes can be made with ease and the whole future schedule can be seen at a glance. (For more information, circle 63 on the Readers Service Card.)

Input-Output

NEW DIGITAL DATA REDUCTION SYSTEM

A new 3-digit readout, digital data reduction system, introduced by the Gerber Scientific Instrument Co., South Windsor, Conn., has been designed for easy operation in reducing large or small quantities of recorded data. With relatively little training, an unskilled operator can reduce X-Y data to point-to-point digital form at the rate of many thousands of tabulations per day. Full rated machine speed is in excess of 10,000 tabulations per day.

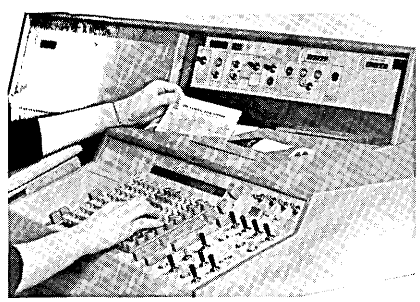


Almost any kind of oscillogram, graph, drawing, or other chart material can be read quickly and easily using the new Gerber Model GDDRS-3B. Output may be typewriter keypunch, paper tape punch, flexowriter, adding machine, and plotters.

The new X-Y data reduction system consists of four basic components: scanner, reading head, keyboard, and power supply. All controls are within easy reach of the operator. Material is read by manually positioning two hairlines. Visual readout is shown via digital display. Printing is performed on pushbutton command. A separate keyboard allows insertion of additional information at will, such as code instructions. (For more information, circle 64 on the Readers Service Card.)

MICR ALL-FIELD ENCODER

A multi-purpose magnetic-ink encoding machine has been designed, by the National Cash Register Company, Dayton, Ohio, to prepare documents for bank automation systems. The machine provides for magnetic imprinting of all coded fields of checks and other bank items -- it can replace two or three separate machines now used by banks for magnetic encoding.



New NCR 481 "All-Field Encoder" imprints magnetic characters, endorsements on documents for bank automation.

The MICR All-Field Encoder, Class 481, machine can encode in any combination of all four check fields -- serial number, account number, amount, and routing.

It has been designed to tie in with computer-controlled distribution techniques. Standard features include consecutive-number audit trail, correction of errors through a single key, synchronized signal lights for the operator, and a special electrical keyboard for modification of the document encoding.
(For more information, circle 65 on the Readers Service Card.)

READ/PUNCH UNIT FOR USE WITH UNIVAC 1004

A new Read/Punch Unit for use with the UNIVAC 1004 Card Processor (see Computers and Automation, September, 1962) has been announced by the Univac Division of Sperry Rand Corp., New York, N.Y. The new device reads standard 80 or 90 column punched cards and punches additional data into the same cards at the rate of 200 cards per minute. Control of the new unit is maintained through the plug board of the 1004 Processor.

Card reading and punching performed by the UNIVAC 1004 Read/Punch Unit completely overlaps reading, processing and printing operations in the processor. Simultaneity enables the two units to complete more work in less time than can be turned out by many other larger, more costly systems. Both reading and punching are automatically verified by a weighted hole-count check feature at the post-punch station. Error cards are automatically segregated to the Select Stacker. The Processor can be halted upon the detection of an error if the operator so chooses.

Existing 1004 installations do not have to be reprogrammed for the addition of a UNIVAC Read/Punch Unit.
(For more information, circle 66 on the Readers Service Card.)

BC124 CARD READER

A new high-speed card reader has been developed by Burroughs Corporation, Detroit, Mich. The new solid-state reader, designated the Burroughs BC124, has a maximum demand feed rate of 800 cards per minute, serial photoelectric reading of card columns, and the ability to handle 51-, 60-, 66- and 80-column cards.

The input hopper and the output stacker each have capacities of 2400 cards, which may be added or removed without interrupting operation. During an eight-hour day, the potential capacity of the unit is 384,000 cards.

Read circuitry is automatically monitored on every column and between card cycles, with complete margin checking. Invalid characters can be detected during card reading, and under operator control.

The BC124 will process intermixed standard and post-card

thickness card stock. It also will process binary punched or card image cards.
(For more information, circle 67 on the Readers Service Card.)

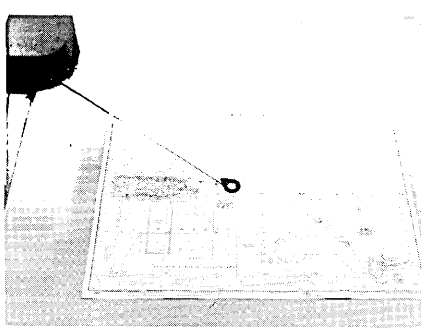
OPTICAL SCANNER SPEEDS HANDLING OF CREDIT CARD SALES

IBM Corporation, White Plains, N.Y., has announced a new optical scanner for accurate accounting of the rising volume of credit-card sales -- more than one billion sales annually in the petroleum field alone. The new device, known as the IBM 1282 optical-reader card punch, was developed for use in any business area utilizing credit cards.

The 1282 can "sense" marks made by hand as well as imprinted information. It automatically punches this information into cards for use in high-speed data processing. Both hand-entered marks and imprinted information are sensed and punched in a single pass through the machine. With the 1282 working as part of a computer or punched-card system, the credit-card sales form becomes the punched card for automatic data processing.
(For more information, circle 68 on the Readers Service Card.)

INFOTRACER

A new electronic tracing device for inserting graphic data into data processing and display systems has been introduced by Temco Electronics Display Systems Plant of Ling-Temco-Vought, Inc., Dallas, Texas. It is called Infotracer and allows unskilled operators to introduce such source material as maps, drawings, photographs, or other graphic information, into computing and display systems.



Graphic data such as a map is transformed into suitable form for presentation by tracing the contour lines of the source material with the Infotracer. Potentiometers within the device measure the displacement of its head and transform the data into X and Y axes analog voltages. These voltages are introduced to suitable electronic display systems for large-scale display or for remote reproduction. Accuracies of ±0.15% of full scale are achieved.

The complete unit consists of the Transducer Head and a Control Unit. The Transducer Head can be mounted on any suitable flat surface. The Control Unit can be mounted either adjacent to the tracing surface or separately up to a distance of several feet. The standard Infotracer has a 30 x 30-inch tracing area.
(For more information, circle 69 on the Readers Service Card.)

PHOTO-ELECTRIC READER FOR SQUARE-HOLE PAPER TAPE

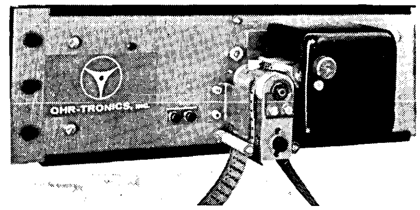
A high speed, bi-directional, photo-electric perforated-tape reader has been developed by the Digitronics Corp., Albertson, N.Y. It is designed to read 6-level square-hole paper tape.

The new reader, Model OB3500, has two read stations built into the machine. These are one character apart; so the tape may be read at the first station, then re-read one character later at the second station, and thus a 100% accuracy check can be made by the user.

The all-solid-state Model OB3500 operates usually at a speed of 50 inches per second. At this speed, the stop distance is .030". The reader can be supplied at any speed from 5 inches per second to 100 inches per second.
(For more information, circle 70 on the Readers Service Card.)

PAPER TAPE READER, MODEL 119

Ohr-Tronics, Inc., New York, N.Y., has announced a new paper tape reader, Model 119, which reads up to 8-channel paper-tape bi-directionally, at a speed of 30 cps. Sensing of the holes is accomplished by the use of star wheels. When a star wheel enters the hole, an arm carrying the star wheel closes a switch. Bounce time of the sensing switch is well under a millisecond. Two electromagnets are used for stepping the tape in either direction. Available voltages are 24, 48 and 90 V.D.C. Coils are designed for continuous duty and are arc-suppressed with zener diodes. An



interrupter switch is provided to protect the star wheel sensing switches and also for self-stepping of the tape.
(For more information, circle 71 on the Readers Service Card.)

Components

GENERAL-PURPOSE TEST INSTRUMENT FOR QUICK AND EASY FAULT ISOLATION

Engineers at the National Bureau of Standards (U.S. Department of Commerce), Washington, D.C., have developed FIST (Fault Isolation by Semi-Automatic Techniques), a troubleshooting system. The system has been devised for testing modularized electronic equipment to isolate faulty modules without removing them.

The system consists of a small (1/5 of a cubic foot), hand-carried, general-purpose test instrument together with the special circuits and receptacles built in as part of the prime equipment being tested. The test instrument has a red light, a green light, a test plug on a cord, and a self-test receptacle; it includes four voltage comparators and logic circuitry. The operator can check tester operation at any time by plugging it into its self-test receptacle.

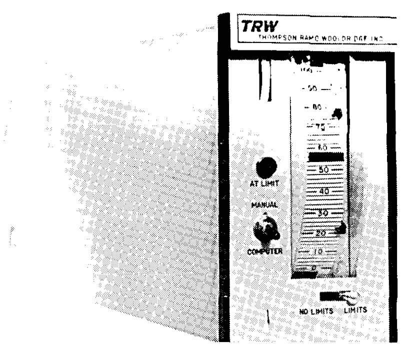
In use, the test set gives a green (good) or red (bad) indication when plugged into each test receptacle at which a test is possible. The module is within tolerance if a good indication is obtained. If neither indicator lights -- the no-test response -- this indicates that all needed inputs are not present at the module.

The operator can test the modules in any order with a uniform simple procedure for all types of tests. The operator needs no skill or training to identify and replace the failed module.

Now being applied to a naval radar equipment, the system promises, when more widely adopted, to have far-reaching consequences in training and procedures used for maintaining electronic equipment. The greatest impact of the FIST troubleshooting system is expected to be in alleviating the shortage of capable electronic technicians, by enabling unskilled personnel to do many of the required tasks. (For more information, circle 72 on the Readers Service Card.)

COMPUTER CONTROL SET STATION

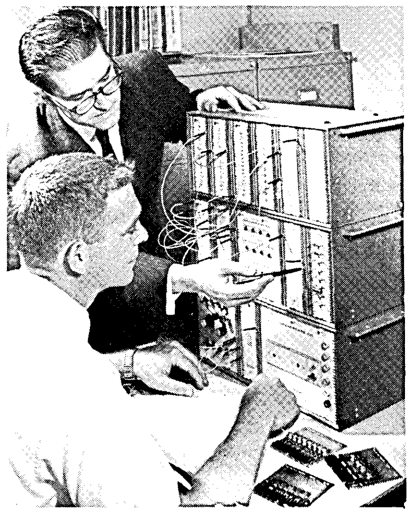
TRW Computer Division, Thompson Ramo Wooldridge Inc., Canoga Park, Calif., has developed a new instrument for the process industries -- a Computer Control Set Station. The Set Station was developed to enable TRW industrial computer customers to integrate their present instrumentation with their computer systems. It is compatible with all existing electronic or pneumatic instrumentation.



Direct digital control of valves can be accomplished by connecting the output of the Set Station directly to a control valve through appropriate transducer or positioner elements. The TRW Set Station also has manual or computer overrides, illuminated indication of computer mode, illuminated indication of hi-lo limit actuation, mechanical hi-lo limit stops, and bumpless control under operating conditions. (For more information, circle 73 on the Readers Service Card.)

DIGITAL CIRCUIT BREADBOARD AND TRAINING KIT

A new Breadboard and Training Kit, designated MBK1, is now available from Packard Bell Computer, Los Angeles, Calif. It consists of an indicator panel, signal generator, power supply, and module sections and adapters. As many as eighteen digital circuit modules can be connected and operated simultaneously (sections holding six modules each can be added as desired). MBK1's design permits interconnection of digital modules for circuit evaluation without a soldering iron or oscilloscope.



-- MBK1, rack-mounted or table top digital module Breadboard and Training Kit.

The Breadboard Kit aids design engineers in developing and checking out small digital systems and sub-systems. It is also useful for classroom instruction, laboratory testing of digital equipment and breadboarding test circuits. (For more information, circle 74 on the Readers Service Card.)

PEOPLE OF NOTE

BABCOCK ELECTED SHARE VP

James D. Babcock of The RAND Corporation, Santa Monica, Calif., recently was elected Vice President of SHARE in Miami Beach, Florida. SHARE is an international organization for the cooperative pooling of computer programming techniques, representing over 200 companies and government agencies engaged in scientific and commercial data processing using IBM high-speed digital computers. Mr. Babcock is head of programming systems in the Computer Sciences Department at RAND.

UNIVAC VICE PRESIDENT, FINANCE AND ADMINISTRATION

Fred R. Raach was named Vice President - Finance and Administration, a new post, in an announcement made by Dr. Louis T. Rader, president of the UNIVAC Division of Sperry Rand Corporation. Formerly, Mr. Raach was Vice President - East Coast operations for Robert Heller & Associates, management consultants. In his new position, his responsibilities include international operations, accounting, personnel, labor relations, business planning and patents and licensing.

COMPUTER SCIENTIST JOINS BOEING

Dr. Clarence Ross has joined The Boeing Company's Aero-Space Division, Seattle, Wash. Dr. Ross will serve as coordinator of division computer programs, advising management on best utilization of its computer facilities. He was formerly with the Systems Research Laboratories of Dayton, Ohio, where he directed research programs for the U.S. Air Force in digital computers and computer techniques.

R. E. McDONALD NAMED VICE PRESIDENT, GENERAL MANAGER

R. E. McDonald, General Manager of UNIVAC Operations, St. Paul, Minn., has been named a vice president of the UNIVAC Division of Sperry Rand Corporation.

Mr. McDonald joined Engineering Research Associates, St. Paul, in 1953 (acquired by UNIVAC in the same year) as director of manufacturing. He was named general manager of St. Paul Operations in 1956, and in 1959, also assumed the post of general manager of the Military Department.

As Vice President and General Manager, UNIVAC Operations, he will continue as chief operating officer of UNIVAC's research, development, and production facilities in the Twin Cities area and will assume added responsibilities with respect to overall UNIVAC objectives.

EDWARD SEAMAN ELECTED VICE PRESIDENT

Memorex Corporation, Santa Clara, Calif., (manufacturers of precision magnetic tapes) has elected Edward S. Seaman as Vice President, Sales. Mr. Seaman, as national sales manager, was responsible for organization of the direct field sales force and introduction and sales of the tape products. In 14 months of selling activity, Memorex achieved multi-million sales, raising the company to number two position in the industry in sales of heavy-duty computer tape and broadband instrumentation tape.

APPLIED DATA RESEARCH, INC. APPOINTS PRESIDENT

Richard C. Jones has been appointed President of Applied Data Research, Inc., Princeton, N.J. Mr. Jones, formerly Marketing Manager, succeeds Ellwood Kauffman, president of ADR since its founding in 1959. Mr. Kauffman, who resigned in early September as president, continues his company affiliation as a director and special staff consultant.

BUSINESS NEWS

COMPUTER SALES BY FRANCHISED DEALERS IS GP'S NEW MARKET PLAN

For the first time in the history of the computer industry, a complete line of computers will be marketed by franchised sales representatives -- a method similar to that used to sell automobiles, appliances, and other more familiar products.

General Precision, Inc., has announced the establishment of a nationwide network of franchised representatives to market its three low-cost computers (LGP-21, LGP-30, RPC-4000) to business, scientific, industrial, and educational concerns.

The new franchise marketing plan will enable General Precision to increase its U.S. sales coverage in the rapidly growing market for small computers, according to George C. Ensslin, vice president of the Commercial Computer Division of General Precision's Information Systems Group.

General Precision previously marketed its computer line through a nationwide sales staff -- the traditional method of marketing computers.

In GP's new marketing plan, a franchised representative is granted the right to sell the computer line to firms in his designated geographical area. He can increase his staff as the market expands in his franchise-protected territory.

The franchised representatives are free to concentrate wholly on new sales. General Precision backs up the representatives with an expert staff of field applications analysts, field service engineers, and a home-office task force that explores and trouble-shoots new marketing areas. This service staff has been built up over the past several years to support the LGP-30 and RPC-4000 sales program.

Franchised representatives will also handle peripheral equipment, such as input-output devices, that are produced by other manufacturers and are compatible with General Precision computers. This provides an earnings potential previously unavailable to staff salesmen. It will also result in lower prices to customers because a single representative will market all computer equipment needed for an installation.

Among the factors which influenced the selection of the new franchise marketing plan GP's spokesman cited:

First, computers are inexpensive enough today to be marketed by regional representatives in business for themselves. Ten years ago, a computer with a capacity of the LGP-21 occupied an entire room and was very expensive. In effect, only a large computer firm had the capital and facilities to market its own equipment.

Second, computers such as the LGP-21 are small enought to be carried to a customer for demonstration. The LGP-21, for example weighs only 90 pounds and can be transported in a station wagon. Expensive display and demonstration rooms in every big city in the U.S. -- traditionally a factor contributing to high overhead costs -- are no longer necessary. The saving is passed on to the customer.

Third, knowledge about computers and their applications has become so widespread that there are men in all corners of the U.S. who are qualified to go into business for themselves selling computers.

Fourth, the franchise marketing plan enabled GP to increase its sales force overnight. Many companies signed as franchised representatives already have sales staffs marketing compatible products in well defined areas.

RCA SETS SALES AND EARNINGS RECORD

Sales and earnings of RCA in the first nine months of 1963 were higher than any comparable period in the company's history, according to Chairman David Sarnoff.

Profits after taxes for the first nine months climbed by 29 per cent to a record of $44,200,000, as compared with $34,300,000 in the same 1962 period.

Sales for the period rose by 4 per cent over the first nine months of 1962 to a new high of $1,314,000,000.

RCA attributed the nine-month record in part to rapid and sustained progress toward the goal of profitability in the company's EDP business, with the cross-over still anticipated before the end of the next year.

Reviewing specific developments in the offing, Chairman Sarnoff said:

"Our firm bookings for electronic data processing units, both installed and on order, are today 35% higher than one year ago. Our progress this year has solidified our conviction that RCA has a profitable future in data processing.

"Our government billings for defense and space totalled $420,-000,000 for the first nine months of 1963. This represented a decline of 9% from the $460,000,000 in billings for the same period of the previous year. The smaller volume of government billings reflects an interesting reversal of business trends. Our commercial and industrial sales and profits are advancing sharply and more than offsetting the general leveling off of government business -- a leveling off which is now evident throughout the electronics industry.

"We anticipate that 1963 will be the best year in RCA's history for both sales and profits."

COLLINS EARNINGS HELD DOWN BY COMPUTER PROGRAM

Collins Radio Company has announced net earnings of $3,682,132, for the fiscal year which ended August 2, 1963. Comparable earnings for 1962, restated to reflect a change in depreciation policy adopted in 1963, were $3,477,000.

Net sales for the year were $250,092,826, compared with $207,775,637 for fiscal 1962.

Backlog of firm orders on August 2, 1963 totaled $241,000,000, up from $230,000,000 a year earlier.

In reviewing the achievements of the year, President Arthur Collins said that the development of communication and data processing systems is the company's most significant new product area, both in terms of required investment and ultimate earnings potential. He said, ". . . This program (data processing) . . . has had a marked effect on profits during 1962 and 1963, and is expected to continue to do so in some measure until the end of fiscal 1965. Although profits are expected to improve in fiscal 1964, the degree of improvement, as in the last two years, will be modest."

In the Annual Report, Mr. Collins points out:

"The computer system design has exceeded expectation. Performance and reliability are excellent. Production cost targets have been met. Original budgets for programming have been exceeded although expenditures are still within feasible limits.

"Market acceptance has been gratifying. At the end of fiscal 1964, there will be about 30 Collins computers in service, including those in our own Data Center.

"Extensive operational use has demonstrated the practicability of large scale message switching. Although other computer suppliers are doing limited switching, the Collins accomplishment places us in a unique position as to these more demanding applications and is attracting world-wide attention."

COMPUTRON SALES AND EARNINGS PEAK

Computron Inc. reports net earnings of $174,429 on sales of $2,251,891 for fiscal 1963 ended June 30. This compares with net earnings of $14,616 on sales of $535,628 reported for fiscal 1962.

Frank Radocy, President, reports the company plans to put heavy emphasis on new and improved product development throughout fiscal 1964, in an effort to continue to introduce new concepts in the magnetic tape industry.

MOORE'S SALES, PROFITS INCREASE

Moore Corporation, Limited, reports that for the first six months of 1963 there was an increase of 6.2% in net sales and an increase of 4.8% in net profit, compared with the first half of 1963.

Sales for the first half were $93,095,669, compared with $87,691,076 in the same period of 1962.

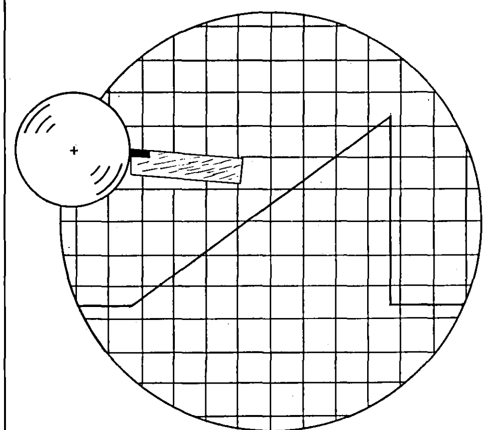
Net profit after income taxes was $7,099,524 compared with $6,766,543 in 1962. Moore is a leading manufacturer of continuous forms for high speed data printout.

DURA CORP. EARNINGS CLIMB 28 PER CENT

Consolidated net earnings of Dura Corporation rose 28 per cent during the fiscal year ended July 31, 1963, to $1,914,809, compared to $1,450,612 in the previous period.

Sales for all of the company's 11 divisions and subsidiaries increased 12 per cent for the year to $63,184,194. Consolidated sales during the 1962 fiscal year totaled $56,519,501.

Dura's newest subsidiary, Dura Business Machines, Inc., which only a year ago introduced its new high-speed automatic typewriter, has 400 machines installed and a large backlog of orders according to President J. Thomas Smith. Additional data handling equipment has recently been introduced and shows great promise, according to Mr. Smith.



NOTICE

TO: CERTAIN NEW SUBSCRIBERS IN SEPTEMBER

As a premium for your new subscription, in some of the subscription offers of "Computers and Automation," we offered our "Glossary of Terms in Computers and Data Processing." At the time your new subscription was received in the middle of September we were getting 40 to 60 new subscriptions a day, and the special supply of the "Glossary" for premiums was exhausted, and so we sent you a substitute premium.

We expect a new supply of the "Glossary" from the printer in November.

If you do not find the premium which you received from us useful to you, we invite you to send it back to us with a note. We shall willingly exchange it for a copy of the "Glossary" as soon as the new supply is available.

The Editor

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 American-made general purpose computers installed or on order as of the preceding month. 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.

Most of the figures are verified by the respective manufacturers. In cases where this is not so, estimates are made based upon information in the reference files of COMPUTERS AND AUTOMATION. The figures are then reviewed by a group of computer industry cognoscenti.

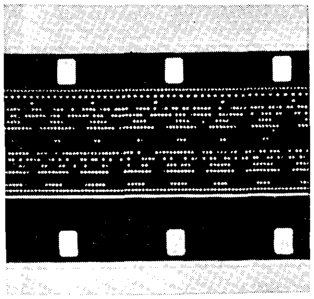
Any additions, or corrections, from informed readers will be welcomed.

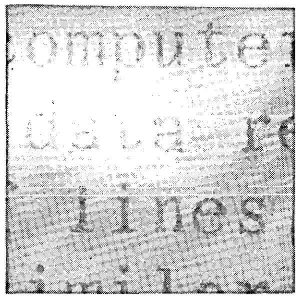
AS OF OCTOBER 20, 1963

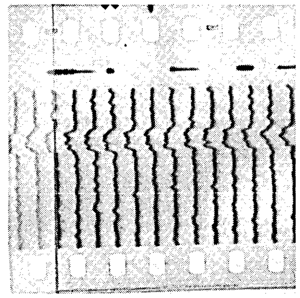
NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
Addressograph-Multigraph Corporation	EDP 900 system	Y	$7500	2/61	18	10
Advanced Scientific Instruments	ASI 210	Y	$2850	4/62	11	3
	ASI 2100	Y	$3000	12/63	0	3
	ASI 420	Y	$12,500	2/63	1	X
Autonetics	RECOMP II	Y	$2495	11/58	110	X
	RECOMP III	Y	$1495	6/61	28	X
Burroughs	205	N	$4600	1/54	58	X
	220	N	$14,000	10/58	44	X
	E101-103	N	$875	1/56	144	X
	B250	Y	$4200	11/61	58	29
	B260	Y	$3750	11/62	47	39
	B270	Y	$7000	7/62	33	23
	B280	Y	$6500	7/62	32	21
	B5000	Y	$16,200	3/63	10	20
Clary	DE-60/DE-60M	Y	$525	2/60	125	1
Computer Control Co.	DDP-19	Y	$2800	6/61	3	X
	DDP-24	Y	$2750	5/63	1	16
	SPEC	Y	$800	5/60	10	0
Control Data Corporation	G-15	N	$1000	7/55	283	1
	G-20	Y	$15,500	4/61	26	2
	160/160A	Y	$1750/$3000	5/60 & 7/61	327	35
	924/924A	Y	$11,000	8/61	18	19
	1604/1604A	Y	$35,000	1/60	53	9
	3600	Y	$52,000	6/63	4	6
	6600	Y	$150,000	2/64	0	1
Digital Equipment Corp.	PDP-1	Y	Sold only about $120,000	11/60	44	8
	PDP-4	Y	Sold only about $60,000	8/62	18	9
	PDP-5	Y	Sold only about $25.000	9/63	3	11
	PDP-6	Y	Sold only about $300,000	7/64	0	1
El-tronics, Inc.	ALWAC IIIE	N	$1820	2/54	32	X
General Electric	210	Y	$16,000	7/59	79	4
	215	Y	$5500	-/63	0	23
	225	Y	$7000	1/61	144	52
	235	Y	$10,900	2/64	0	16
General Precision	LGP-21	Y	$725	12/62	54	32
	LGP-30	semi	$1300	9/56	465	6
	L-3000	Y	$45,000	1/60	1	0
	RPC-4000	Y	$1875	1/61	103	3
Honeywell Electronic Data Processing	H-290	Y	$3000	8/61	8	X
	H-610	Y	$3500	9/63	1	6
	H-400	Y	$5000	12/61	65	40
	H-800	Y	$22,000	12/60	54	9
	H-1400	Y	$14,000	3/64	0	10
	H-1800	Y	$30,000 up	12/63	0	8
	DATAmatic 1000	N		12/57	5	X

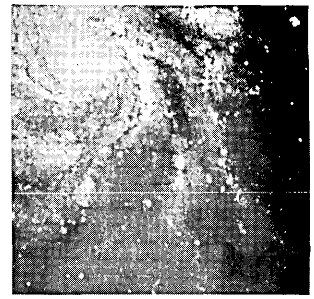
NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
H-W Electronics, Inc.	HW-15K	Y	$490	6/63	1	2
IBM	305	N	$3600	12/57	650	X
	650-card	N	$4000	11/54	520	X
	650-RAMAC	N	$9000	11/54	130	X
	1401	Y	$3500	9/60	6300	2200
	1410	Y	$12,000	11/61	235	276
	1440	Y	$1800	4/63	78	1330
	1460	Y	$9800	10/63	0	280
	1620	Y	$2000	9/60	1370	150
	701	N	$5000	4/53	2	X
	7010	Y	$19,175	2/64	0	31
	702	N	$6900	2/55	2	X
	7030	Y	$160,000	5/61	6	X
	704	N	$32,000	12/55	65	X
	7040	Y	$14,000	6/63	15	40
	7044	Y	$26,000	6/63	10	13
	705	N	$30,000	11/55	120	X
	7070, 2, 4	Y	$24,000	3/60	465	120
	7080	Y	$55,000	8/61	58	25
	709	N	$40,000	8/58	18	X
	7090	Y	$64,000	11/59	260	30
	7094	Y	$70,000	9/62	47	57
	7094 II	Y	$76,000	4/64	0	12
Information Systems, Inc.	ISI-609	Y	$4000	2/58	19	1
ITT	7300 ADX	Y	$35,000	7/62	6	3
Monroe Calculating Machine Co.	Monrobot IX	N	Sold only - $5800	3/58	176	4
	Monrobot XI	Y	$700	12/60	270	213
National Cash Register Co.	- 304	Y	$14,000	1/60	29	0
	- 310	Y	$2000	5/61	45	33
	- 315	Y	$8500	5/62	105	135
	- 390	Y	$1850	5/61	410	280
Packard Bell	PB 250	Y	$1200	12/60	148	14
	PB 440	Y	$3500	11/63	0	12
Philco	1000	Y	$7010	6/63	5	15
	2000-212	Y	$52,000	1/63	2	7
	-210, 211	Y	$40,000	10/58	22	7
Radio Corp. of America	Bizmac	N	-	-/56	4	X
	RCA 301	Y	$6000	2/61	320	195
	RCA 3301	Y	$15,000	7/64	0	3
	RCA 501	Y	$15,000	6/59	68	11
	RCA 601	Y	$35,000	11/62	2	2
Scientific Data Systems Inc.	SDS-910	Y	$1700	8/62	22	40
	SDS-920	Y	$2690	9/62	17	14
	SDS-9300	Y	$8000	1/64	0	1
Thompson Ramo Wooldridge, Inc.	TRW-230	Y	$2680	8/63	8	7
	RW-300	Y	$6000	3/59	37	2
	TRW-330	Y	$5000	12/60	12	17
	TRW-340	Y	$6000	12/63	0	4
	TRW-530	Y	$6000	8/61	19	6
UNIVAC	I & II	N	$25,000	3/51 & 11/57	49	X
	Solid-State II	Y	$8500	9/62	27	9
	III	Y	$20,000	8/62	30	100
	File Computers	N	$15,000	8/56	58	0
	60 & 120	N	$1200	-/53	830	4
	Solid-state 80, 90, & Step	Y	$8000	8/58	393	18
	490	Y	$26,000	12/61	17	22
	1004	Y	$1500	2/63	300	1750
	1050	Y	$7200	9/63	3	11
	1100 Series (except 1107)	N	$35,000	12/50	23	X
	1107	Y	$45,000	10/62	10	10
	LARC	Y	$135,000	5/60	2	X
X -- no longer in production				TOTALS	16,359	7992

5000 POINTS PER SECOND









Information International, Inc., Maynard, Mass., has developed a fully automatic Programmable Film Reader to read scientific or engineering data recorded on photographic film, paper, or similar media. Readout can be had on IBM-compatible magnetic tape, or in the form of numerical print-outs, graphs or plots, or visual CRT displays. This article describes the system and its applications.

THE FILM READING SYSTEM Using 16 or 35 mm. film as a medium for recording scientific data has many advantages. Because of the small input power and limited storage space that are required, it is particularly suitable for recording data produced by recording devices in space vehicles or aircraft; by wind and current measuring devices; and by other devices of similar nature.

However, reading or transcribing the data from film once it has been recorded has presented many problems in the past. It has generally been necessary for an analyst or researcher to read the data visually from the film and transcribe it by hand. This has been found to be a time-consuming, laborious and relatively expensive operation. In some cases, semi-automatic film reading devices are available. However, these can read only about 5000 points per day and require a human operator.

Information International, Inc., of Maynard, Mass., has now developed a completely automatic computer film reading system which can read film at the rate of approximately 5000 points per second. Scientific data recorded on 16 or 35 mm film can be read completely automatically and printed out in the form of numerical listings or recorded on magnetic tape for further processing and analysis. The film reading system is based on three major elements: A general purpose digital computer, together with a visual display scope; a film reading device; and computer programs for using the computer and film reader.

THE FILM READING PROCESS The film reading process involves the scanning of film by a rapidly moving light point on the visual display scope. The output of this scanning operation is detected by a photo-sensitive device in the film reader and relayed to the digital computer for further processing and analysis. In addition to translating the data itself into a more desirable format, the film reading system can also furnish additional summaries and analyses of the data as may be required.

EXTREMELY FLEXIBLE SYSTEM The flexibility of the film reading system in two respects should be emphasized. First, almost any format of data on film can be read, with appropriate modifications to the basic computer program. This includes data represented in the form of lines, graphs (e.g., radar pulses), points, and other similar forms of data. Second, almost any type of desired output may be obtained once the basic data is obtained from the film. Forms of output which are available include the following:

(i) A print-out or listing of data on paper.
(ii) A record of the data on magnetic tape.
(iii) Visual representations of data. These may take the form of a continuous graph (using a digital x-y plotting device). Or they may take the form of photographs — still or motion — of scope displays.

In addition to data recorded on film, data recorded on paper can also be read by means of the film reading system.

SYSTEM APPLICATIONS

(i) Analysis of data produced by oscillographs or other types of graphic recorders
(ii) Tracking and analysis of objects for which motion pictures are available (e.g., missile tracking studies)
(iii) Reading of astronomical or astrophysical data recorded on film (e.g., analysis of stellar configurations)
(iv) Reading photographs of cloud chambers, bubble chambers, and spark chambers
(v) Counting of particles (such as blood cells or bacteria) in photographs
(vi) Character recognition

To the best of our knowledge, Information International is the only commercial firm supplying fully automatic computer film reading systems. We do essentially two things. We develop and manufacture film reading systems for clients to use at their own facilities (as, for example, in the case of radar film reading systems we have developed for Lincoln Laboratory and the U. S. Air Force). And we furnish services for reading films which are sent to us for processing (as in the case of oceanographic current meter film).

III is able to supply equipment to satisfy a variety of customer needs. Customer options include transmittive or reflective input media, binary density decision, multiple level density measurement, local contrast measurement, and various degrees of system resolution.

We can supply a completely set-up, ready-to-run "turnkey" film reading system (including a medium price, general purpose computer). Or we can provide the basic film reading device, appropriate computer programs, or technical consulting to those planning to develop their own film reading systems. The film reading device itself may be used with specialized film reading computer programs, such as those we have developed, which make use of highly sophisticated filtering techniques to minimize the effect of "noise" (dirt, scratches, general illegibility) on the film. As a result, the film reading system is capable of reading film in relatively poor condition. Or, where the quantity of data on film is not great enough to justify investment in a film reading system, I.I.I. can furnish services for reading film and transcribing data on a production basis. A brochure describing the film reader and film reading systems we have developed is available on request.

INFORMATION INTERNATIONAL INCORPORATED
P. O. BOX 106 • MAYNARD, MASS.

Circle No. 12 on Readers Service Card

CONSIDERATIONS IN COMPUTER DESIGN
(Continued from Page 26)

efficiency is thereby accomplished, since a few bits will entirely identify a small number of registers . . . whereas many bits are needed for the full memory addresses. This may appear a useless efficiency. However, it is an essential part of a new approach along with the concurrence of parallel memories and parallel functions. I plan to describe, from this point on, how this new approach removes a good deal of the logic waste mentioned earlier. Needless to say, this approach is exemplified in the **Control Data** 6600 Computer.

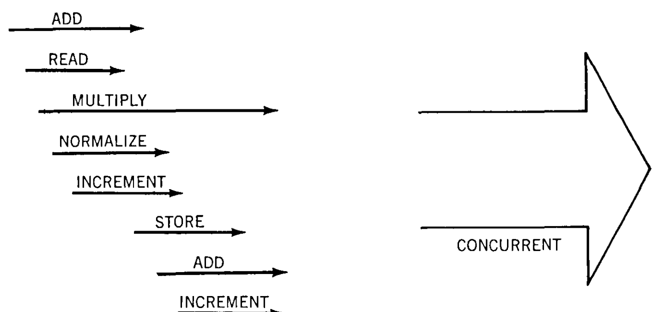
Sequence

In any computer program, the results are obtained by the execution of *sequential* operations. Among these operations are some whose order of execution is unimportant to the result. In fact, the operations tend also to separate into somewhat independent trains, some housekeeping, some computational, some memory, and so on. These independent trains occur (or can occur) nested, so to speak, in the total sequence. A typical computer makes no attempt to take advantage of this nesting. Each instruction is taken in sequence and performed in sequence. If the computer had several arithmetic units of independent nature, and the ability to discriminate between those steps which must retain the original program order and those which need not, a positive improvement could be had.

It isn't difficult to visualize a number of independent arithmetic units. However, it requires a very detailed examination of each instruction to determine how to discriminate on the sequential order. Back to the above plug-for-simplicity, here is where it really counts. Simply stated, orderly sets of instructions can be checked for sequence order quickly and efficiently. The conditions which make up the basis for the order of events to follow can be logged and up-dated. A quick decision can be made on which kind of order constraints are active, and a proper next step can be taken. The next step can be in the form of a go-ahead or a wait until conditions are more suitable.

This cannot be visualized in the same way as the typical sequential machine. In such a machine, some underlying control mechanism, e.g., a pulse, is formed at the beginning of a computation and proceeds through paths in the hardware like a mouse in a maze. Sometimes the pulse is duplicated for parallel controls of the data. However, only one of these duplicates provides the sequential continuity to the next step.

In the multiple unit machine, the control system begins similarly. A pulse is formed in the beginning, and sequential steps are taken up to, but not including, the first actual arithmetic or logical operation. From that point on, this original pulse is spread to a most complex network of paths, of which no sensible connection with sequence can be seen. This network serves to maintain an up-to-date reservation list on all units and transient memory registers. New operations can begin execution only if reservation conditions are favorable. Once an operation is issued to its unit, its reservation is made and thereafter monitored until the execution is complete. During the execution, the conflicts of use of trunks, registers, and the order-keeping are more or less an automatic part of this reservation control. As new instructions are brought up and thrown into this caldron, the order of their arrival is the *only* information about the ultimate desired order. Inside the caldron, late arrivals may actually proceed ahead of their turn as long as no impediments exist. (Note: It's like supper out. I've always been delayed getting a table for six.)



Despite all the confusion in describing such a system of multiple units, it makes no sense to have them if they cannot operate concurrently. More than that, concurrency is our only way out of the wire-speed limit. There are drawbacks to a complex system such as this. However, the drawbacks are almost exclusively on the side of design and manufacture, not on the use of the computer. The only reasonable question to ask is: "Do the difficulties of design and manufacture result in cost or competitive disadvantage?" Let me discuss the general subject of design and manufacture.

At odds

One thing has characterized the history of computer design more than any other: flexibility in the small. Building blocks made up of identical repeatable circuits have been constructed into generalized groupings, in themselves very flexible. To keep the number of these groupings small, for logistics and manufacturing reasons, some waste is allowed. By and large, however, the waste is minimal and pays off in over-all flexibility. Design involves mostly the complex interconnection of these grouped circuits obeying the well-established ground rules. Manufacture of the circuits proceeds somewhat independent of design, once the basic groupings are fixed and estimates are made of the number of each. Now then, with standard building blocks, the importance of wiring between them is obvious. In fact, the wiring allows the flexibility, so to speak. We have seen that wire length and speed of signals on wires are fast developing into a limitation. It isn't hard to see that wiring must be minimized, shortened, removed, or otherwise offset. Also, it isn't difficult to see that flexibility may be lost in the process. In truth, the two are really at odds.

The passing of time

The first thought in minimizing wire length is to reduce it. Make everything smaller. Yet work is performed on everything but the wire in this effort. The result is great reduction of circuit volume with no reduction in wiring volume. The wiring volume is now about half the total volume.

If the circuits could be more carefully or cleverly grouped, it might be possible to remove some wires. This very laudable thought hits directly at the idea of flexible circuit blocks. Of course, a multi-level method of assembling modules is possible (the mother-board technique), but this is also basically inflexible. No, it's too bad, but flexibility has got to go. What is the result? The principle effect is in design with some small effect on manufacturing. The design-and-build process is lengthened, since manufacture must wait for complete design. What I have touched on in the last few paragraphs is the very real present-day problem facing the industry. Without exception, the techniques being formulated for the next round of electronic equipment are based on design inflexibility except at very small levels. Integrated circuits offer no improvement unless coupled with more complex groupings to minimize or remove wires.

Depositing techniques demand geometric and topographic design of whole groups of circuits. Multi-layer printed wiring requires photographic design processes. These are *all* at the engineering and designer level, not below. The entire direction of the computing industry is toward *design* inflexibility.

(To be Continued in the Next Issue)

Make over 70

TEACHING MACHINES /
PROGRAMMED LEARNING MACHINES /
COMPUTING, REASONING, PUZZLE-SOLVING
AND GAME-PLAYING MACHINES

with our

TEACHING MACHINE, PROGRAMMED LEARNING, AND AUTOMATIC TEACHING COMPUTER KIT K33

WITH OUR TEACHING COMPUTER KIT K33, you can make over 70 small machines which electrically read punched paper tape, signal correct answers, give rewards out of a chute, keep score, etc., responding to situations in teaching, programmed learning, computing, reasoning, solving puzzles, playing games, etc. Each machine works on flashlight batteries .... is FUN to make, FUN to use and play with, and TEACHES you — both (1) any information which can be programmed for learning in a series of items or questions on paper tape, and (2) information about how to put together electrical, computing, reasoning, and teaching circuits and devices. All connections with nuts and bolts — no soldering required — completely safe. The TEACHING COMPUTER KIT K33 is the result of 15 years of our design and development work with miniature mechanical brains and scientific educational kits, including the Brainiac electric brain construction kit K18, the Probability and Statistics kit K22, Simon (miniature automatic digital computer with 129 relays), Squee (electronic robot squirrel), etc.

ONLY A FEW OF THE MACHINES THAT YOU CAN MAKE: Teaching Machines: the Pat-on-the-Back Machine; the Spelling-the-Sound-F Machine; the Answering Machine; the Bronx-Cheer Machine; the Forgive-and-Forget Machine; the Scold-and-Forgive Machine; the If-Answer-Told-No-Reward Machine; the Infinitely-Rewarding Machine; the One-Reward-per-Frame Machine; the Automatic Teaching Computer; Scoring Machine for Honorable Student; Scoring Machine for Student with Weak Conscience; Podunk University's Pigeon Rewarding Machine; the Answering Machine with 100 Answers; the Answering Machine with 540 Answers; .... Logic Machines: the AND/OR Machine; the OR ELSE Machine; the NOT BOTH Machine; the IF AND ONLY IF Machine; the Logical Syllogism Machine; .... Computing Machines: Machines for Adding 7, Squaring, Finding Cube Root, ...; Decimal-to-Binary Converter; .... Puzzle-Solving Machines: the Case of the Missing Hyphen; the Riddle of Sundorra; Hawkshaw the Detective's Machine Made for Bluebeard; the Mysterious Multiples of 369; the Waxing and the Waning Moon; the Daisy Petal Machine; .... Game Playing Machines: Nim; the Game of 21 in Sundorra; Black Match.

WHAT COMES WITH YOUR KIT K33?

- Every special part needed to make the experiments and mechanisms in the kit, including:
  — a Tape Mechanism, which rolls punched paper tape through a reading station where it is read electrically,
  — a Chute Mechanism, which automatically delivers rewards or computes score,
  — four Multiple Switches operating electrically,
  — a Flip-Flop operating mechanically and electrically,
  — prepunched and prelabeled Panel Board, Lamps, Buzzer, small Balls for rewards or scoring, Hand Punch for your own program tape, etc.,
  — in total, over 400 parts of more than 50 kinds — everything you need to make hundreds of different computing, reasoning, and teaching machines.
- Also, 15 illustrative learning programs (Skinner style, Pressey style, etc.) on prepunched paper tape totaling over 500 frames, including as subjects:
  Physics — Light, Heat, and Incandescence; Geological Time Scale; Boolean Algebra — Introduction; Elementary Algebra — Sets, Natural Numbers, Variables; Hamlet's Soliloquy; Chess Strategy Using Pawns; Management — PERT Method; Pharmacology — Corticosteroids; Spelling the Sound F; Spelling Long E with EI or IE; Chemistry — Atomic Structure; Geometry — Some Aspects of Symmetry; Finding Approximate Square Roots; Meaning of Certain Proverbs — in total, 15 samples, so that you can make your own programmed learning tapes to run on your own teaching computer.
- Full descriptions of over 60 experiments
- Book "Teaching Machines, Programmed Learning, and Automatic Teaching Computers: An Introduction through Experiments" by Edmund C. Berkeley, — over 80 pages — over 100 diagrams

TEACHING MACHINE AND PROGRAMMED LEARNING KIT K33 .... another Berkeley Enterprises' kit with limitless possibilities and hours of built-in fun and instruction .... $19.95, LESS $2.00 PREPUBLICATION DISCOUNT FOR ORDERS RECEIVED PRIOR TO NOVEMBER 30, 1963, i.e.: $17.95. (For shipment west of Mississippi, add 80 cents; outside U.S., add $2.10)

— 7-Day Full Refund if not Satisfactory —

- - - - MAIL THIS COUPON OR A COPY OF IT - - - -

Berkeley Enterprises, Inc.
815 Washington St.
Newtonville, Mass. 02160

Please send me when published the Teaching Machine and Programmed Learning Kit K33. (Returnable in 7 days for full refund if not satisfactory — if in good condition.) I enclose $____________ in full payment.

Name ________________________

Address ________________________

____

Circle No. 84 on Readers Service Card

BOOKS AND OTHER PUBLICATIONS

Moses M. Berlin
Allston, Mass.

We publish here citations and brief reviews of books and other publications which have a significant relation to computers, data processing, and automation, and which have come to our attention. We shall be glad to report other information in future lists if a review copy is sent to us. The plan of each entry is: author or editor / title / publisher or issuer / date, publication process, number of pages, price or its equivalent / comments. If you write to a publisher or issuer, we would appreciate your mentioning **Computers and Automation.**

Bickley, W. G., and R. E. Gibson / Via Vector to Tensor: An Introduction to the Concepts and Techniques of the Vector and Tensor Calculus / John Wiley & Sons, Inc., 440 Park Ave. S., New York 16, N. Y. / 1962, printed, 152 pp, $4.50

The aim of this book is to enable students to read with understanding the scientific books and papers in which the ideas and language of the vector and tensor calculus are used. The first four chapters which make up the vector section can be regarded as a refresher course leading the student to the comprehension of the tensor section which follows. The five chapters in the section concerning tensors are as follows: "Tensors and Their Transformation," "Covariant Differentiation," "The Metric Tensor," "Some Geometry," and "Tensors in Mathematical Physics." Two appendices include: "Suggestions for further reading," and "Tensor and physical components." Exercises included at the end of each chapter. "Hints and Answers to the Exercises," p. 139. Index.

Mills, Edwin S. / Price ,Output, and Inventory Policy: A Study in the Economics of the Firm and Industry / John Wiley & Sons, Inc., 440 Park Ave. S., New York 16, N. Y. / 1962, printed, 271 pp, $7.95

The purpose of this book, addressed to economists, is to formulate and test models which take explicit account of the effects of uncertainty and inventory holding on firms' decision making. From a decision theory point of view, the models developed in this book are special cases, and in no sense can this book be said to contain "the" theory of price determination under uncertainty. It is the author's belief that economists' understanding of price formation in uncertain circumstances will grow as theoretical and empirical investigations proceed. This book is intended to be a contribution in this direction. Among the thirteen chapters are: "The Analysis of Expectations," "Perfect Competition," "Imperfect Competition: One-Period Horizon," "Imperfect Competition: Multiperiod Horizon," and "Application to Experimental Data." List of references and index included.

STATEMENT OF OWNERSHIP AND MANAGEMENT
OF COMPUTERS AND AUTOMATION

October 11, 1963

Computers and Automation is published 12 times a year at Newtonville, Mass.

The names and addresses of the publisher, editor and managing editor are:
Publisher, Berkeley Enterprises, Inc., 815 Washington St., Newtonville, Mass. 02160; Editor and Managing Editor, Edmund C. Berkeley, 815 Washington St., Newtonville, Mass. 02160.

The owner is:
Berkeley Enterprises, Inc., 815 Washington St., Newtonville, Mass. 02160.

Stockholders holding one per cent or more of the stock are:
Edmund C. Berkeley, 815 Washington St., Newtonville, Mass. 02160; Max S. Weinstein, 25 Highland Drive, Albany 3, N.Y.

The known bondholders, mortgagees, and other security holders owning or holding one per cent or more of the total amount of bonds, mortgages, or other securities are: NONE.

The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was 3732.

Edmund C. Berkeley, Editor

NEW PATENTS

Raymond R. Skolnick
Reg. Patent Agent
Ford Inst. Co.
Div. of Sperry Rand Corp.
Long Island City 1, New York

The following is a compilation of patents pertaining to computer 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 Commissioner of Patents, Washington 25, D. C., at a cost of 25 cents each.

July 2, 1963

3,096,510 / Don N. Lee, Torrence, Calif. / Ampex Corporation, Redwood City, Calif., a corp. of Calif. / Circuit for Sensing Signal Output of a Magnetic-Core Memory.

3,096,511 / Andrew Taras, Binghamton, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of New York / Apparatus for Effecting Concurrent Record, Read and Checking Operations.

3,096,521 / Johannes Hugo Petermann and Nora Anne Petermann, Wilhelmshaven, Germany / Olympia Werke AG., Wilhelmshaven, Germany / Magnetic Data Recording Apparatus.

July 9, 1963

3,097,306 / Lester Mintzer, Newton Center, Mass. / Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., a corp. of Delaware / Magnetic Core Digital Storage and Transfer Circuits.

3,097,349 / Franz L. Putzrath, Oaklyn, and Thomas B. Martin, Collingswood, N. J. / Radio Corp. of America, a corp. of Delaware / Information Processing Apparatus.

3,097,350 / Harold Noel Coates, East Grinstead, England / International Computers and Tabulators, Ltd., London, England, a company of Great Britain / Magnetic Core Registers.

July 16, 1963

3,098,119 / Jerome H. Lemelson, 43A Garfield Apts., Metuchen, N. J. / ——— / Information Storage System.

3,098,161 / Pierre Michel Bizet, Saint-Ouen, France / Compagnie Industrielle des Telephones, Paris, France, a corp. of France / Bilaterally Operable Transistorized Shifting Register.

3,098,215 / David P. Waite, Topsfield, Mass. / General Electric Company, a corp. of New York / Data Storage and Transmission System.

3,098,217 / Abraham Franck and George F. Marette, Minneapolis, and Berc I. Parsegyan, St. Paul, Minn. / Sperry Rand Corporation, New York, N. Y., a corp. of Delaware / Magnetic Device Sensing, Shifting and Encoding Circuit.

3,098,218 / Thomas Harold Flowers, Mill Hill, London, England / Her Majesty's Postmaster General, London, England / Binary Digital Number Storing and Accumulating Apparatus.

July 23, 1963

3,098,996 / Ernest R. Kretzmer, New Providence, N. J. / Bell Telephone Labs., Inc., New York, N. Y., a corp. of N. Y. / Information Storage Arrangement.

3,098,997 / Winthrop J. Means, Summit, N. J. / Bell Telephone Labs., Inc., New York, N. Y., a corp. of N. Y. / Information Storage Arrangement.

3,099,002 / Carl P. Spaulding, San Marino, and Merton Carr Wilson, Pasadena, Calif. / Datex Corp., Monrovia, Calif., a corp. of Calif. / Encoder Circuits.

3,099,003 / Carl P. Spaulding, San Marino, and Merton Carr Wilson, Pasadena, Calif. / Datex Corp., Monrovia, Calif., a corp. of Calif. / Encoder Circuits.

3,099,004 / Hans Heuer, Wilhelmshaven, Germany / Olympia Werke AG, Wilhelmshaven, Germany / Arrangement for Series-Transmission of Coded Signals.

July 30, 1963

3,099,820 / Raymond W. Ketchledge, Whippany, N. J. / Bell Telephone Labs., Inc., New York, N. Y., a corp. of N. Y. / Optical Storage System.

3,099,821 / Frederick L. Post, Poughkeepsie, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of N. Y. / Magnetic Core Device.

3,099,822 / Emrys John Williams, Stevenage, England / International Computers and Tabulators, Ltd. (formerly The British Tabulating Machine Company Limited) / Magnetic Data Storage Devices.

August 6, 1963

3,100,296 / Frederick Jonker, 3939 Legation St., N.W., Washington, D. C. / ——— / Superimposable Card Search and Data Storage System.

August 13, 1963

3,100,599 / Donald G. Hebert, South Windsor, Conn. / Royal McBee Corp., New York, N. Y., a corp. of N. Y. / Data Processing Equipment.

3,100,834 / Frederick M. Demer, Johnson City, and Martin J. Kelly, Endwell, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of N. Y. / Magnetic Data Processing.

3,100,835 / Orest J. Bedrij, Poughkeepsie, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of N. Y. / Selecting Adder.

3,100,836 / Gerard T. Paul and Orest J. Bedrij, Poughkeepsie, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of N. Y. / Add One Adder.

3,100,837 / William J. Gesek, Jr., Linden, N. J. / R.C.A. Corp., a corp of Dela. / Adder-Subtractor.

3,100,838 / Michael E. Szekely, Belle Mead, N. J. / R.C.A. Corp., a corp. of Dela. / Binary Full Adder Utilizing Integrated Unipolar Transistors.

3,100,887 / Robert M. Wolfe, Colonia, N. J. / Bell Telephone Labs., Inc., New York, N. Y., a corp. of N. Y. / Ferroelectric Shift Register.

3,100,888 / Robert E. Olĕksiak, Brookline, Mass. / I.B.M. Corp., a corp. of N. Y. / Checking System.

August 20, 1963

3,101,416 / Claude Marie Edmond Masson, Paris, France / Societe d'Electronique et d'Automatisme, Courbevoie, France / Magnetic Core Switching Systems.

3,101,417 / William C. Elmore, Swarthmore, Pa. / Burroughs Corp., Detroit, Mich., a corp. of Mich. / Magnetic Core Device.

August 27, 1963

3,101,894 / Frederick L. Smith, Dayton, Ohio / The National Cash Register Co., Dayton, Ohio, a corp. of Md. / Data Recording System with Zero Suppression.

3,102,195 / Karl F. Frank, Garden City, N. Y. / Micro Balancing, Inc., a subsidiary of Giannini Scientific Corp., Garden City Park, N. Y. / Pickup Means for Punched Data.

3,102,203 / Joseph T. McNancy, La Mesa, Calif. / General Dynamics Corp., Rochester, N. Y., a corp. of Dela. / Photosensitive Data Providing System.

3,102,207 / Albert E. Ellis, Jr., New York, N. Y. / Bell Telephone Labs., Inc., New York, N. Y., a corp. of N. Y. / Transistor Memory Circuit.

3,102,238 / Lynn R. Bosen, Costa Mesa, Calif. / Collins Radio Co., Cedar Rapids, Iowa, a corp. of Iowa / Encoder with One Frequency Indicating One Binary Logic State and Another Frequency Indicating Other State.

September 3, 1963

3,102,995 / Tirey C. Abbott, Jr., Los Angeles, and Herbert L. Bernstein, Inglewood, Calif. / The National Cash Register Co., Dayton, Ohio, a corp. of Md. / Character Reading System.

3,102,996 / Frank A. Hill, Van Nuys, and Howard L. Stahle, Montrose, Calif. / General Precision, Inc., a corp. of Delaware / Computer.

3,102,997 / Gerhard Dirks, 44 Morfelder Landstrasse, Frankfurt am Main, Germany / Selective Transfer of Magnetically Stored Data.

3,102,998 / Robert E. Staehler, North Caldwell, N. J. / Bell Telephone Labs., Inc., New York, N. Y., a corp. of New York / Storage System.

3,102,999 / Rune Bernhard Bernemyr, Farsta, Karl Gösta Herbert Lindberg, Bandhagen, and Bengt Gunnar Magnusson, Farsta, Sweden, and Carl Gunnar Svala, Galion, Ohio / Telefonaktiebolaget L. M. Ericsson, Stockholm, Sweden, a corp. of Sweden / Magnetic Memory Arrangement.

3,103,001 / William T. Hage, Alliance, Ohio / Babcock & Wilcox Co., New York, N. Y., a corp. of New Jersey / Logic Control Unit for Data Collecting, Storing, Transmitting and Computing System.

September 10, 1963

3,103,309 / Gosta Roland Englund, Stockholm, Sweden / Svenska Dataregister AB, Stockholm, Sweden, a corp. of Sweden / Data Handling Apparatus.

3,103,577 / Frank G. Willard, Clarence, N. Y. / Westinghouse Electric Corporation, East Pittsburgh, Pa., a corp. of Pa. / Digital Signal Sensing Apparatus.

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.

designed with price in mind

Get the performance, reliability and versatility you require in a magnetic core memory system at significant savings in cost.

The Ferroxcube 52•10 Memory System provides a 10 usec cycle time, with half cycle mode of 6 usec, and access time of 4 usec. The programmer can select sequential, sequential interlace, or random access modes of operation. Capacity ranges from 32 to 16,384 characters in various bit lengths.

A unique design, the Ferroxcube 52•10 combines sealed modules, with a versatile speed range to meet a majority of specifications. Output levels and access modes can be tailored for specific requirements.

Write for complete details on Ferroxcube general purpose memory systems.

LOW-COST, GENERAL-PURPOSE MEMORIES

by

FERROXCUBE
CORPORATION OF AMERICA
SAUGERTIES, NEW YORK

Circle No. 82 on Readers Service Card