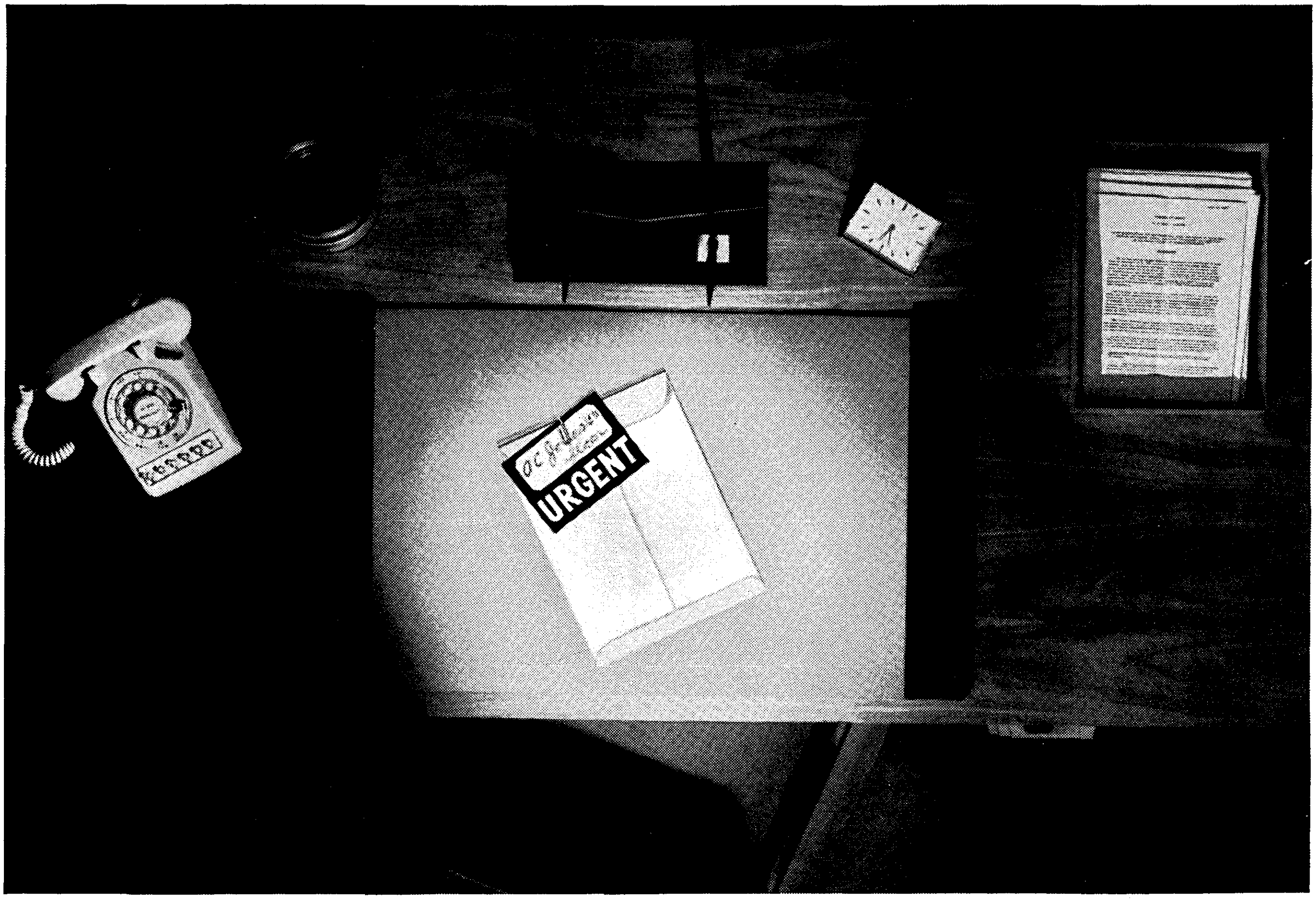
September, 1965

computers and automation

6

Editing and debugging during time-shared computer operations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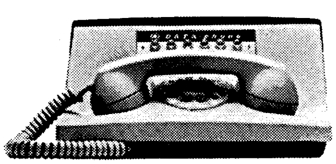

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Did the Vikings introduce computer tape to our shores as early as 789 A.D.?

Dr. Jerome B. Dewdrop believes they did. According to Dr. Dewdrop, the occasion was the landing in Narragansett Bay of a group of Norse singers bound for the first Newport Jazz Festival. The group included, in addition to the Vikings, such long-maned attractions as Erik and the Reds, The Four Norsemen, and one Bea Striceland, who sang "Melancholy Baby" accompanied by lyre.

As for the view that data processing equipment was *not* introduced until much later, as a result of the work of the 17th century mathematical wizard Descartes, Dr. Dewdrop poo-poohs it.

"An interesting theory," scoffs Dr. Dewdrop in his classic study entitled 'The Vikings and All That Jazz', "but just one more case of putting Descartes before the Norse!"

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When the photograph on the front cover was taken, the time-shared computer was servicing several local and remote users. The computer is the PDP-6 computer at Digital Equipment Corp. in Maynard, Mass. The equipment from left to right is the printer, the memory, the central processor with a DEC tape for each console, and the multiplexer which can handle up to 64 in/out channels. For more information, see page 41.

computers and automation

SEPTEMBER, 1965 Vol. 14, No. 9

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

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The Computer Field and Bandwagons

How much "follow the leader", "climb on the bandwagon", "everybody's doing it—why don't you?"—is there in the computer field?

In 1939, a book "The Fine Art of Propaganda", edited by A. M. and E. B. Lee of the Institute for Propaganda Analysis, was published by Harcourt Brace and Co. This book was directed towards analyzing the radio speeches given every Sunday by a pro-fascist and pro-Nazi priest, Father Charles E. Coughlin of Detroit. The book explained the many "tricks of the trade" in propaganda. Each of these tricks received a vivid name and a little pictorial symbol; then parts of the text of Father Coughlin's speeches were reprinted, punctuated with these little symbols, to display the propaganda tricks employed.

The Institute for Propaganda Analysis was formed by a group of American liberals to react to the then-new distortion in American social processes produced by the then-new effects of the radio, as it became fully used in the 1930's as an instrument for mass persuasion. This view is expressed clearly in the following paragraph:

> . . . .Speeches as they are delivered over the radio, inject a new and startling factor into our political, economic, and social processes. Except for such programs as "The Town Meeting of the Air", those who listen to a speaking program are left wholly at the mercy of the orator's word-magic. The spell cannot be broken by hecklers. At the end of the talk the speaker is not confronted with the obligation to answer questions and meet objections from the floor. . . .

The bandwagon propaganda trick

> . . . .is a means for making us follow the crowd and accept a propagandist's program as a whole, without examining the evidence for and against it. His theme is: "Everybody's doing it. Why not you?" . . . He appeals to the desire common to most of us, to "follow the crowd" . . . he wants us to follow the crowd in masses . . . With the aid of all the other propaganda devices, all of the artifices of flattery are used to harness the fears and hatreds, prejudices and biases, convictions and ideals common to a group. Thus is emotion made to push and pull us as members of a group onto a Band Wagon . . . We should ask ourselves before we succumb to his wiles: "What is the evidence for and against his program?"

In the computer field there have been a number of bandwagons. Some of them naturally have been good ones, but many of them have been bad, causing much waste and heavy costs.

One of the bandwagons is the idea of buying a computer in the first place. It has been estimated that 40% of all computer installations are wasteful, inefficient, or borderline. This is a severe indictment against many American businessmen and their capacity to make wise business decisions; apparently they did not take to heart the often-repeated advice "even the finest tool has to be used with skill", and they climbed on a bandwagon without sufficient study.

Whenever I have been asked for advice about whether a firm should buy its first computer, I have always said "experiment first with a small segment of your work in a computing service bureau, and see what happens."

Another of the bandwagons is the idea that an association of computer people has to be big and "important", have an executive secretary and 16 employees, publish voluminously, and have costly dues (say $18 a year). When the Association for Computing Machinery started in 1947, dues were $2 a year; its sole function really was to be an "animated mailing list", to keep its members informed about planned meetings so that they could come to them. In those years, it seemed to many computer people that it was unfair for an association to tax all of its members for things that only a few might want, such as the "Journal of the Association for Computing Machinery"; and subscriptions to the Journal were, as I remember, optional. Apparently because there are other big and important societies with heavy dues, the ACM has chosen to climb on that bandwagon also; but the case for needing to is far from established.

Time-shared computer systems are in our opinion a new bandwagon. These systems will survive, it is certain. Some of these systems will be really useful. Some of these systems in fact are indispensable, such as the airline reservations systems. But also it seems to me clear that after a few more years, time-shared computer systems will have receded into the background for many applications, because less intricate and less costly ways will be found to supply computing power as needed.

Perhaps the biggest bandwagon of all in the computer field has been the growth of computers in less than 20 years to an industry on the order of $5 billion a year in the United States, and more abroad. This bandwagon is without a doubt a good one, in the sense that here is one of the those great and revolutionary changes in technology which represent a mighty stride towards increased control by human beings over the world we find ourselves in. This bandwagon is drawing in great numbers of people, as a field in which they can do their life work. But some of these people are not qualified; and it would be good to discourage them from climbing on this bandwagon.

In any case, the reason "everybody's doing it—why don't you?" is one of the weakest and most sheep-like of reasons for doing anything. Every improvement in any human activity begins with the thoughts or the actions of a small minority.

Edmund C. Berkeley

EDITOR

FURTHER COMMENTS ON "COMPUTERS AND THE PUBLIC SECTOR OF THE ECONOMY"

From: W. H. Ferry
Center for the Study of Democratic Institutions
Santa Barbara, Calif. 93103

My warm compliments on the dignified and telling manner in which you dealt with Messrs. Nebel and Sexton [see the April issue of "Computers and Automation", page 11].

The editorial position of "Computers and Automation" is exactly what it should be. Everyone outside your highly specialized field can be grateful that you are focusing so clearly on the central issue: machines in the service of man, and not the other way around.

CORRECTION

In the April issue of "Computers and Automation", the following notice should have appeared at the end of each of three articles:

"Based on a talk given at the National Automation Conference of the American Bankers Association, San Francisco, Calif., March 10, 1965."

These articles were:

E. C. Wallace, Jr., "The Selection and Training of Men and Women Programmers in a Bank"

W. P. Livingston, "The Stopping of Moving of Checks"

Martin Greenberger, "Banking and the Information Utility"

COMMENTS ON "EDUCATION IN THE FIELD OF COMPUTERS AND DATA PROCESSING"

I. From: Rev. R. J. Verstynen, O.S.A.

Assistant Principal
St. Rita High School
Chicago, Ill.

I have read with interest the editorial which appears in the July issue of Computers and Automation Magazine. I found it most interesting and thought-provoking.

Although we are neophytes in the field of electronics and data processing, I feel that we have made some contribution to the educational aspects of data processing.

Here at St. Rita we believe that we have the first data processing class in the high school field in the State of Illinois and perhaps in the midwest part of our country. We have confined our educational work to data processing because at the present time the field of electronic computers would be far beyond our economic status.

During the past year we graduated 35 boys from our first data processing class. We are happy to announce that all 35 boys have been gainfully employed in the data processing field. I would find it most helpful to us if we could receive additional information on the educational background that teachers must have to continue to teach in a high school in this field. For example, when we began our teaching of data processing, we informed the accrediting agencies that the two men who are teaching this particular subject at our school were men with an electronics background and the only actual on-the-spot education in data processing that they had received was from the I.B.M. school here in Chicago. They have accepted our program on a conditional basis saying that they wish to observe for a period of three years what progress we have made in this particular area. However, we do need to know or be guided by computer and data processing people who are in the field and who are inquiring each day as to how the educational background of teachers can be advanced.

Could we receive if possible more information concerning the following questions? You speak of the DPMA certification program initiated in 1960. To whom might I write in order to receive detailed information regarding this certification program?

We would also be interested in obtaining any further information which you have regarding the self-screening test which you propose. I think this would be an excellent idea for this particular field. Do you feel that the high school can contribute a worthwhile service to the data processing industry? Certainly we cannot teach computer installation and processing. However, I do feel that we can make a very basic contribution in the field of data processing when limited to the tabulating area.

You may be assured that we will be most grateful for any information that we can receive relative to the data processing field. We would also be most happy to contribute whatever we can to the expanding program of data processing education particularly at the secondary level.

II. From the Editor

DPMA stands for the Data Processing Management Association. Its address is 524 Busse Highway, Park Ridge, Ill. 60068.

The DPMA will be glad to furnish information about its certification program to any person who inquires.

Computers and Automation did propose a self-screening test which a person could give himself to decide if the field of computers and data processing might be a good field in which to find his life work. But there is a long way to go before such a test becomes a reality; however, we have started down the road with several inquiries to several places.

Mr. Verstynen says "certainly we cannot teach computer installation and processing." We disagree. We think that in two or three more years it will be widely recognized that high schools can and should teach at least some information about computers and computer processing. After all, the processing of information by a computer is very like many simple familiar processes, such as figuring on one's fingers, or signaling with lights, or performing a sequence of steps of calculating that may be called for on a printed form bearing directions.

III. From: J. E. Bakken

Assistant Controller
Midwest Oil Corp.
Denver 2, Colo.

With reference to your editorial in the July 1965 issue of **Computers and Automation,** relative to education of data processing oriented personnel, it is my personal opinion that the present memberships of three of the leading data processing oriented societies (DPMA, Systems & Procedures Association and Association for Computing Machinery) are already well qualified in their fields. The educational problem, then, is one of training non-members so that they may qualify for data processing positions and ultimate membership in these organizations.

The massive educational program involved here is of such magnitude that professional educators, rather than persons presently occupying data processing positions, must be the teachers and developers of data processing educational programs. The professional societies must be in a position to continue to encourage development and dissemination of new ideas, concepts and theories, to allow the total body of knowledge to continue to expand. These societies, and their inherent limitations in full-time manpower, must not be relegated to the problems of basic data processing education.

IV. From the Editor

It may well be that many of the members of the data processing oriented societies are well-qualified, but it is certain that not all of them are. Furthermore, joining a society on the basis of being interested and paying dues is no sound guarantee of competence.

Although professional educators certainly must assume the major task of education in the field of computers and data processing, I am sure that many of the members of the societies are interested in teaching, able to teach, and would willingly teach, formally or informally. There is a source of help here which could be organized and focused by actions of the societies.

PORTION OF STATEMENT BEFORE SUBCOMMITTEE NO. 3 OF THE HOUSE JUDICIARY COMMITTEE JUNE 17, 1965

John F. Banszhaf, III
Computer Program Library
New York, N. Y. 10017

I hope to consider with you today only two topics: copyright protection for computer programs and use of copyrighted material in information storage and retrieval systems.

I understand that no one else has requested permission to appear before this subcommittee to present the views and position of the data processing community. From an examination of the record of conferences and panels held prior to the drafting of the present bill, it is easy to see that they did not appear at that time either to present their ideas. In effect then, I think that I appear before you today as the sole and very unofficial representative of the data processing community.

I hope that you will not consider the absence of an official representative as an indication of disinterest on the part of computer manufacturers and users. That I think would be an incorrect assumption. In the first place, computers as we now know them are only about fifteen years old. The industry is a new and rapidly changing one. There are few established organizations in this area and they are in their infancy compared to many which have already addressed this subcommittee. Perhaps most important of all, copyright is very new to the computer industry. Unlike organizations of publishers, authors, and others who depend in large part for their livelihood on the copyright law and thus are well informed and vitally interested in any proposed changes, computer users have until very recently thought themselves divorced from any interest in the area. It was not until the Copyright Office's recent decision that any serious thought was given to copyright protection for programs. At about the same time, computer users began to wonder if they were infringing on any copyrights through their use of material in information storage and retrieval systems. The date of this sudden awakening was the summer of 1964. At this point all of the preliminary conferences were over and a bill was before Congress. Is it any wonder then that no official position has been forthcoming?

Yet the two subjects upon which I will touch this morning are of vital importance to the data processing community and it would be a mistake to assume that they are not interested. The news of the first program registrations was reported in almost two dozen periodicals, including the New York Times. Since that time, well over a dozen articles have appeared on the subject of legal protection for programs. That subject has also been the topic of at least four conferences.

Computer users are beginning to take advantage of the protection. I am told that the Copyright Office has recently registered a few more programs and I know of some which are pending. Moreover, I know of a number of programs which have been copyrighted and of others which are in the process of being copyrighted and which haven't yet been registered. For these reasons I believe it would be wrong to think that computer users are not interested in protection for their programs.

I would like to commend the drafters of the new bill for including within it protection for computer programs. I refer specifically to:

(1) the very broad definition of copyrightable work appearing in Sec. 102 which seems to affirm the earlier decision of the Copyright Office that programs are copyrightable subject matter;

(2) the equally broad definition of literary work in Sec. 101 to specifically include works expressed in numbers or symbols;

(3) the very broad definition of copies in Sec. 101 which banishes any doubts that protection against reproduction of copyrighted works on magnetic tape or other unreadable data processing format would be barred by the ghost of White-Smith vs. Apollo.

Since there appears to be no substantial oppposition to extending copyright protection to computer programs, I

(Please turn to page 27)

THE EVOLVING TIME-SHARING SYSTEM AT DARTMOUTH COLLEGE

Kenneth M. Lochner
Computation Center
Dartmouth College
Hanover, N. H.

The Dartmouth Time-Sharing System is an open-ended system which can accept jobs simultaneously from a number of remote teletype consoles (foreground) and from tapes, card reader, or disk (background). The system design and programming development have been going on for more than 2 years, and will not be completed until some time in 1966. However, for over a year the system has been in operation more than 8 hours a day, handling jobs from 30 remote consoles.

Development of the system was made possible by a grant from the National Science Foundation; a concurrent grant was made for development of course materials relating to use of the time-shared computer in mathematics courses. Equipment was purchased from the General Electric Computer Department and consists of a GE-235, a Datanet-30 Communications Controller, and a dual access disk file.

The Master Computer

The D-30, which is a computer, not just a polling device, is the master computer and schedules all nontrivial operations in the 235. The D-30 can communicate with the 235 via a computer interface unit (used to transfer commands to the 235 and receive job status reports from the 235) or the dual access file. In addition, the D-30 handles input/output from and to the teletypes, allocates and releases disk space, and analyzes and responds to user commands. The 235 is used for editing, compilation, program runs, and large block transfers from one area of the disk to another. Incoming problems share the 235 in short bursts of time on a rotating basis.

The Slave Computer

The 235 is multi-programmed in the sense that it can do peripheral-to-peripheral operations (e.g., tape to printer, card to printer, or tape to card) at the same time it is executing commands of the D-30. The disk file is used for storage of user source programs, systems programs, and object programs which have been swapped out after using one burst period. Although there is no technical reason for it, we do not allow the user to save the object program. This is because most of our programs can be compiled in less time than it would take to retrieve the source program and transfer it to a working area.

Software

When the system was first put into operation, only one algebraic compiler, BASIC, was available; background problems could not be run concurrently with time-sharing; and only very simple editing of source programs could be done. Subsequent additions have included: TEACH, a system which allows an instructor to code BASIC programs to analyze the results of a student program while the student's program is running; a fairly complete version of ALGOL 60; a machine-language interpretive program called DIP; a program maintenance system called EDIT; and background capabilities. The system now handles about 1,000 users a month—a steadily rising figure. During the next year, work will begin on an information retrieval system; of course, the capabilities of the system will have to be expanded to handle this new function.

Although our experience with a time-shared, user-oriented system is relatively brief, it has necessarily covered numerous aspects of development and use. We shall examine only three aspects of this experience: approach used to develop the system; response by our users; and ideas relating to optimizing the use of a time-shared system.

Approach Used to Develop the System

In contrast to the trend toward grandiose, super-comprehensive systems design, the Dartmouth time-sharing system has been and continues to be evolutionary in development. That is, the original design called for modest capabilities which would be useful to a large class of computer users; yet enough flexibility was maintained to allow for continuing development. The system is continually being reworked and expanded, in response to critical comments and requests by users. Modifications have ranged from such simple changes as printing out, whenever requested, the amount of time a program has been running, to such projects as the addition of background capabilities. As users increase in number and sophistication, we are acquiring a large pool of informed critics who can help us tailor the system to their needs.

However, as is true with all large operating systems, we run some risk in modifying a system which is in daily use and upon which a great number of users depend. This risk is minimized by the master-slave mode of operation, for the master computer can reload the slave at any time the slave fails to respond to commands or interrogation. Hence, by restricting most changes to systems operating in the 235 computer, program malfunctions usually affect only the programmer using a new system.

For 235 systems, other than the 235 supervisor itself, two versions are usually available: one, the standard working version; the other, an experimental version. Persons using the experimental version do so at their own risk. In addition, certain periods during the time-sharing operation are dedicated to debugging experimental versions of the D-30 and 235 executive programs. User files are protected by periodic disk dumps and by the fact that the 235 cannot access the disk file without permission of the D-30. The only major problems occur when a systems programmer attempts to patch the master executive program during real time—a practice which is not looked on with favor. The risks are slight but probably greater than commercial firms could tolerate.

Interaction with Users

Another problem which arises with a continually evolving system is that of keeping users informed of new system capabilities. It is hoped that in the future the system itself will be able to inform the user of what can be done and how to do it. As a first step in this direction, EDIT has been programmed to explain itself to users who have forgotten the system or have never used it. However, if a syntactically correct command is issued, the command is executed and the explanation omitted.

We have responses from at least two sources which indicate that users are generally satisfied with development to date. Even though the system is incomplete, a number of firms have decided to set up commercial installations using the same equipment and software, with the software modified slightly to do commercial work. Also, comments from on-campus users indicate the current system is clearly adequate for all but a small minority. A few have programs or problems which are, in some sense, too large for the system to handle, e.g., the problem would use more main memory than is available, operate with large amounts of data, or require a great deal of computer time to run to completion.

Some of these problems will be solved by allowing the user to access data files which are external to his source program of remote console. Then he will be able to set up a large program as a chain of medium-sized programs, communicating via a common data file. But presumably there will always be some problems which exceed the capacity of a system; in a time-shared environment these large programs pose an even more serious problem than they do in a standard operation.

Suppose you have 40 users time-sharing a central computer, and 10 of these have problems which run 15 minutes each. (Obviously, faster computers, multi-programming, etc., only allow you to multiply these figures by some appropriate constant.) Just allowing these 10 teletypes to share the processor would mean it would take 2½ hours for any one program to run to completion. And if swapping time required an additional 12 to 16 percent overhead, it would be over 3 hours before these programs finished. This is disastrous for two reasons. A long program requires mostly 235 time, in contrast to a shorter problem in which the user spends more time editing, typing, or "just thinking"; thus, the probability increases that users with small problems will have frequent waits because the central processor is in use when they want it for running or listing their programs. Second, it ties up a remote console which is best used for debugging, information retrieval, or programs which require frequent interaction between user and computer.

Mr. Kenneth B. Lochner, Jr., is chief programmer at the Dartmouth Computation Center. He received a B.S. I in history from Iowa State Univ., an M. S. in mathematics from Montana State College, and has passed his preliminary examinations for a Ph.D. in mathematics. He has been in the computer field since 1960.

Combining Time-Shared and Sequential Handling of Problems

One possible solution, which we will attempt to implement at Dartmouth, is to combine sequential (i.e., each job in the stack runs to completion before the next is begun) and time-shared handling of problems. It is hoped that this will not only ease the difficulties posed by long problems, but will also help to optimize the use of the 235. One queue of jobs (the long-running ones) would be processed sequentially; a second queue of programs (short jobs, initiated at the remote consoles) would be handled in a time-shared fashion. The jobs in the sequential job stack would be run whenever the time-shared programs were not using the processor, but would be swapped out whenever a program in the time-shared queue needed service.

If we then provided a way for the user or the supervisory program to initiate the transfer of programs from the time-shared queue to the sequential queue (or vice versa), we could begin to optimize the use of the remote consoles by an appropriate scheduling algorithm. The scheduling algorithm should give a higher priority to programs which have run less than some upper limit or which have been interacting with the remote console fairly frequently; when the program exceeds the preset limit, the supervisory program should take action which would eventually result in the program being transferred to the sequential queue.

This could be done automatically (thus giving the user no choice in the decision), or the supervisory program could suggest that the user initiate the transfer and explain how to do it. In a commercial environment, the user could be encouraged to take this action by offering a lower charge for programs which run in the sequential queue. In a university, the process would probably have to be automatic for certain classes of users and suggestive for other classes.

This method would mean that there would always be a pool of programs which could be used to smooth out the peaks and valleys of demand for the central processor time which occur in a time-shared environment. Furthermore, lines to the remote consoles could be cleared for work which requires real-time interaction with the running program.

Of course, this discussion does not consider the problem of attaching too many consoles to a system; this problem can be solved only at a particular installation. The specific number of teletypes that can be handled by a system is heavily dependent on the class of problems being run from the remote consoles.

During the coming year at Dartmouth a great deal of effort will be spent trying to optimize the time sharing system in some fashion similar to that described here. We are hampered by the fact that both computers have only 16K memories (one 20 bit, the other 18 bit word length), but most of us take pleasure in making two medium-sized computers stand up and do tricks.

```
RUN
WAIT.

TICTAC

15:28   MAY 29, 1965

MY MOVE:

 X - -
 - - -
 - - -

YOUR MOVE: ? 5

 X - -
 - O -
 - - -

MY MOVE:

 X - -
 - O -
 - - X

YOUR MOVE: ? 2

 X O -
 - O -
 - - X

MY MOVE:

 X O -
 - O -
 - X X

YOUR MOVE: ? 3

 X O O
 - O -
 - X X

MY MOVE:

 X O O
 - O -
 X X X

YOUR MOVE: ?
```

Computer plays Berkeley at tic-tac-toe, and wins — but does not know it.

THE ROMANCE OF GOOD TEACHING— AND THE TIME-SHARED COMPUTER

Edmund C. Berkeley
Editor, Computers and Automation

```
OLD PROBLEM NAME--BART
WAIT.
READY.

RUN
WAIT.


BART        15:08    MAY 29, 1965

INPUT ANY RANDOM NUMBER TO START SERIES : ? 765
INPUT THE AMOUNT OF YOUR CAPITAL : ? 1000
 INPUT INTENDED NUMBER OF BETS : ? 5
 NOW GIVE YOUR CHOICES AND THEIR BETS --
  INPUT PAIR 1      ? 22,10
  INPUT PAIR 2      ? 11,10
  INPUT PAIR 3      ? 15,5
  INPUT PAIR 4      ? 33,10
  INPUT PAIR 5      ? 18,5

  THE NUMBER IS  6

  OF A TOTAL BET OF  $ 40   ,
   YOU HAVE LOST  $ 40   AND WON  $ 0
  YOUR CAPITAL HAS SUNK FROM  $ 1000     TO  $ 960

 INPUT INTENDED NUMBER OF BETS : ? 0


TIME:   2 SECS.
```

Computer plays Roulett with Berkeley, who loses all his bets

On May 29, 1965, I returned to my 40th year alumni reunion at Phillips Exeter Academy (Exeter, N.H.), and found—among many other interesting and exciting changes—one of the consoles of the Dartmouth College time-shared computer. It was situated in a mathematics classroom of the central Academy Building.

At the console that Saturday afternoon were two students, James F. Bowring, Grade 9, and Barton Evans, Jr., Grade 11. Each had a game programmed on the computer: Bowring, Tic-Tac-Toe; and Evans, roulette. At my request they allowed me to play each game with the computer.

In the charts accompanying this article are Bowring's program for Tic-Tac-Toe and Evans' program for Roulett (minus the last "e" of "roulette" for that is "unnecessary"). Also shown are the print-outs of the games that I played. The language used is BASIC. To participate instead of just watch was a very satisfying experience to me—even though I came out second-best on both games.

My thoughts went back to a mathematical question I had asked my mathematics professor, Billy Francis, at Exeter my senior year, when I was taking college algebra with him: "Mr. Francis, if that is synthetic division, what would synthetic multiplication be?" He said to me, "That's a good question. Work it out and bring it to class tomorrow morning." (And I did.)

In those years of course there was no time-shared computer for mathematically-inclined students to have a chance at. But even in those years, there was excitement and challenge. Over the long years, the form has changed, but the fine intellectual stimulation of my old school still persists. And now in many, many schools the possibility of students having access to a computer is multiplying, with opportunities for immense stimulation to all of them.

```
TICTAC    15:20    MAY 29, 1965

100 PRINT "YOU ARE ABOUT TO PLAY A GAME OF TIC-TAC-TOE WITH"
110 PRINT "THE BOYS AT DARTMOUTH. GOOD LUCK. (THEY'RE GOOD.)"
120 PRINT
130 PRINT "THERE ARE NINE POSSIBLE MOVES. THE COMPUTER GOES "
140 PRINT "FIRST. GOING ACROSS A TIC-TAC-TOE BOARD THE SQUARES"
150 PRINT "ARE LABELED 1,2,3,4,5,6,7,8, AND 9 RESPECTIVELY. "
160 PRINT "ALWAYS PLAY TO WIN. THIS MEANS MOVING BETWEEN ANY "
165 PRINT "TWO SQUARES OCCUPIED BY THE COMPUTER. NEVER MAKE"
170 PRINT "A MOVE THAT HAS ALREADY BEEN MADE BY EITHER YOU "
175 PRINT "OR THE COMPUTER. CONTINUE TO PLAY UNTIL YOU EN-"
180 PRINT "COUNTER A WIN OR TIE STATEMENT. --JAMES BOWRING"
190 REM ----------------------------------------------------
195 DIM A(100), X(100), C(20,20), B(20,20)
200 FOR P=1 TO 8
210 FOR P1=2 TO 9
220 READ B(P,P1)
230 NEXT P1
240 NEXT P
260 FOR P=2 TO 9
270 FOR P1=2 TO 9
280 READ C(P,P1)
290 NEXT P1
300 NEXT P
310 PRINT
311 FOR P=1 TO 9
320 LET A(P)=0
325 LET X(P)=0
330 NEXT P
331 FOR P=2 TO 9
332 READ F(P)
333 NEXT P
340 FOR M=1 TO 5
345 PRINT
350 PRINT "MY MOVE: "
360 PRINT
370 LET A(1)=1
380 LET A(B(1,X(1)))=1
385 IF M=3 THEN 550
390 LET A(C(X(3),X(1)))=1
395 LET A(F(X(4)))=1
400 GOSUB 900
403 IF M=4 THEN 650
407 IF M=5 THEN 495
410 PRINT
415 PRINT "YOUR MOVE: ";
420 INPUT P
```

Figure 1 — Bowring's Program for Tic Tac Toe — Part 1

```
425 IF A(P)<>0 THEN 700
430 LET A(P)=2
440 PRINT
450 LET X(M)=P
460 GOSUB 900
490 NEXT M
495 PRINT
500 PRINT "TIE. GOOD GAME. ENTER 1 FOR NEW GAME, 0 FOR END: ";
501 INPUT S
502 PRINT
503 IF S=1 THEN 340
510 STOP
550 IF X(1)=5 THEN 580
560 LET A(B(2,X(1)))=1
570 GOTO 390
580 LET A(B(X(2),X(1)))=1
590 IF X(2)/2=INT(X(2)/2) THEN 610
600 GOTO 390
610 LET Z=1
620 GOTO 390
650 IF Z=1 THEN 410
653 PRINT
655 PRINT "I WIN. ENTER 1 FOR NEW GAME, 0 FOR END: ";
660 GOTO 501
700 PRINT
701 PRINT "CHEATING AGAIN ? ...  REENTER MOVE: ";
710 GOTO 420
900 LET I1=1
910 FOR I=1 TO 3
920 IF A(I1)=0 THEN 960
930 IF A(I1)=1 THEN 980
940 PRINT " O";
950 GOTO 990
960 PRINT " -";
970 GOTO 990
980 PRINT " X";
990 LET I1=I1+1
992 NEXT I
994 PRINT
996 IF I1<9 THEN 910
998 RETURN
1200 DATA 7,7,3,9,7,3,7,7,5,9,5,8,5,9,3,3,0,0,0,7,0,0,0,0,0,0,0,6,
1210 DATA 0,0,0,0,0,0,0,0,0,0,0,0,0,0,4,0,0,0,0,0,0,0,3,0,0,0,0,
1220 DATA 0,0,0,2,0,0,0,0,0,5,0,6,9,0,5,5,9,0,0,7,9,0,0,0,0,0,0,8
1230 DATA 0,6,0,0,0,8,0,0,0,6,2,2,3,8,7,2,0,5,2,2,0,0,9,3,0,0,0,0
1240 DATA 9,5,9,4,3,5,0,5,3,0,7,0,3,0,5,0,8,0,6,0,4,0,2,0
9999 END

1 GOTO 195
```

<u>Figure 2</u> — **Bowring's Program — Concluding Part**

```
LIST


BART      14:05   MAY 29, 1965

1      REM    THIS PROGRAM PLAYS A LIMITED GAME OF ROULETT.  WHEN RUN,
2      REM  JUST ANSWER THE QUESTIONS ASKED AND HOPE FOR THE BEST.
3      REM    WHEN IT ASKS FOR YOUR CAPITAL, SIMPLY GIVE THE AMOUNT OF
4      REM  MONEY YOU WISH TO PLAY WITH.  WHEN THAT IS USED UP, THE
5      REM  PROGRAM WILL PLAY AGAIN IF YOU LIKE.  TO BET ON NUMBERS
6      REM  FOR EACH ROLL, GIVE THE NUMBERS OF CHOICES YOU WANT,  AND
7      REM  THEN GIVE EACH "PAIR", I.E. - THE NUMBER 24, AND A BET OF
8      REM  25 DOLLARS.  IT MUST BE NOTED THAT, TO THIS DATE, YOU MAY
9      REM  ONLY BET ON SINGLE NUMBERS AND NO OTHER TYPE OF BETS, SUCH
10     REM  AS "ODD" OR "EVEN", "RED" OR "BLACK", ETC.
11
12     REM   INITIATED BY  BART EVANS  ON MAY 29, 1965, AND MAY BE RUN
13     REM  BY ANYONE WHO WISHES. (SAVED UNDER NO. S04510)
14
100    DIM N(100), B(100)
110    FOR Z = 1 TO 100
120    LET N(Z) = 0
130    LET B(Z) = 0
140    NEXT Z
145
150    PRINT "INPUT ANY RANDOM NUMBER TO START SERIES : ";
160    INPUT X
170    FOR Z = 1 TO X
180    LET X = RND(X)
190    NEXT Z
195
200    PRINT "INPUT THE AMOUNT OF YOUR CAPITAL : ";
210    INPUT C
215
220    LET H = 0
225    LET B = 0
230    LET W = 0
240    LET L = 0
250    PRINT " INPUT INTENDED NUMBER OF BETS : ";
260    INPUT K
265    IF K = 0 THEN 580
270    PRINT " NOW GIVE YOUR CHOICES AND THEIR BETS --"
275
280    FOR Z = 1 TO K
290    PRINT "   INPUT PAIR"Z;
300    INPUT N(Z), B(Z)
```

Figure 3 — Roulett Program of Evans — Part 1

```
310  LET B = B + B(Z)
320  NEXT Z
325
330  GOSUB 5000
335
340  FOR Z = 1 TO K
350  IF N(Z) = N THEN 380
360  LET L = L + B(Z)
370  GOTO 390
380  LET W = W + B(Z) + (35*B(Z))
390  NEXT Z
400  LET H = H - L + W
405
410  PRINT
415  PRINT "  OF A TOTAL BET OF  $"B ","
420  PRINT "   YOU HAVE LOST  $"L "AND WON  $"W
425
430  IF H < 0 THEN 480
440  PRINT "  YOUR CAPITAL HAS GROWN FROM  $" C "TO  $" C + H
450  LET C = C + H
460  PRINT
470  GOTO 220
475
480  IF C + H < 0 THEN 530
490  PRINT "  YOUR CAPITAL HAS SUNK FROM  $"C "TO  $" C + H
500  LET C = C + H
510  PRINT
520  GOTO 220
525
530  PRINT "   BUDDY, YOU'RE CLEANED OUT..."
540  PRINT "    WANT TO TRY AGAIN ? TYPE 1 FOR YES, 0 FOR NO : ";
550  INPUT Z
560  PRINT
570  IF Z = 1 THEN 200
575
580  STOP
585
5000 LET N = INT (38*RND(X))
5100 IF N <> 37 THEN 5500
5200 PRINT
5300 PRINT "  THE NUMBER IS  00"
5400 GOTO 5700
5500 PRINT
5600 PRINT "  THE NUMBER IS " N
5700 RETURN
5800
9999  END
```

Figure 4 — Roulett Program of Evans — Concluding Part

THE "SMALL" COMPUTER VERSUS TIME-SHARED SYSTEMS

Marvin Emerson
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The question facing many an engineer today in order to solve a problem is whether to spend three hours in tedious slide rule work or to send it on to the computer center and take up to 24 hours for an answer — since a minimal flow of the problem is from the engineer to the programmer, then to the scheduler, then to the key punch operator, then to the computer room, and finally back to the engineer in the form of results.

This time barrier between the user and the computer has focused attention on two solutions: the small, personal computer and the time-shared computer system. Both provide for direct communication by the engineer with the computer, and both have the faculty of providing immediate answers to immediate problems.

The Small Computer

The small computer is normally defined as a computer in the $15,000 to $25,000 price range, operable in normal working environments without the aid of special installations and, more importantly, without the use of specialized computer personnel. This, in fact, is the crux of the small computer concept: It must be directly operable by the user. Only where the user (the man with the problem) can communicate directly with the equipment can the small computer hope to compete with larger, faster equipment. Essentially, if a programmer is required to act as an intermediary between the user and the computer, his service might just as well be used on a large-scale machine capable of handling a greater amount of work, consuming less time, and producing more useful answers. If the small computer, however, can be approached directly by the user, then in terms of "throughput time", it can produce more useful answers than a larger machine, and produce them immediately. The quick interaction benefit is so evident that attempts are being made by the large computer manufacturers to achieve the same victory of personal relations between man and machine through the use of time-sharing of a central processor with multiple input-output stations. The time and money spent in the development of time-shared systems are of great magnitude and prove the importance that manufacturers and users alike assign to the direct-access computer. Such systems by virtue of their size and speed do indeed present formidable competition to the small scale computer.

However, let's examine the inherent problems in some detail.

Economical Cost

The basic problem of the time-shared system is one of economics. There is little doubt that from a technical point of view such systems are feasible both from a hardware and from a software point of view, and in fact such systems are now operating in the laboratory environment. However, it remains to be seen whether such laboratory experiments can actually compete in a non-military environment, where costs cannot always be written off against urgency.

It has been estimated that a single station for a time-shared system will cost approximately $32,000. This estimate was based on a central processor with 90 satellite input and output stations, and includes one input-output station, a ninetieth part of the central processor, and the necessary communication lines. Thus the cost of a total time-shared system is somewhere around three million dollars. This includes hardware only. It makes no provision for the extensive software which would be required to put such a system into operation.

Three million dollars in computing equipment is a sizable investment for any company. When the costs of operating and maintaining such a system are included, taking into account personnel, installation, supplies, etc., it becomes clear that not very many companies can afford such a system. This is particularly true since the bulk of the investment is tied up in the very high-speed high-capacity central processor. It is, therefore, not possible to build such a system up slowly.

The other alternative is using a centrally located computation center, and supplementing it with individual small computers instead of mere input-output stations. In this way the company can build its system computer by computer as its needs grow. Such a system can be built up at considerably less cost, since the small computers range in cost from about 20 to 25 thousand dollars, and are cheaper than the input-output time-shared station. Furthermore, most small computers require no special installation and come equipped with a software library which is sufficient for most engineering usage. Another consideration in favor of the small computer is the fact that a failure of the centralized time-shared processor would leave 90 frustrated users sitting idle until operation was restored.

Speed

What are the advantages that the time-shared system offers as opposed to the small computer? Basically two advantages can be readily seen. First, the time-shared system normally offers much greater memory storage than the small computer. Second, it offers faster processing capabilities than most small computers.

The speed advantage, however, is in part imaginary, because of the software packages necessary for the operation of such a system; and at best it is of temporary duration, since the speeds of small computers are rapidly rising into the microsecond range.

Storage

As for the added storage capability, this can be a very significant advantage for certain applications. It has been suggested for example, that such systems could be used by professional groups such as doctors and lawyers to quickly sift through large amounts of information and extract that which is pertinent to the problem at hand. Without a doubt, a large centralized processor is necessary in order to store and retrieve from the huge quantities of data required by such an application. In this kind of application, however, the system really ceases to be a computer per se and becomes basically a large data retrieval operation.

Experience has shown that for engineering and scientific computation the amount of data to be manipulated is relatively small whereas the computational operations required are numerous and somewhat complex. This is the converse of the common business data processing situation where the amounts of data are considerable and the computations performed are relatively simple and few. In the case of the data retrieval system, this would be carried to its logical extreme: amounts of data of even vaster proportions than those used in business data processing and no computation ability at all.

Cost Sharing

One suggested answer to the high cost of time-sharing has been that of cost sharing. Several companies or individuals could be connected by means of some leased wire operation to a large processing unit. The obstacles here are again monetary since the installation of remote inquiry stations presents a considerable additional expenditure. It is likely that the inquiry station itself would have to contain a fast means of transmission as well as the necessary interface between the station and the computer.

In many time-sharing systems, the input/output stations must be provided with more than a typewriter keyboard since certain problems require a means of communication which can be permanently stored, such as cards or paper tape. Thus, the individual station should have both manual and automatic means of communication with a computer.

Software Versatility

The software aspects of a time-shared system present further problems, but in fairness to such systems, let us examine the advantages first.

The basic advantage is related to the large memory capacity of a central process of this type. All the utility programs of the system can be stored in memory at all times and be shared by all of the input and output stations. This would include assemblers and interpreters, compilers of the Fortran or Cobol types, a complete library of software, and various de-bugging aids. The user would, therefore, not have to worry about what programs are in the machine at any given time or whether his source data is acceptable. He could approach the computer in any language and it would be up to the compatible time-sharing system to recognize the particular language he was using, to properly interpret his commands, and to execute them as required.

This concept is highly attractive to the prospective user of a time-shared system, since the programming requirements of various departments within a company, not to say of various companies leasing time on single computers, are quite varied. The price of this convenience, however, is paid first in the complexity of the monitor programs it requires to operate the system, and second, in a loss of efficiency which necessarily occurs in a time-shared machine.

The supervising program of the time-shared system must first of all be a multi-lingual monitor, in the sense that it must be able to distinguish between the various languages and refer incoming instructions to the proper language stores for processing. It must further be capable of assigning proper priorities to the various stations, handling interrupts of various types, and manipulating programs, sub-routines and data in and out of storage. It is evident that a very sophisticated program is called for, and a considerable investment in programming time is required to produce a properly working system of this type. However, this difficulty is basically of a temporary nature since programs of this type will be developed by the computer manufacturers and/or by the users themselves.

Marvin R. Emerson received his Master of Science degree in electrical engineering from the University of Southern California in 1953; but he began his electronic engineering career as an Electronic Technician's Mate in the U.S. Navy 1945-46.

He has had engineering responsibilities in Hughes Aircraft, NCR Electronics Division, the Norden Division of United Aircraft, and Mesa Scientific. From 1963 till now he has been Vice President Engineering with Pacific Data Systems. He holds one U.S. patent and has applied for two more. He is married and has three children.

Software Efficiency

More to the point is the question of efficiency which enters into the picture when the time-shared system is considered. The time-shared system operating under the control of the supervisor program serves a multitude of stations in a sequence of some sort. As each station is served, the monitor examines the input, determines the appropriate programs necessary to interpret it, and calls these programs forth from a secondary storage. It then proceeds to process the input until the time period allocated for the particular station has elapsed, at which time it must return the processing program to its secondary storage and also store both the input information and the intermediate result of its processing, before proceeding to the next station on the line. It is, therefore, evident that a good deal of the computer's time is occupied by calling forth and storing programs of various sorts and that only a portion of its time is spent in an actual computation. Nor is the machine very fast in terms of the elapsed time period required to do a specific job: In a system in which each station was allotted a 15 millisecond period out of a 2 second cycle, 14 minutes of elapsed time would be required to evaluate one minute of actual machine time for the particular station.

This perhaps would not be so bad if the minutes of machine time were all usefully spent in computation. However, in a time-shared system with 110 consoles divided among 220 programmers, each of whom uses his station 4 hours a day, the efficiency of the computer would be reduced to about 27%. In an 8 hour period, 130 useful minutes of computing could be obtained. Divided by the number of programmers using the sytem, each programmer would wind up with 6/10 of a minute of useful computing in the entire 8 hour shift.

When we consider that the usage of a system of this type would in most cases involve interpreters, compilers, or other artificial languages for user communications (systems which in themselves are not highly efficient), it becomes evident that a considerable penalty in efficiency is being paid for the convenience of the time-shared system.

Small Computer

It may be argued that even with all of these inefficiencies the time-shared system due to its basic speed, is still faster than the small relatively slow computer. Since most contemporary computers in the $20,000 range are millisecond machines, whereas the time-shared system is usually in the low micro-second range, it could be argued that 6/10 of a minute on a microsecond computer may at least equal and sometimes surpass the amount of work which can be accomplished on a millisecond computer in an 8 hour shift. Such considerations, however, are only temporary in nature. As the technology advances and the price of core memories and their associated hardware declines, it is almost inevitable that small computers will soon be available in the micro-second range. When this happens, direct use of a small computer will compare favorably in terms of speed with the time-shared system. In terms of this efficiency, it will probably exceed the time-shared system and provide as significant an advantage in terms of turnaround time as the small computer today offers over the central installation.

In summary then it follows that the time-shared system will find its use mainly in specialized applications which require extraordinary storage capabilities for data that must be available and are common to a large number of users. In terms of day-to-day engineering calculations, however, it is likely that the small direct-use computer will be able to hold its own as being more efficient, less costly, and in terms of wasted man hours, more reliable than the time-shared system.

A TIME-SHARED COMPUTER SYSTEM— THE DISADVANTAGES

Neil Macdonald
Assistant Editor, Computers and Automation

In these days, many people consider a time-shared computer system to be highly desirable, and something that should be obtained as quickly as it can be afforded.

When one is in such an optimistic mood, it is worthwhile to be very objective about the disadvantages as well as the advantages. In this short report we shall concentrate on the disadvantages, based largely on some limited but very real experience. Probably there are enough people nowadays concentrating on the advantages.

Down-Time

A number of reasons can cause a time-shared computer system to stop running. They include: scheduled maintenance; finding and repairing failures; adding or subtracting peripheral units; modification of the monitor programming that does the time-sharing; etc. Of course, if there should be two powerful central processors instead of one and both of them on-line, the problem is mitigated—but the cost is much greater.

When such down-time happens, everybody is inconvenienced. If there are 40 users, down-time is equivalent to 40 separate computers all failing at once. Yet, if each of 40 users had his own small computer, it would be almost impossible for all of them to fail together for some six days (as actually happened at one time-shared computer system in April). Only an actual physical disaster on a very large scale could produce such an interruption.

It is undesirable to be in a position to suffer this kind of inconvenience.

Pressure for Access

Another disadvantage to the time-shared computer system is that there is continual pressure for access to the system. For example, at a university; more and more of the faculty and the students will want access, and are likely to receive permission to use the system.

Because of continual pressure, the number of consoles increases and increases. Even a $3-million time-shared computer system cannot change from 90 consoles to 180 consoles without affecting the quality of service the console users receive. Many phenomena of scarcity will appear. It is like the problem of a central city like New York with narrow streets clogged with traffic and parking; finally, people stop going to the central city and instead do their shopping elsewhere. In the same way, people will stop using a time-shared computer system and take their computing to some other facility. No matter how well organized a time-shared computer system may be at one time, there will be a tendency for it to be less well organized at a later time if the pressure for access increases and increases.

Priorities

As a result of pressure for access to the time-shared computer system, it is likely that a system of priorities will be set up. Then some persons with high priorities can get all the time that they want (whenever they want it); less favored persons get less; and the low man on the totem pole has to use a console from 2 to 5 in the morning in order to get access without undue waiting.

Yet, in the case of a small computer, if two programmers who work together are using an entire small computer, it is easy enough for one to say to the other, "Now in about five minutes, you can have the computer for half an hour while I think, and then I will need it again." But woe to the user of a time-shared console if he gives up his party line of access—half an hour later he may be quite unable to recover access to the computer.

Impersonal, Mechanical Arbitrariness vs. Politeness and Courtesy

A person who uses a time-shared computer system is at the mercy of the supervising and monitoring system. It is bad enough to be at the mercy of a human being who supervises a computer room, who is in charge of scheduling work for the computer, and who can put your problem on the computer when he chooses to. But at least you can deal with him as a human being; you can tell him how urgent your problem is; you can beg him for help so that you can meet your deadline; and he can look you in the eye and judge whether you are telling him the truth or a story; and if he says no, you can appeal to his superior, and so place your appeal before a higher court.

Very little of such personal interaction if any is likely to be possible with a time-shared computer system, because a mechanical and impersonal monitoring system makes decisions about your access to the computer. It has no way of looking you in the eye and judging if your appeal is bona fide or not. As soon as the monitoring system concludes that you should have no more access to the computer, you are automatically disconnected, and there is not very much you can do about it, because the system is no longer listening to your console.

Complexity—the OPEN SESAME Problem

The knowledge of how to use a time-shared computer system is likely to expand voluminously and be recorded in a tremendous file of memoranda. Yet information in that file of memoranda is likely to become harder and harder to dig out. At least two causes operate to make this happen.

First, a time-shared computer system implies 20 or more very bright people working on the different parts of the system and developing it. These people with their fast minds are unlikely to be good at explaining on paper to slower minds what they are doing. Consequently, the slower minds (or the minds who were fast 10 years ago, who have now risen in the economic scale, and who have other duties to attend to) find it harder and harder to keep up. Eventually each user will likely use only a small part of the mass of software technique in the time-shared system.

Second, a time-shared computer system is likely to be one of a kind. In contrast, for the usual computer which is sold in tens or hundreds of copies, there is a strong pressure from the market of users to simplify and unify the software, so that it can apply to each copy of the computer. No such pressure exists for a one-of-a-kind time-shared computer system. As a result, its software will cost more, be more complex, and be used less.

It will become harder and harder to learn and remember the OPEN SESAME rules that unlock the treasure.

Cost

Finally, the cost of computing power is steadily dropping. So it seems likely that soon more people can have more computing power for less cost by avoiding the unnecessary troubles of a time-shared computer system, and solving a great part of their need for computer power with a small computer. In much the same way, some families solve almost all their problems about the time-sharing of a car, when both husband and wife have a car each.

Furthermore, it seems quite likely that 90 to 98 percent of the problems that most individuals would like to have a computer for, could be done on a small computer, with, say, a disc memory, for less cost than the appropriate part of the hardware and software of a time-shared computer system.

CALENDAR OF COMING EVENTS

Sept. 8-10, 1965: Industrial Electronics & Control Instrumentation Conference, Sheraton Hotel, Philadelphia, Pa.; contact Lewis Winner, 152 W. 42 St., New York, N. Y. 10036

Sept. 9-10, 1965: VIM (6400, 6600, 6800) Users Group, U. S. Weather Bureau, Washington, D. C.; contact Gordon V. Wise, Mgr., Public Relations, Control Data Corp., 8100 34th Ave., So., Minneapolis, Minn. 55440

Sept. 20-23, 1965: Second Systems Engineering Conference & Exposition, McCormick Place, Chicago, Ill.; contact Clapp & Poliak, Inc., 341 Madison Ave., New York, N. Y. 10017

Sept. 22-24, 1965: UNIVAC Users Association Annual Fall Conference, Hilton Hotel, Pittsburgh, Pa.; contact Bruce M. Wallis, O. E. McIntyre Inc., Prospect Ave., Westbury, N. Y. 11590

Sept. 22-24, 1965: 17th General Meeting of Philco 2000 Users Group (TUG), Kenmore Hotel, Boston, Mass.; contact A. F. Peterman, Ford Motor Co., Manufacturing Services, Room 1110, 3001 Miller Rd., Dearborn, Mich.

Sept. 29-30, 1965: 1965 Fall National Symposium of the Society for Information Display, Commodore Hotel, New York, N. Y.; contact Gordon Burroughs, Corrigan Lane, Greenwich, Conn.

Oct. 4-5, 1965: SWAP Users Group, Radisson Hotel, 45 So. 7th St., Minneapolis, Minn.; contact Gordon V. Wise, Mgr., Public Relations, Control Data Corp., 8100 34th Ave., So., Minneapolis, Minn. 55440

Oct. 4-7, 1965: 20th Annual ISA Instrument-Automation Conference & Exhibit, Sports Arena, Los Angeles, Calif.; contact Public Relations Dept., Instrument Society of America, Penn-Sheraton Hotel, 530 Wm. Penn Pl., Pittsburgh, Pa. 15219

Oct. 10-15, 1965: 1965 Congress of the International Federation of Documentation (FID), Sheraton Park Hotel, Washington, D. C.; contact Secretariat, 1965 FID Congress, 9650 Wisconsin Ave., Washington, D. C. 20014

Oct. 19-22, 1965: Symposium on Economics of Automatic Data Processing, Rome, Italy; contact International Computation Centre, Viale della Civilta del Lavoro, 23, P.O.B. 10053, Rome, Italy

Oct. 20-22, 1965: Fall Conference of the H-800 Users Association, Jung Hotel, New Orleans, La.; contact John D. Kearney, Conference Chairman, NASA Michoud Operations, P. O. Box 29300, New Orleans, La. 70129

Oct. 21-23, 1965: IFAC/IFIP Symposium on Microminiaturization in Automatic Control Equipment and in Digital Computers, Munich, Germany; contact Verein Deutscher Ingenieure — Abt O, P.O. Box 10 250, Düsseldorf, Germany

Oct. 26-28, 1965: CO-OP Users Group, Maison Internationale Des Chemins de Fer, 14 Rue Gene Rey, Paris, France; contact Gordon V. Wise, Mgr., Public Relations, Control Data Corp., 8100 34th Ave., So., Minneapolis, Minn. 55440

Oct. 27-29, 1965: Second National Conference on EDP Systems for State and Local Governments, N. Y. University Graduate School of Public Administration, New York, N. Y.; contact Prof. Herman G. Berkman, Graduate School of Public Administration, N. Y. Univ., 4 Washington Sq., No., New York, N. Y. 10003

Nov. 1-3, 1965: International Systems Meeting, Palmer House, Chicago, Ill.; contact Richard L. Irwin, Exec. Dir., Systems and Procedures Association, 7890 Brookside Dr., Cleveland 38, Ohio

Nov. 2-5, 1965: GUIDE International (User Organization for Large Scale IBM EDP Machines) Meeting, Jung Hotel, New Orleans, La.; contact Lois E. Mecham, Secretary, GUIDE International, c/o United Services Automobile Assoc., 4119 Broadway, San Antonio, Tex. 78215

Nov. 3-5, 1965: Data Processing Management Association Fall International Conference, Adolphus Hotel, Dallas, Tex.; contact R. Calvin Elliott, Exec. Dir., DPMA, 524 Busse Highway, Park Ridge, Ill. 60068

MAN/MACHINE INFORMATION TRANSDUCERS

Sullivan G. Campbell
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The vision of Charles Babbage—the computer as the "Compleat Analytical Engine"—has been largely realized; but the vision of the later prophets—that of a powerful and innovative synthetic tool—has led more to promise followed by disappointment than to prophecy followed by fulfillment.

Analysis

The role of the computer as an instrument of analysis needs no apology: computers and their associated programming systems range freely, performing complicated algorithms on complex information structures, almost without regard for the traditional boundaries between accounting, statistical analysis, combinatory analysis, or hydrodynamics; between numbers and any other form of symbolic information; between arithmetic and syntax; between control in the real world and simulation in the abstract. It is difficult to find significant failures when the computer has been applied to problems in analysis. But it is equally difficult to find significant successes when it has been applied to problems in synthesis.

An attempt to answer a question such as, "In which areas has the performance of the electronic digital computer been most disappointing?" usually elicits legitimate answers relating to the fields of education, engineering, and human organization structures. "Artificial Intelligence" and "intelligence amplification" are frequently cited as areas about which much has been published but in which solid accomplishment has proved unexpectedly elusive. The difficulties in getting computers to translate languages as well as a first-year student with a dictionary; to write poetry, prove theorems, or compose music, are often cited.

Synthesis

When the problem is examined further, it commonly turns out that the computer has failed to synthesize some structure in terms of rules which are not very well understood: even a thoroughgoing analysis of text in one language does not guarantee that the computer can synthesize an adequate translation in another language—just as correct analysis of an engineering problem does not guarantee the ability to synthesize the solution (unless one is deluded into thinking that the result of the analysis of the problem *is* the solution). For example, the student who figures out how fast 7 men can build a house if 2 men can build it in 98 hours is merely misapplying a law of universal linearity; he is solving no problem related either to house building or to resource allocation.

I. Education

Education, in particular, is clearly synthetic; the aim of the process is to synthesize the successful student as a basic product from which various categories of successful adult can be synthesized in turn. The role of analysis in education is largely that of testing—of evaluating performance in order to provide feedback to the system.

Initially, the role of the computer in education, as in most areas, was simply that of saving labor by automatically grading tests. The use of the computer as a continuous monitor of progress, rather than as the scorer of occasional tests, permits an approach closer to the tutor than to the classroom. In some areas of education such an approach can be effective; and this in turn can lead to situations in which the computer alone possesses the relevant data to determine what the next step in the process should be. But the ability of the computer to monitor continuously, to decide the next step on the basis of all past responses, is nearly worthless unless adequate information can flow between student and machine.

II. Engineering

The engineer, like the educator, is primarily a synthesizer. Analysis can only tell him how well he is doing, whether the bridge will fall down or not, whether the rocket is going to fall into the ocean or on land; and analysis can only tell the educator that this particular student is doing well or badly in this particular course. Like the educator, the systems engineer requires analysis to tell him the consequences of his acts. Like any innovator, he is not impressed by critical analysis which comes too late to be of real benefit. He requires almost continuous feedback; as the complexity of the problems with which he must deal increases, he is forced to suppress ever higher levels of detail.

The Properties of a Computer

The computer has always been regarded as a sort of super slide rule; and more recently it has been looked upon increasingly as a mechanized handbook. In reality it is much more than either or both of these: it is a device for analyzing complex problems on a time-scale commensurate with human reaction times and decision mechanisms; and it is a device which can handle increasingly high levels of detail because humans are continuously reducing such higher levels of activity to routine detail which can be handled by a computer.

Man/Machine Information Transducer

It is not possible to store in an office all the tables which a computer could compute, all the alternative designs which a computer could examine, or even all the text which a computer could scan. Nor is it very practical to put the computer itself in the office, because either then it must be a very small computer, of limited utility; or if it is a large computer, it uses more space and costs far more money to use than the original inhabitant of the office. What can be put in the office is a device which communicates on one side with the human user, and on the other side, via electronic communication links, with the computer. We shall call such a device a man/machine information transducer, or MMIT.

Strangely enough, we know much more about the information capabilities and requirements—capacities and powers—of computers than of human beings. A computer is really two-sided: an I/O channel usually has the same capacities in or out, although the devices attached to it may be one-sided; but this one-sidedness usually relates to that of the human beings on the other side of the device. At best, the human being can take in information many orders of magnitude faster than he can generate it. This imbalance is intensified by the fact that the primary human output mechanism—the voice—is at present unintelligible to the computer, leaving the human with little more than his ten fingers as primary media for communicating to the computer.

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Power of Language

What the human lacks in bandwidth, then, he must make up in the power of the language he uses. Much has been made of the fact that the computer does not understand English—written English or spoken English, proper English or improper English. We frequently talk as if this were unfortunate. Yet we may doubt that English is really the proper language for instructing computers even if they could understand it, any more than it is the proper language for doing mathematics. Mathematics could not develop into certain areas until the proper symbolism was developed; physics could not develop until the required mathematical language was created. In the same way, it may be doubted that computers can be applied successfully in certain areas until the proper symbolism is defined and implemented. Perhaps in time natural language will come to be influenced by computer language as much as computer language is influenced by natural language.

The human being, then, is challenged to develop appropriate languages for telling the computer what he wants it to do for him (although as soon as this happens, the computer begins using the same language to talk back to the programmer). Since the computer may work for a long time in response to a relatively simple set of instructions, and since it takes the man much longer to figure out what he really wants than it takes him to write it down, this particular imbalance is often not disturbing. It is serious only to the extent that in many areas the required language has not yet been generated, and it therefore becomes excessively difficult to describe to the computer what is desired; but the solution would still appear to lie more in better languages than in direct voice translation into computer input.

Cost

It is almost taken for granted today that the eventual triumph of totally integrated circuitry combined with improvements in packaging and in systems design and organization will drive the cost of internal computing and storage down close to zero; but that at the same time, the Man/Machine Information Transducer—the MMIT—will neither come down much in cost and size, nor go up much in performance. Indeed, the problems of the integrated circuit on a single chip have been solved to the extent that it is possible to concentrate more on packaging; and the problem of designing an efficient system for the central processor unit (CPU) and memory has been solved rather well also. So now it is possible to concentrate more on the periphery—on using such systems as utilities, to serve multiple users with multiple requirements from multiple locations, via time-sharing; and hence to the problems of interconnecting such systems with the proper mix of communications, storage, and computing. Such approaches demand improved systems design, improved communications capabilities and prices, and particularly, improved terminal hardware combined with improved terminal languages.

Improved systems designs already exist. Improved communications capabilities pose problems neither in technology nor in cost; but they can probably not be made available satisfactorily without a change in pricing structure comparable to that which Charles Babbage brought about more than a century ago with his early operations analysis which led to the penny post. Terminal hardware cannot be expected to shrink either in cost or in size proportionally with the shrinkage of electronic componentry. The reasons are that its size is determined by the requirements of the human user, and its cost in part by imaging and mechanical considerations which are not altogether electronic. What can be expected of the MMIT is an increase in function, in usefulness, and in reliability. Substantial decrease in price can only result from substantial acceptance in the market place and the resulting benefits of mass production.

Input Requirements

Ideally, the man would like to communicate to the computer, via the MMIT, both graphical and digital information, and control information. Since his own direct input is manual, the useful limits of what he can do are largely obtained by providing a keyboard (with adequate character set); control buttons; and analog input devices which give him the facility of drawing, pointing, and performing simple geometric operations on whatever he is looking at. The utility of keyboard and control buttons is unquestioned; but with the exception of certain very specific applications, it is not clear that the advantages of analog joysticks, dials, and light pen pointers are really superior to those of an adequate MMIT language which would instruct the device to do the same thing. As DesCartes observed, a point can be located by coordinates as well as light pen; and a rotation can be called for by an instruction as well as by a knob. However, satisfactory languages for communicating with the MMIT do not now exist. It appears probable that such languages can be best created by beginning with certain specific applications, and developing good languages for those applications, rather than attempting to write the "Super-Universal MMIT" language all at once.

Voice Input

Obviously, the ideal MMIT would also accept voice input, and would read either digital characters or graphical information presented to it. Such devices are just now coming within the capability of the technology, and may be expected to find their place initially within large centralized installations. It should be more economical to transmit such images directly to the central computer via digital scan, and interpret them there, than to attempt to deal with them at the MMIT. However, this does not mean that the MMIT should not possess a certain amount of storage capability, both digital and graphical, in order to maximize the total-systems performance-cost ratio, taking into account communications, storage, and computing. As integrated circuitry and mass memories become available, the economics will inevitably change toward including more function in the MMIT. This can minimize communications requirements in the same way that specialized storage facilities within the other parts of the system, including the CPU, can minimize information transfer.

Output Requirements

On the output side, the upper limit to the bandwidth required by the user, via any display, might be taken as that required to reproduce the total visual surroundings of a human being within the ability of the eye to resolve and the neuron to react. Considering the requirements for spatial resolution, intensity, and color, this implies a bandwidth on the order of 20 kilomegacycles. While it is true that this is orders of magnitude beyond the bandwidth of the optic nerve, we live out our lives immersed in that much accessible information, and we have the ability via secondary feedback (hearing, smell, touch, etc.) to select any desired part of it at any time. Further, if many human beings are watching the same MMIT, perhaps for different reasons (else there is little purpose to having many people watching it) it becomes increasingly difficut to guess where each one will concentrate his center of vision at any given time (in fact, if we knew that, the problem might have been solved already). Such display rates are possible at present only via photographic film or similar graphic device; but such information is necessarily canned, and of limited usefulness here. For comparison purposes, video display can operate practically at about 20 megacycles; high-speed communications lines operate up to about 200 kilocycles, and can transmit digitized documents at about the maximum rate at which humans can scan them; and telephone lines can transmit encoded digital information (characters) at reasonable human scanning and reading rates. (In dealing with textual and graphical information, it is the scanning rate rather than the reading rate which is important. What the human being frequently desires is to scan, looking for an interesting event or for information which he desires; when he sees such information, he may either react to it, or he may prefer to create a hard copy of it for later examination.)

Characteristics of the MMIT

The most important characteristics of the MMIT can now be listed; the order of importance will vary somewhat with the application. They are:

1. Resolution
2. Size
3. Brightness
4. Ability to view in high ambient light
5. Ability to add information selectively
6. Selective erasure
7. Variable brightness (shades of gray)
8. Retentiveness
9. Hard copy capability
10. Color
11. Ability to recall previous displays
12. Feedback (via program or writing device)
13. Programmable decay
14. Dimensionality
15. Perspective

Not all of these characteristics can probably be achieved in a relatively low-cost, simple display. Yet it appears possible that most of the more important ones will be achievable through new technologies in imaging and display, and that other characteristics can be added when and if they are required. In addition to the ubiquitous cathode ray tube, almost daily there are advances in electroluminescence, in photoconductors, in photochromism, in deformation and other new types of imaging, including reusable thermoplastics; in new writing techniques, using lasers and other light sources capable of modulation; and in holography. None of these developments has yet achieved a completely satisfactory state of development for the applications in question. But it was not necessary to wait until integrated circuitry had been proved in order to define new systems based on integrated circuitry. Neither is it necessary to wait until the final testing and proving of new MMIT technology to commence early design and experimentation with actual hardware and actual applications.

c&a CAPITAL REPORT

A Special Report from C&A's Washington Correspondent

Hearings were held in July by the House Military Operations Subcommittee on the role of the General Accounting Office. Industry witnesses took the opportunity to complain loud and strong about the treatment they sometimes receive from GAO. As its middle name implies, GAO accounts for the Government's money. It does so by examining the contract records of Government agencies and their contractors, sometimes years after the contract is completed. It has often been called "the watchdog of Congress," but there are enough misgivings in Congress about GAO's operations that the public hearings were called.

When he opened the hearings, Congressman Chet Holifield said, "There are many cases where GAO has asked the Government agencies to attempt to recover from contractors the amount of alleged overpricing. In a goodly number of cases, contractors have paid up; in others they have contested the GAO findings, and the Government has been unwilling or unable to recover, because the agency officials believed there was no basis in law or equity to effect such recoveries."

But the cases are numerous where the contractor has been forced to pay up or risk losing future Government business. Robert H. Charles, Assistant Secretary of the Air Force, cited one case that concerned computers used by Lockheed Missiles & Space Company. He quoted the GAO report resulting from inspection of Lockheed's records:

"Our review of the leasing of electronic data processing equipment by (Lockheed) has disclosed that rentals paid by the contractor for use of the equipment (four IBM 7094s and eight 1401s) during a 20-month period were excessive because the manual time recording method used did not accurately record machine use time. This condition was subsequently corrected by the contractor through the installation of automatic timing devices on the EDP equipment. On the basis of use-time recorded by the contractor after timers were installed, we estimate that excessive rental payments to the equipment manufacturer during the preceding 20 months amounted to about $604,000, essentially all of which has been charged to Government contracts."

Asst. Secy. Charles then said that despite the fact that the manual system was what was intended by the parties —Lockheed and the Air Force—GAO persisted in requesting refunds. He again quoted the GAO report:

"It is apparent that after the installation and use of the automatic timing devices, the amount of chargeable use time was significantly reduced. We believe that the rentals were paid on the basis of an inaccurate determination of use time. On the basis of the accepted method of meter measurement which was in effect at Lockheed, and now is in general use, a refund is justified. We are recommending, therefore, that the Department of Defense, in coordination with the equipment manufacturer and Lockheed, take action to resolve the matter with due regard for the interests of the Government."

Charles said, "The GAO here has recommended that the Air Force seek a refund notwithstanding the fact that both parties entered into a contract which permitted and contemplated such a manual time measurement system. It is my feeling that refund action under such circumstances renders meaningless the contractual obligations of the parties.

"In effect," Charles concluded, "this GAO report is suggesting that when an improvement is made, the practices of the past should be re-examined to determine whether they resulted in any 'unnecessary' cost to the Government which we should now try to recoup. To do so would, in our judgment, deter our contractors from introducing needed changes and improvements. Such a policy would have the effect of penalizing progress instead of encouraging it."

Close to 100 GAO reports have been released to the public on EDP matters alone, and this public airing is another thorn in the side of both the contractor and the contracting agency. On the basis of one report, a contractor may be made to look like a criminal, although there is never any mention of the contractor's over-all performance. The reports are picked up in the press galleries of the Capitol Building and often given to and read by the general public as facts, rather than as GAO judgment, as many believe they are. In addition, the reports name contracting officials in such a way that their Government career standings may be damaged, although they may be guilty only of a single questionable decision.

William H. Moore, of the Electronic Industries Association, told the subcommittee, "We recommend that GAO discontinue its practice of public release of its audit reports, or at least set forth such information in a separate appendix which would be provided to the Congress and to the Government agencies involved, but would not be included in the public release. We also recommend that GAO honor reasonable requests of contractors for confidential treatment of such information."

On the closing day of the hearings, Frank H. Weitzel, who is now serving as acting Comptroller General since the resignation of Joseph Campbell because of ill health, summarized GAO's position on these matters:

"We recognize that no one likes to be audited or to be criticized for actions taken and decisions made. However, it should be remembered that it is the duty of the General Accounting Office to make audits for Congress, which include critical examinations of administration of Government contracts. As long as audits are to be made, whether by the General Accounting Office or by some other audit agency, there are bound to be differences between the auditor and the agency or contractor."

But Weitzel indicated that there will be more protection of the contractors in the future, by giving them a chance to reply to GAO's charges before the reports are released to the public. He also said there is no need to mention the contracting officers, or to include language such as "excessive," "unwarranted," or "unjustified" when talking about contractor profits.

If carried through, these improvements might soothe the feelings of contractors and bring about increased integrity in Government contracts.

Sperry Rand's Univac Division won out over some stiff competition recently when it was awarded a $1.3 million-a-year lease contract to supply the Army with 63 small computers. As reported here in July, the computers will replace most of the punch card accounting machines now in use at various Army commands.

Although it was up against formidable competitors, including Burroughs, which won a 151-computer contract from the Air Force last year for the same purpose, Univac's prize can be looked at in the light of a Government program that has evolved under Lee Johnson, Vice President of Federal Marketing. This program has at its center the fact that Univac does not bid on all EDP contracts that come along in hopes of getting a fair share, but just on those that it feels confident of bringing in. This is the "rifle approach," rather than the "shotgun approach," and Univac has been highly successful with it.

Univac had another edge on its competitors on this contract. Last year, it sold the Army about 80 Univac 1004s, some of which the individual Army commands may send back for updating to 1005s, which are one cut above 1004s. Cost of this updating would be $250 a month on each machine, or $6,000 if purchased. The 1005s will have stored programs, rather than the external plugboard of the 1004s. Another major difference will be their ability to handle magnetic tape, as well as punch cards.

READERS' AND EDITOR'S FORUM

(Continued from page 9)

will be quite brief in explaining why I feel that it is a giant step forward for the computer industry. In the United States today, over a billion and a half dollars are spent annually, directly or indirectly, in the development of computer programs. By the end of 1970, over half a million people are expected to be employed in programming activities having an annual economic value equal to that of all computer manufacturing. Programming today is certainly big business.

But the development of programming has been severely inhibited by the lack of legal protection. The Patent Office has ruled that programs cannot be patented. Without copyright protection, programs cannot be distributed on a wide scale with the hope of financial return. The result has been waste, needless duplication of effort, and the fact many valuable programs were never written. Programs which were written were often kept secret. Many programs were never written because none of the development cost could be passed along to other users.

With copyright protection, much of this will change for the better. Program writers will be able to develop programs for a wide market rather than waiting for a single large user to request a particular program. Programs previously kept secret may be made available under copyright protection for a small leasing fee. All in all, computer programs will be put on the profit system which so far has always served to encourage creativity and the interchange of valuable information. Gentlemen, I wholeheartedly support the bill insofar as it extends copyright protection to computer programs. In this regard, I think I speak also for the computer industry. I can say that I have heard no serious objections and that this is also the position of Mr. W. H. Eichelberger, Chairman of the Committee on Copyrighting and Patenting Computer Programs of the Association of Computing Machinery, who was kind enough to write to me in his personal capacity.

My position is quite different, however, with regard to the bill as it applies to computers used in information storage and retrieval systems. Here I must respectfully suggest that the bill as it now appears goes too far. I feel that if the bill is enacted in its present form, electronic information retrieval systems will be unfairly burdened and users will be prohibited from using copyrighted material in ways which would otherwise be lawful if a computer were not involved. I think this point is particularly important because there has been so little discussion on this topic. What little discussion has occurred was by representatives of other groups whose interests were usually contrary to those of computer users. Even here, the statements were usually prefaced by such remarks as "Well, I don't feel competent, because I don't understand these machines well enough" or "I don't understand this business either." (see 3 Copyright Law Revision at 120-21) Perhaps then the best way to approach the problem would be to examine how computers function in this area.

Computers are used in information retrieval systems because of their ability to scan and examine material at an almost unbelievable speed. As they scan this material, they can examine it for key words and symbols or perform other more complicated operations upon it. The material which they scan can be of several different types. In the simplest case, they scan lists of titles or symbols representing them to match these against the requests of the researcher. This activity itself presents no copyright problems because an author has no copyright in the mere title of his work. The output of the search is a list of titles and their citations. It seems clear that such an activity cannot hurt the author and probably works to his benefit if readers are led to his works.

In the second case, the computer scans the copyrighted work itself. The work may be recorded in a computer medium such as magnetic tape or, with the use of some newly developed devices, the computers may scan the printed work directly. Here there are some serious copyright problems. It seems clear that it would be a violation of the author's copyright if the output of the search was a printout of a substantial portion of the author's work. It is not clear whether it should also be a violation of his copyright to scan the work with the aid of a computer or whether the making of the magnetic tape to facilitate the scanning constitutes an independent violation.

Another problem results when the computer itself performs some operation upon the copyrighted work. In an extreme case, the computer could translate it into another human language or create a rather complete summary or abstract. In other cases, it may "digest" the work into a single sentence or set of symbols. The resulting work may be for the benefit of the computer (to be scanned by the computer in later operations) or for the benefit of human readers. Once again, the computer may work from a magnetic tape or directly from the printed work.

(To be Continued in the Next Issue)

"ACROSS THE EDITOR'S DESK"

Computing and Data Processing Newsletter

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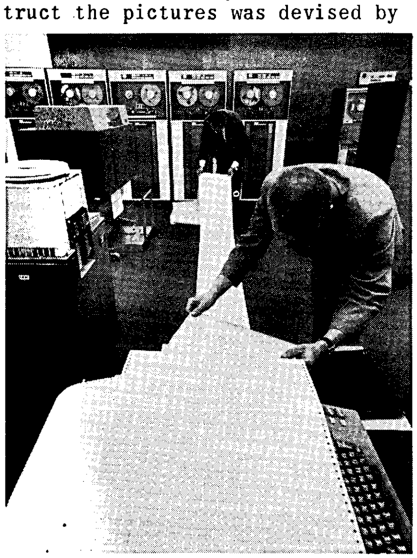
APPLICATIONS

PICTURES OF MARS 'DEVELOPED' BY DIGITAL COMPUTER

Scientists at Pasadena, Calif., used a digital computer to "develop" the photographs of Mars taken by the Mariner IV spacecraft as it passed within 5600 miles of the red planet. The technique used to construct the pictures was devised by



— Photograph of Mars, sent back to Earth in a series of digits by the Mariner IV spacecraft, is printed digitally on reams of paper about twenty feet long.

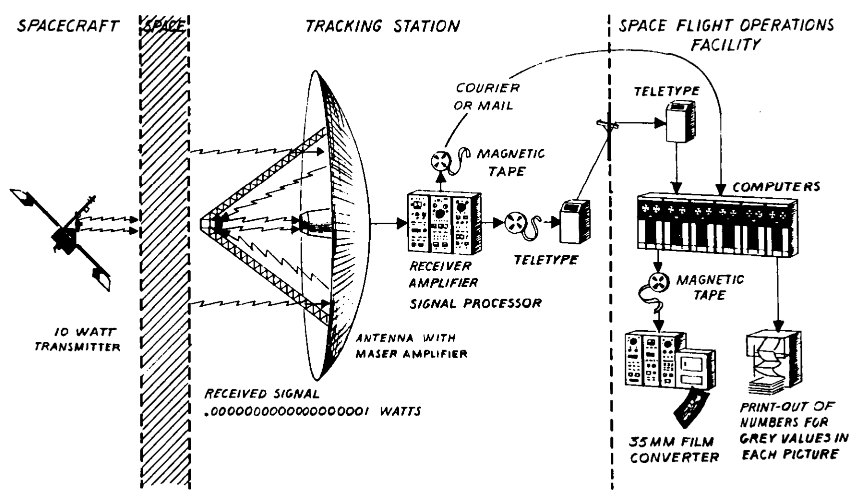
the California Institute of Technology Jet Propulsion Laboratory.

The pictures Mariner took were radioed 135 million miles to Earth in a slow, steady stream of digits. The transmission time required for each picture was eight hours and thirty-four minutes. To overcome some of the limitations of sending the intricate information over such great distances with a tiny transmitter, an IBM 7094 computer processed the data.

The pictures were taken by a single television camera aboard the 575-pound spacecraft and recorded in digital form on magnetic tape. Each picture is composed of 200 scan lines, and each line is made up of 200 dots. Each of the 40,000 dots that make up a picture can be one of 64 different shades of gray from white to black.

Mariner radioed these pictures to Earth receiving stations in electronic units of information known as "bits". A bit is either zero or one, and six bits make up one dot in a picture. For example, 010100 is a code, sent by Mariner

MARINER IV TV TRANSMISSION AND RECORDING



— This diagram shows how photographs of Mars taken by the Mariner IV spacecraft were processed.

and understood by the 7094 computer to be the number 20.

Once 40,000 of these numbers had been collected and decoded by the computer, they were put on a magnetic tape. The tape was then inserted into a film converter. This machine scans a piece of 35mm film with a beam of light. It responds by making 40,000 dots of film that range in intensity from 0 to 63. Zero is white and 63 is black. (This process is similar to the production of pictures on home television sets.)

The slow stream of digits sent by the Mariner IV were collected by three world-wide tracking stations that have been following the spacecraft since it was launched on November 28, 1964. As the information was received, it was sent to JPL by phone and Teletype lines. Within the Space Flight Operations Facility (SFOF), the computer complex consists of an IBM 7044 input/output processor, two 1301 disk storage devices and the 7094 computer. Another identical complex is used as a back-up in the event of an emergency.

COMPUTER USED TO TEST NEW DRUGS

Last July Smith, Kline and French Laboratories received an SDS 925 computer system which is being used in the development and testing of new drugs. The SDS computer has an important role in all of the tests which new drugs must pass before they are proven effective and safe for use. These include toxicity, molecular weights, protein content, potency and physiological responses. Studies involve virtually all of the biological and physical sciences.

In determining the effectiveness of new drugs and eliminating undesirable side effects, the 925 measures brain waves, heart beats, blood pressure and respiration of animals who are given the drugs. Physiological responses are fed into the SDS computer through analog-to-digital converters and multiplexers. Some of the responses are analyzed "on-line" at the time they occur; others are recorded on analog tape for subsequent refinement and analysis of data.

One of the methods of studying a drug's usefulness is to determine where and how rapidly it is distributed in the body after it is administered. For this purpose, scientists treat the drug with a minute quantity of a radioactive carbon isotope and at specific time intervals measure the distribution of radioactivity in various parts of the body. The 925 computer analyzes isotope counts, making corrections that permit the researchers to determine the drug concentration in any area of the body.

Another area of application for the SDS system is that of "operant conditioning", in which animals are conditioned to press levers or buttons in order to receive a reward or avoid a mild punishment. The computer will process statistical data measuring their ability to accomplish these tasks under normal conditions and after administration of various drugs.

The system includes an SDS 925 computer with 8192 words of memory, two levels of priority interrupt, Teletype keyboard/printer, paper tape reader and punch, and an SDS MAGPAK cartridge-loaded magnetic tape system.

MORE THAN 600 HOLIDAY INNS CONNECTED BY 'HOLIDEX'

A 50,000 mile communications network now connects more than 600 Holiday Inns with an IBM electronic reservation control center in Memphis, Tenn. The new reservation system, known as Holidex, was designed and built to Holiday Inns specifications by IBM Corporation.

Holidex is being used to handle more than 25,000 requests each day for out-of-town reservations. It makes possible the confirmation of room reservations anywhere in the Holiday Inn chain (world's largest motor hotel chain) in about one minute, according to Kemmons Wilson, chairman of the board.

By pressing a few buttons on a specially designed reservation terminal, innkeepers can request accommodations at any motel in the chain and get printed confirmation. If the guest's first choice cannot be filled, the IBM control unit at Memphis headquarters quickly searches its memory for other types of rooms available at the guest's first choice and for available rooms at three other Holiday Inns in the same geographical vicinity. Holidex automatically notifies the desk clerk of the alternate accommodations.

Confirming reservations is the prime, but not the only function of Holidex. Terminals also can be used for administrative communications throughout the system; for an innkeeper to order supplies from the parent company; and to alter or cancel room reservations.

Another time-saving feature of Holidex is that inns do not have to be contacted directly each time a reservation is made. Each innkeeper "advises" the computer what type of accommodations are available and for what periods. When these rooms are booked, the computer takes this into account and seeks alternate locations. Innkeepers can open or close room categories at any time.

Holidex is thought to be the largest computer controlled commercial communications network in the world. It required more than 50,000 miles of telegraph grade lines through the Bell System to connect all Holiday Inns with an IBM 7740 communications control unit in Memphis.

Holiday Inns are currently operating in 45 states, Canada and Puerto Rico. Another 85 inns are under construction with an additional 150 locations on the drawing board. As new inns are opened to the traveling public, a terminal will be installed linking it with the central reservation system.

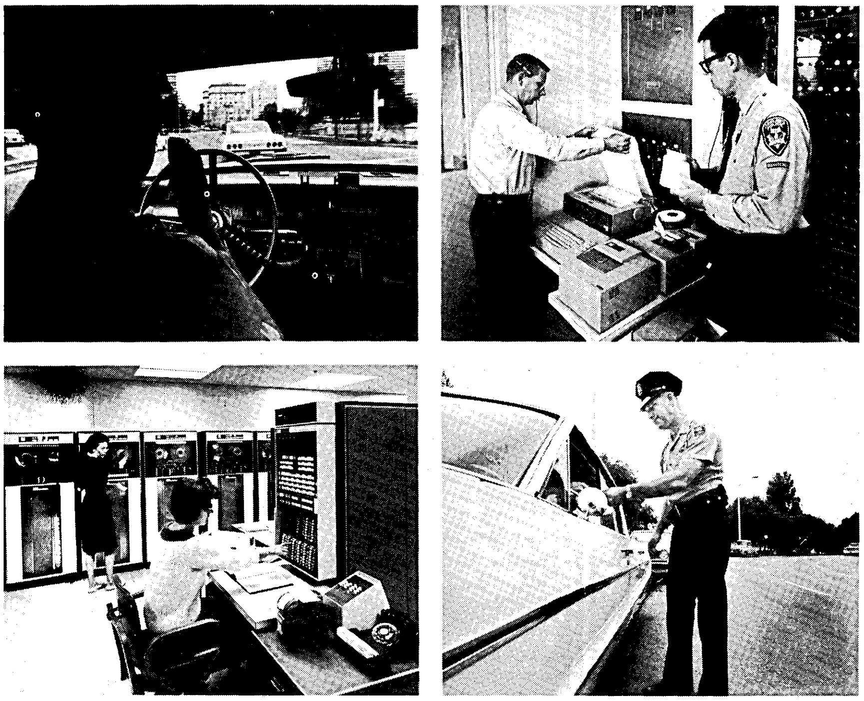
POLICE INFORMATION NETWORK

Last July 1 the first stages of a huge, fast, computerized information system became operational in Oakland, Calif. This new system called P.I.N. (Police Information Network) provides a centralized electronic file for warrants of arrest. It is designed to eventually serve the 93 separate law enforcement agencies in the nine Bay Area counties.

The P.I.N. system uses IBM electronic data processing equipment as the hub of a teleprocessing network. Inquiry terminals, resembling elaborate typewriters are used by police radio dispatchers to obtain information from the central memory bank of the computer miles away.

Telephone lines connect these terminals to the computer complex which serves most of the data processing requirements of Alameda County. This data processing center, the largest and most productive local government computer installation in the United States, is capable of processing all police warrant inquiries without noticeable interference to its normal workload. The IBM equipment in the P.I.N. consists of a 7044 data processing system, a 7740 communications control computer, a 1302 disc file, and 1050 inquiry terminals.

to determine if the number is on the wanted file stored in the memory of the computer. Lower left, the IBM 7044 data processing system which could hold all of the outstanding license numbers and names collected by the 93 law enforcement agencies in the nine Bay counties. Lower right, when the officer approaches the car (less than two minutes following his request) he is aware of



These photos depict the steps involved in the P.I.N. Upper left, the officer calls for a license check of the car he is following. The radio dispatcher, upper right, in this case the Oakland Police, uses an IBM 1050 inquiry terminal whether the car is stolen or the owner wanted on a warrent.

The new system is expected to substantially reduce the 500,000 outstanding warrants representing bails and fines of over $5 million.

NASA SCIENTISTS USE DIAL-O-VERTERS FOR "PREDICTS"

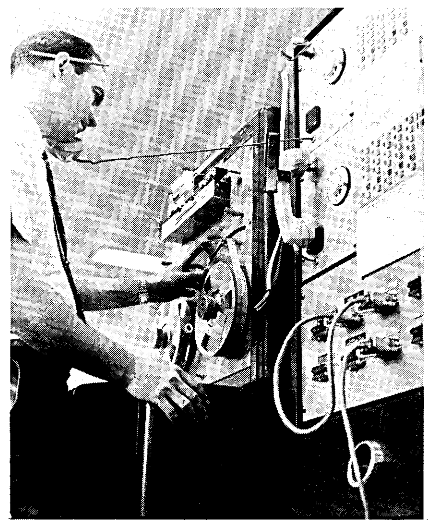
Pointing an antenna at an object that's 300,000 miles away and traveling at a speed of 18,000 miles an hour, is the kind of problem faced every day by National Aeronautics and Space Administration scientists, who must receive data from and transmit commands to 22 U.S. satellites now in orbit.

They solve the problem with remarkable success by using what they call "predicts". Predicts are highly accurate estimates of when a satellite will pass over a particular ground station, and what its angle and distance will be. With this information, crews in the worldwide Space Tracking and Data Acquisition Network (STADAN) can aim their giant antennas (ranging in size from 40 to 85 feet) in advance of the satellite pass.

A tremendous volume of such information must move between the computers at Goddard Space Flight Center, Greenbelt, Md., and STADAN stations, and it must move with both speed and accuracy. This operation is performed in large part by Digitronics Dial-o-verters (manufactured by Digitronics Corporation, Albertson, N.Y.). These automatic devices not only flash information at a rate of 150 characters per second, but constantly review their own work to assure error-free transmission. An incorrect figure in a "predict" could mean that a command to a satellite would miss it by thousands of miles, possibly causing the failure of a multi-million dollar experiment.

Parity checking avoids such errors. If the machine is fed a number that appears wrong, it will not punch it out, but will ask the sending source to try again. This will be done up to three times, if necessary, then an alarm will sound to alert a human operator to take over.

The information moves from a computer on paper tape into a Digitronics Dial-o-verter, which "reads" the tape and converts it into electrical impulses. Telephone equipment sends these as tones over special lines to vari-



— Mr. Donald Pangle, shown operating a Dial-o-verter Paper Tape Terminal, is ready to transmit satellite information to the network of tracking stations.

ous terminals. At these stations, Dial-o-verters reconvert the messages to punched paper tape for printing out. Parity-checking takes place at both sending and receiving ends, as a double protection against errors.

NEW CONTRACTS

SDS AWARDED CONTRACT BY AICPA

System Development Corporation (SDC), Paramus, N.J., has been awarded a contract by the American Institute of Certified Public Accountants (AICPA) to develop an applied research and educational program in computer technology. The six-month study, to be conducted by SDC's New York Metropolitan Operations Center, will focus on capabilities of information processing systems as they relate to accounting, auditing, tax work, and management services. Results of the research program will be used in organizing an expanded educational program which will serve to communicate developments in computer technology to the C. P. A.

GRANTS FURTHER COOPERATIVE RESEARCH IN MECHANICAL TRANSLATION

An exchange of linguists to further cooperative research in mechanical translation was begun in July between The University of Texas and Tokyo Electrical Engineering College (TEEC). The work in translation by computer is supported under the U.S.-Japan Cooperative Science Program through separate grants to the Linguistics Research Center at the University and to TEEC. The TEEC grant will be administered by the Japan Society for the Promotion of Science and The University of Texas grant by the National Science Foundation.

Bates Hoffer, a member of the Linguistics Research Center staff, has arrived in Tokyo where he will be the only American working with Japanese linguists during the nine-month program. While in Japan, he will supervise collection of Japanese text and hand coding of Japanese dictionary entries in computer-usable form and serve as consultant on problems of English structure with the TEEC linguists who are designing an English-to-Japanese translation system.

Dr. Keiji Hiramatsu of TEEC and Mrs. Sae Yamada of Rissho University in Tokyo are working in Austin on problems of designing a Japanese syntax for use in the UT Linguistics Research Center's translation system. Scott Baird, a member of the LRC staff who taught English in Japan for three years, is working with the visiting linguists.

Although work in German, Russian, Chinese, Hebrew and other languages has been under way at the Linguistics Research Center for several years, the new program will be the first attempt to adapt Japanese to the computer translation system at The University of Texas. The grant to the Texas research group is a direct result of the seminar on mechanical translation held in Tokyo in April, 1964.

NASA AWARDS SDS $1.1 MILLION IN JUNE ORDERS

Scientific Data Systems, Santa Monica, Calif., received orders for $1.1 million of computers and peripheral equipment from National Aeronautics and Space Administration during June, the company announced.

The NASA purchase includes three SDS 930 computers and one SDS 92 computer. The NASA systems are scheduled for delivery this year and were not included in previously released backlog figures.

RELIABILITY RESEARCH GETS ARMY CONTRACT, NAVY CONTRACT

Reliability Research and Technology Inc. has received a $70,000 contract to develop a Preferred Items List of missile parts for the U. S. Army Missile Command. The work is part of a Department of Defense standardization project and covers resistors, capacitors, switches, circuit breakers, electrical connectors, bolts, nuts, screws, washers and rivets.

A $35,000 contract to collect and compile data on board communications operations of U. S. Navy destroyers also has been received by the firm. This worldwide survey will take Reliability Research and Technology engineers aboard 54 ships deployed in the four fleets. The data will provide design parameters for a U. S. Navy Advanced Communications System (NSACS) under development at the U. S. Navy Electronics Laboratory in San Diego, Calif.

Reliability Research and Technology is located in Alhambra, Calif. and has a branch office in San Diego. It is a wholly-owned subsidiary of Planning Research Corporation of Los Angeles.

CONTROL DATA RECEIVES CONTRACT FOR MINIATURE INTEGRATED CIRCUIT COMPUTER

Control Data Corporation announced that it has received a $450,000 contract from Sanders Associates, Inc., Nashua, N.H., to develop a special miniature integrated circuit airborne computer for a U. S. Navy project. Sanders Associates, Inc., is engaged in research, development, and production of electronics components and systems, gyroscopes, accelerometers, hydraulic servo valves and related types of equipment.

The special-purpose computer is a single-address machine capable of a variety of control and data reduction tasks. This airborne computer, including 8192 words of memory, is only .6 of a cubic foot in size, weighs 35 pounds, and has a maximum power consumption of 125 watts. Basic memory size is 4096 24-bit words, expandable to 23,768 24-bit words.

CONTRACT FOR TRAINING PROJECT IN DATA PROCESSING

The Institute of Computer Technology, Inc., a private non-profit organization located in Silver Spring, Md., has been awarded a contract by the Department of Health, Education and Welfare to conduct a training project in the field of electronic data processing. The training project, to be conducted under the Manpower Development and Training Act (MDTA), is to train Washington residents who are either unemployed or underemployed to serve as technicians in the rapidly expanding data processing industry.

A pilot project conducted last year, entitled project PREPARE (see Computers and Automation, July 1964, p. 43), very successfully demonstrated the feasibility of training and placing data processing technicians from the rolls of the unemployed. (Thirty-two of the 34 persons trained have found jobs in the field.) The new program will be conducted at the Institute's downtown Washington facilities. Trainees will be selected by the D. C. Employment Service.

CYBERNETICS SYSTEMS GRANT

New practical techniques giving paralyzed patients partial use of their limbs and control of internal muscles may result from a five-year, $1 million grant to Case Institute of Technology from the Vocational Rehabilitation Administration. The grant is for research into "cybernetic systems for the disabled".

The research constitutes a joint program with the School of Medicine and the Department of Psychology of Western Reserve University, the Physical Medicine and Rehabilitation Department of Highland View Hospital, and the Systems Research Center at Case.

The research will follow two main approaches. One is the extension of the study of the Case Research Arm-Aid (see Computers and Automation, November 1964, p. 38), which already has demonstrated the use of computer memory and control to help essential functions such as eating. The second line of investigation is the attempt to apply external electrical stimuli to paralyzed muscles so that use of limbs may be regained. In both cases the patient and his assistive machine form a cybernetic system that may be designed using the same principles on which space vehicles are built.

AMPEX RECEIVES CONTRACT FROM WESTERN ELECTRIC

Ampex Corporation, Redwood City, Calif., has received a contract for more than $200,000 from Western Electric Co., Inc. for production of digital tape transports to be used in Bell System electronic switching systems.

The contract calls for delivery of the nine-track Model TM-7 transports beginning this fall and continuing through spring, 1966. The tape transports will record and store data and perform input functions in Bell System electronic switching systems being installed in various parts of the United States. They will be used in those systems having automatic data features.

The tape transports will be produced at the company's Computer Products Division, headquartered in Culver City, California.

INFORMATICS AWARDED PMR CONTRACT

Informatics Inc. (a wholly-owned subsidiary of Data Products Corporation), Sherman Oaks, Calif., has received a $92,000 contract from the United States Navy for the development of Peripheral Site Computer Programs at the Pacific Missile Range.

The contract calls for providing a Peripheral Site Computer Programming System which will be made operational at Point Mugu, Calif. Making this site operational is an important step in strengthening the capabilities of the Pacific Missile Range test facilities. These computers are part of the larger Real Time Data Handling System serving the entire Pacific Missile Range, and are located at Point Mugu and San Nicolas Island in the California area and in the Hawaiian Island chain.

The peripheral site computers will be used to reduce the workload on centralized large computers by permitting system readiness tests, instrumentation control, local data recording, and data processing on UNIVAC 1218 computers.

$400,000 AIR FORCE SOFTWARE CONTRACTS TO INFORMATICS INC.

Informatics, Inc., Sherman Oaks, Calif., has received over $400,000 in contracts from the Rome Air Development Center to evolve a system for on-line computer use. The system to be known as DOCUS (Display Oriented Compiler Usage System), will employ display equipment, operating on-line with large-scale computers.

The user of the system will be able to program his problem on-line, starting with simple functions and developing more complex ones as he proceeds. Special compiler languages will be used for this purpose.

The system is most directly oriented toward the command and control, and intelligence data handling operations of the Air Force. The techniques developed, however, will be applicable to modern commercial computer usage. These techniques will give non-professional computer users better means for communicating directly with large-scale, time sharing systems.

NEW INSTALLATIONS

BUNKER-RAMO INSTALLS LARGEST MARKET QUOTATION FACILITY

The largest electronic stock market quotation facility in the United States was dedicated in July in the brand new Chicago (Illinois) office of Paine, Webber, Jackson & Curtis. The new market information complex is nearly twice the size of any other brokerage office installation.

The equipment supplied by The Bunker-Ramo Corporation includes a Teleregister display board 105 ft. long and a battery of 30 Telequote III desk top devices which enable Paine Webber personnel to obtain individual quotations instantly on several thousand stocks and commodities.

LE GROUPE DROUOT INAUGURATES NATIONWIDE DATA COMMUNICATIONS NETWORK

One of the most extensive computer networks to be used by an insurance firm anywhere in the world has been installed by Groupe Drouot, one of France's largest privately-owned insurance firms. The computer network — an industry first in Europe — is an IBM Tele-processing system which will provide instant data communications between the firm's 40 regional branches and its Marly-le-Roi headquarters near Paris.

An IBM 7010 data processing system and magnetic disks capable of storing 280 million characters, together with four auxiliary computers (an IBM 1440, two IBM 1401's, and an IBM 1460), and an IBM 1418 optical reader form the heart of the system. IBM 1050 data communications devices link each regional office via private telephone lines directly with the central computer at Marly. "Up-to-the-second" information regarding any of the 430,000 automobile policies handled by Groupe Drouot is available within a few seconds. In the near future, the system will be extended to include the greater part of the Groupe's 2.75 million policies, including life and industrial, fire and casualty, and other lines.

ARMORED CARRIER TO GET HONEYWELL 120 COMPUTER

Honeywell's electronic data processing division has received an order for a Honeywell 120 data processing system from Armored Carrier Corporation. Armored and its affiliates, Southern Couriers, Inc., Carolina Virginia Couriers, Inc., and Trans Canada Couriers Ltd., operate in 32 states and southern Canada and daily transport more than a billion dollars in non-negotiable instruments. The Honeywell computer will be used primarily for vehicle route analysis.

Armored's computer installation, due for delivery in early 1966, will consists of an H-120 central processor with 8192 characters of memory, three magnetic tape devices, a combination card reader/punch, and a 450 line-per-minute printer.

VICTOR MANUFACTURING INSTALLS TWO SYSTEM/360s

Increased profit through tighter control of labor and manufacturing costs was the motivation that led to the recent installation of two new IBM System/360s at Victor Manufacturing and Gasket Co., Chicago, Ill. Victor Gasket is the first company in Chicago to install a System/360, IBM's new line of computers.

The first of the two computers, a Model 30, was installed in July. This includes a central processor, five tape drives, a punched card reader and a printer. A second Model 30 arrived late in August. The two computers will replace other data processing equipment installed at Victor three years ago.

Primary jobs being performed by the computers are order writing, invoicing and payroll. Some major new cost control programs include a unique material control application in which the computer checks the amount of materials used in the manufacturing process against predetermined usage standards. Any variances are printed in a weekly report for follow-up and corrective action by management. Management and distribution of Victor's more than 20,000 sealing products will be aided and controlled by the computer. Victor Gasket operates five plants in the U.S. and is the world's largest manufacturer of gaskets and the pioneer in synthetic rubber oil seals.

CONTROL DATA 3200 INSTALLED AT ARECIBO, PUERTO RICO

Installation of a new Control Data Corporation computer at Arecibo, Puerto Rico, will speed computing at the world's largest radar-radio telescope perhaps 20 to 100 times.

The new computing system, with a Control Data 3200, replaces an earlier system including a small-scale Control Data 160-A computer at the Arecibo Ionospheric Observatory. (The 20-100 range of improvement in computing efficiency is related to the type of problem being worked on by the new computing system in comparison with the older one.)

The observatory is operated by Cornell University under a research contract with the Air Force Office of Scientific Research and with support from the Advanced Research Projects Agency. The purpose of the Arecibo observatory is three-fold — study of the earth's outer atmospheric layer (the ionosphere), the planets and other bodies in the solar system, and more distant celestial objects such as stars and galaxies.

UNIVAC 1050 ACQUIRED BY CAMBRIDGE THERMIONIC

Cambridge Thermionic Corporation, Cambridge, Mass., has announced the installation of a Sperry Rand Corporation UNIVAC 1050 Card System. Acquisition of the new computer provides CAMBION® with new and expanded data processing capabilities and enables the company to better facilitate its Dial-A-Part 24 hour a day shipping service and maintain continuous inventory and production control. In addition, the new UNIVAC 1050 Computer will assist CAMBION in keeping its distributors and representatives constantly abreast of up-to-the-minute marketing data and sales analyses.

Principle components in the new system now in operation are: an 8192 character internal memory; a 600 card per minute reader; a 200 card per minute punch; and a 600-750 line per minute high-speed printer.

RCA 301 COMPUTES BILLS FOR SO. CALIF. WATER CO.

Customers of the Southern California Water Company recently began paying their first water bills computed, printed and addressed to them by an RCA 301 electronic data processing system.

This computer system was installed to provide the company with capability for greater growth and improved management information.

The 301 not only handles customer billing, but also will cover such applications as rate analysis, inventory, accounting and simulation of proposed acquisitions on the company's financial position.

HOME SAVINGS BANK BEGINS COMPUTER OPERATION

Home Savings Bank, Boston, Mass., is the first savings bank in New England to begin operation of an electronic system that establishes a direct link between teller windows on the bank floor and customer records stored in an IBM computer on another floor. The system enables tellers to cut in half the time required to handle customer transactions, and provides even greater accuracy in maintaining individual accounts, according to Alton P. Cole, president.

Equipment includes an IBM 1440 computer, five 1060 teller terminals, one 1050 data communications system and three 1311 disk storage drives.

The 96-year old Home Savings Bank handles some 53,000 savings accounts and 13,000 mortgage loans for customers in the Boston area.

EUROPEAN GEOPHYSICAL COMPANY ORDERS ASI COMPUTER

Advanced Scientific Instruments has announced an order from Compagnie Generale de Geophysique, Paris, for an ADVANCE Series 6040 computer and peripheral equipment. The system will be used for digital analysis of geophysical data, with emphasis on seismic data processing. Compagnie Generale de Geo-Physique is the largest geophysical exploration service company in Europe, and is one of the largest internationally.

The system to be shipped to CGG will include a 6040 central processor with a 16,000-word memory, various input and output channels, teletypewriter, magnetic tape system, punched card equipment, high-speed random-access memory, and two specialized devices specifically employed in seismic analysis — the seismic communications system and the convolver-filtering subsystem. The ASI seismic system has a capability of providing real-time dynamic and static corrections to analog or digital seismic records to enhance or clarify the seismic reflection signals.

ORGANIZATION NEWS

CONTROL DATA CORPORATION ACQUIRES CERTAIN ASSETS OF GENERAL PRECISION'S BUSINESS COMPUTER OPERATION

William C. Norris, President of Control Data Corporation, and J. W. Murray, Board Chairman of General Precision Equipment Corporation, have announced the acquisition by Control Data of certain assets of the business computer operation of General Precision Inc's Librascope Group, in exchange for an undisclosed number of shares of Control Data Corporation common stock.

Involved in the purchase are General Precision's existing business computer rental and service contracts, inventory of business computers, and highly experienced business computer sales and service organization. Among these computers are over 400 LGP-21, LGP-30 and RPC-4000 computers used by customers ranging from the smallest to the largest business and governmental units in the country. Control Data intends to serve past and future customers for these systems. Continuing production, leasing, sale and servicing of these small computers will be carried on.

Mr. Murray had announced, in February of this year, that General Precision is concentrating its activities wholly on the development, manufacture, and sales of computers to the military, space and special-application markets, in which it has an established and growing position. General Precision also will continue to make and sell its line of drum and disk memories including mass memories for large computers, for its own computers, and in original equipment made by other manufacturers.

NEW YORK STOCK EXCHANGE FORMS NEW SUBSIDIARY

Formation of a new subsidiary of the New York Stock Exchange to provide a comprehensive brokerage accounting service has been announced by Exchange President Keith Funston. The new subsidiary, to be known as the Central Computer Accounting Corporation (CCAC), has been approved by the Exchange's Board of Governors. Initially CCAC will be open to all member organizations wishing to use its services. Eventually the service will be made available also to qualified non-member organizations.

A wide range of brokerage accounting services will be offered including the calculation of purchase and sale data, printing of confirmations and statements, margin accounting, production of control and surveillance reports, and bookkeeping for the users' securities business on all exchanges and over-the-counter markets.

Three IBM System/360 computers, together with an auxiliary RCA Spectra 70 computer, will make up the data processing units in the computer center, and it is expected that Honeywell will provide optical scanners and associated devices for input/output to and from brokers' offices, Mr. Funston reported.

The service, which represents the latest move in the Exchange's extensive automation program, is expected to be operational in mid-1966.

SHAREHOLDERS OF PLANNING RESEARCH APPROVE MAJOR ACQUISITION

Acquisition of Mesa Scientific Corp. by Planning Research Corp., Los Angeles, Calif., was approved by Planning Research shareholders at a special meeting. Mesa stockholders had approved the matter earlier. Final legal transfer of ownership was expected to take place in August following approval by regulatory authorities.

The activities of Mesa are heavily devoted to computer software. The professional services of Planning Research involve, to the extent of 40 percent of its revenues, computer software activities quite complementary to those of Mesa. Planning Research services also cover a wide area of technical and economic analyses and research.

Dr. Robert W. Krueger, president of Planning Research, told shareholders that, excluding computer rentals, the combined companies make up the country's largest and most diversified computer software service.

RCA ESTABLISHES SPECIAL MARKETING ACTIVITY

The Radio Corporation of America has announced the establishment of a special marketing activity that will offer RCA-developed data processing equipment to other U.S. computer manufacturers.

"This move was made in response to the increasing demand for data processing systems with expanded capabilities in communications, mass memory and random access," according to A. K. Weber, Vice President and General Manager, RCA Electronic Data Processing. "RCA is in a position to provide the equipment to round out such systems," he stated.

Mr. Weber said the following equipment should be of particular interest to other computer makers: RCA 3488, a computer mass memory system with multi-billion character capacity; Video Data Terminal and Interrogator units which show data pulled from the computer memory on a television cathode ray tube for speedy reference or decision making; and magnetic tape devices with data rates ranging from 60,000 decimal digits per second up to 240,000 decimal digits per second.

The new marketing program will be headed up by P. B. Reed, Division Vice President, International and Special Account Sales.

NEW C-E-I-R VENTURE SET FOR PUERTO RICO

C-E-I-R, Inc., and the Puerto Rico Industrial Development Co. (PRIDCO) have joined in the formation of a research and computer services company in San Juan, P.R., according to an announcement by Dr. H. W. Robinson, president of C-E-I-R, and Mr. Rafael Durand, executive director of the Puerto Rican Economic Development Administration.

The new enterprise, in which C-E-I-R has a 60% interest, will be named Management Sciences International. The Puerto Rican company will make available a business data processing and scientific computing service for both industry and the Commonwealth government, with full-range professional support from keypunching to the management sciences.

EDUCATION NEWS

COMPUTER IS AN EDUCATIONAL TOOL IN ALTOONA

In the Senior High School of Altoona, Pa., a General Electric 215 computer is proving that high school students can learn computer programming and operation as part of their regular science and mathematics studies.

Installed last September, the computer already has become an important educational tool for some 1000 of the school's 3300 students. It permits more time to be spent on theories and principles and less on the boring drudgery of tedious calculations, according to Dr. Thomas R. Heslep, superintendent of schools. Thus far, no drastic changes have been necessary in course scheduling or teaching personnel. Student and teacher acceptance of the computer and computer-oriented subjects has been very enthusiastic, says Dr. Heslep. In fact, he plans to extend the program this fall to the city's two junior high schools.

To date, Fortran programming language has been taught to junior high school Algebra II classes and to most science and mathematics classes at the senior high level. About 350 of this past year's graduating class of 1000 students have learned to program mathematics and science problems for the computer. The class of '65, according to Dr. Heslep, has the distinction of being the last to graduate without direct computer experience. Not so the sophomore and junior classes. They started computer instruction last September and many already use the $250,000 machine like seasoned veterans. Next year's graduating class will have averaged 720 hours of instruction, including summer school — and by 1967, each of the machine programming students will have averaged more than 1000 hours at graduation. Mathematics and science students will have complete familiarity with the Fortran programming languages.

Dr. Heslep's goal is to have all college-bound youngsters leave school with a knowledge of Fortran programming. To reach this goal, the Altoona educator has ordered a General Electric Datanet-15 data transmission controller and a disc file. The new equipment will permit the GE-215 to receive and transmit information automatically over telephone and telegraph lines between the central computer and classrooms in the high school and two junior high schools. "We'd like to prove that a central installation can serve many schools in math-science instruction,' he explained. "And, we're willing to train teachers in other schools to prove it," he added.

To emphasize his point, Dr. Heslep said 27 of the high school teachers — about one in ten — have taken special courses in machine language programming. He doubts that any high school in the country has this large a percentage of trained computer instructors. Dr. Heslep attributes this lead in computer education to the fact that the GE-215 is used strictly as an educational tool in Altoona

— Left to right, juniors Paul Howard, 16; Sallyann Sassaman, 17; and Linda Hayes, 16, are shown developing a computer program for the GE-215.

Dr. Heslep believes if computer studies are introduced early in high school, the programming courses can be incorporated directly into text material. "The student would learn just enough programming techniques each year to program the science and math problems he needs. Thus, by the time he reaches his senior year, he has gradually learned the more advanced programming routines and languages," he explained.

As a "calculated guess", the Altoona educator "estimates that students will do better on college board math and science exams as a result of computer instruction". He insists it is impossible to program a math or science problem without first understanding it. "When a student is able to program a problem, he understands it completely," he explains. "And, what he understands, he not only retains, but he builds upon. It is a direct and logical part of the educational process." Dr. Heslep leaves little doubt that the age of the computer has arrived at the high school level.

COMPUTER-CONTROLLED AUDIO-VISUAL METHOD OF TEACHING MORSE CODE

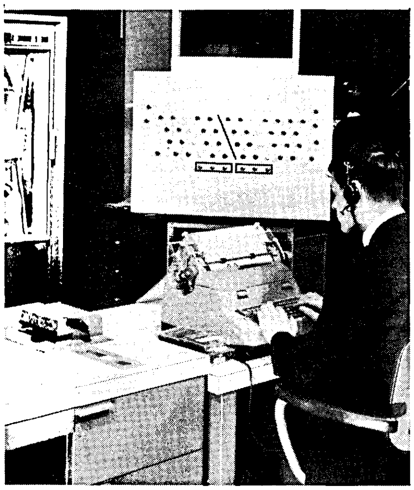
A computer-controlled, audio-visual method of teaching Morse code has been developed by Sylvania Electric Products Inc., New York, N.Y. Sylvania is a subsidiary of General Telephone & Electronics Corporation.

The Sylvania system is an automated instructional program that appeals to both sight and sound. The method equips a trainee with earphones, a typewriter and an electronic display board outlining an unlettered keyboard. He is taught to depress the typewriter key corresponding to a light on the display each time he receives by earphone the "short-long" signals representing the same letter. For example, as he hears two dots and a dash, representing the letter "u", he sees the light flash indicating the position of the typewriter key "u" which he then depresses, using the touch type system.

The computer triggers both the audio and visual signals. It is so programmed that a new set of signals is not presented until the trainee has responded correctly to the current one. This permits the trainee to proceed at his own speed of learning.

Gradually the display lights are delayed so that the trainee is responding to the audio signals alone. The lights then are used only to inform him of an error.

The system, developed by the Applied Research Laboratory of Sylvania Electronic Systems, a division of the company, is seen as a more reliable and faster



— A trainee is shown receiving Morse code instruction with audio-visual system.

method of Morse code instruction for both military and civilian users.
(For more information, designate #41 on the Readers Service Card.)

NEW PRODUCTS

Digital

UNIVAC REAL-TIME COMPUTER FOR MILITARY APPLICATIONS AND THE APOLLO MOON PROGRAM

Sperry Rand Corporation, New York, N.Y., has announced a powerful new military computer especially valuable in such real-time applications as missile-range instrumentation, tactical command and control telemetry, navigation and fire control.

The new system, designated the UNIVAC 1230, is a medium-scale real-time military digital computer. The computer's operation is fully-automatic because the sequence of operation is determined by a program of internally stored single-address instructions capable of self modification. Extremely high computing speed is obtained because the device operates in a parallel mode, in which all the digits of a word are operated upon simultaneously.

The UNIVAC 1230 has a control memory which has a cycle time of 400 nanoseconds and operates in synchronism with a two microsecond main memory overlapped to provide an effective 1 microsecond cycle time. The computer can perform 500,000 additions per second.

The computer's random-access main memory provides 32,768 thirty-bit words of storage with capability for expansion to 114,688 words. The control memory has a capacity of 128 thirty-bit words with an option of an additional 128 words which are directly addressable. A smaller nondestructive readout memory which stores 64 words is used for automatic program recovery. Either of two 32-word bootstrap programs in this memory may be selected by a switch.

The 1230 computer contains 16 input and 16 output channels, capable of transmitting 30-bit words in parallels at a maximum rate of 500,000 words per second under full buffer control for communication with peripheral equipment of other computers.
(For more information, designate #42 on the Readers Service Card.)

LOW-PRICE ELECTRONIC ACCOUNTING SYSTEM FROM NCR

The National Cash Register Company, Dayton, Ohio, has announced the 395-300, a new desk-size business system selling for $10,900. This new addition to the company's 395 family of electronic accounting systems is said to provide the decision-making performance and speed of a small computer while keeping the economy of a conventional mechanical accounting machine. Owen B. Gardner, NCR's vice president for data processing, said the solid-state 395-300 is "the only totally electronic accounting machine in its price class".

The new series, like the rest of the 395 family, uses computer addresses and instructions and has a magnetic disc memory. It provides 20 or 40 totals, giving users of the 395 system a choice of 20, 40, 80, or 120 electronic totals among machines available. Each total, being electronic rather than mechanical, is stored as a 14-digit word and can be accessed at the rate of 29 times a second.

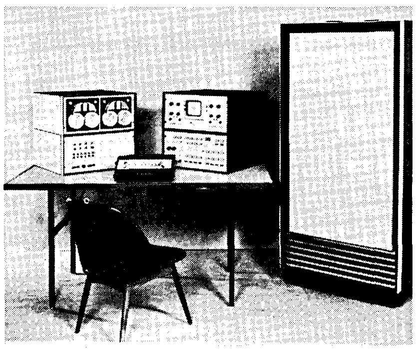
— NCR 395-300. Conventional mechanical "counter line" units, like that held by Gerry Fox, are replace by magnetic disc memory. Memory of 395 is about the size of a 45 RPM phonograph record.

Although many installations of the system will require only the console unit, a combination with a peripheral 100-card-a-minute punched card reader permits completely automatic runs. Card output and punched tape output peripheral devices also are available. Although the 395 is a self-contained processing system, NCR says, by-product data can also be created automatically in card or tape language for input to a larger computer.
(For more information, designate #44 on the Readers Service Card.)

INTEGRATED CIRCUIT VERSION OF LINC COMPUTER

The SPEAR µ-LINC, developed by SPEAR, INC. of Waltham, Mass., is a new commercial version of the LINC, acronym for Laboratory INstrument Computer, which was conceived and developed first at Massachusetts Institute of Technology and later at Washington University, St. Louis, Mo. The LINC is a powerful low-cost digital processor which can be readily employed in the laboratory environment by scientists and engineers who have not had previous training in computer programming and operation.

The standard µ-LINC contains 16 analog input channels with multiplexer and A-D converter, and several sets of digital input and output lines for control and data transfer. It also includes a 2048 word (12-bit) random-access core memory, and dual magnetic tape units which provide 1,572,864 bits of additional storage. The system includes an alpha-numeric keyboard, a CRT display for waveform and alpha-numeric presentation, and plug-in interface modules providing flexibility for tying other laboratory equipment into the system. System cycle time is 8 μ-sec.



— SPEAR μ-LINC computer, integrated circuit version of LINC.

The conversion from discrete components to fully integrated logic circuits using Motorola MECL logic, has been accomplished without sacrificing compatibility between the SPEAR μ-LINC and the LINCs produced at MIT. As a result, all programs and hardware that have been developed for use with the original LINCs can be used with the SPEAR μ-LINC without modification.

The first SPEAR μ-LINC was delivered in June to the Weston Observatory of Boston College where it is being used as the heart of a system for collation and processing of seismic signal data.
(For more information, designate #43 on the Readers Service Card.)

NEAC-1210, DESK-SIZE COMPUTER

The Nippon Electric Co., Ltd. (NEC) of Japan has joined in the latest trend toward simplification of electronic data processing equipment. Mr. Yasmasa Togo, President of Nippon Electric New York Inc., USA sales affiliate for the parent company, has disclosed that a revised version of the NEAC-1210 will be designed expressly for the American business market; and according to Mr. Togo, should be available for marketing in the United States early in 1966.

The NEAC-1210 differs from other comparable-sized computers, in that it employs the Japanese invented parametrons in place of transistors for its logic element. The parametron is a magnetic-electronic logic device invented by the Japanese physicist, Dr. Gotoh. The uniqueness of the parametron circuit is that it uses majority decision logic. In other words, the phase of an oscillating frequency is decided by the majority of inputs.

The NEAC-1210 consists of a computer, an electric typewriter, a reader, and a card-punch device. It operates on a fully electronic automatic principle, using stored programs similar to those used by computers of larger size and more complex engineering mechanisms. The simplicity of its design enables any person who can use a typewriter to learn its operation in a very short period of training.

A magnetic-drum type storage device is capable of storing up to 250 words of 12 digits each. For other purposes, the storage capacity can be changed to 500 words by reducing the number of digits per word to 6.

The NEAC-1210 combines fractional millisecond high-speed computation, with simultaneous output of printed information. In addition, it also is capable of coding the output of punched paper tape, edge-punched cards, tabulating cards, or any combination of these.
(For more information, designate #45 on the Readers Service Card.)

MODEL 4020 PUNCHCARD DATA PROCESSING SYSTEM

D P A, Inc., Dallas, Texas, recently introduced its model 4020 punchcard data processing system. The D P A model 4020 combines, in a single device, a solid state programmable arithmetic processor manufactured by Wylie Laboratories, El Segundo, Calif., and an accounting machine.

"This combined system," D P A President Bob L. Caldwell said, "is capable of performing a full range of arithmetic operations through control panel programming. The market for the 4020 is the several thousand business firms whose requirements for computational ability have outgrown their present systems, but do not need large scale computers."

Deliveries of the model 4020 punchcard data processing system will begin this month.
(For more information, designate #46 on the Readers Service Card.)

Software

COMPUTER SYSTEM FOR ACCOUNTANTS

The Monrobot Computer Systems division of Litton Industries, Orange, N.J., has announced the introduction of its packaged computer system for accountants.

The automatically controlled business system, designed for use with the Monrobot XI desk-sized, all-purpose computer, provides a complete method of preparing financial statements for clients in small and medium-sized businesses. The packaged system creates journals, general ledgers, statements of earning and financial conditions, in addition to payroll compensation records and annual and quarterly reports.

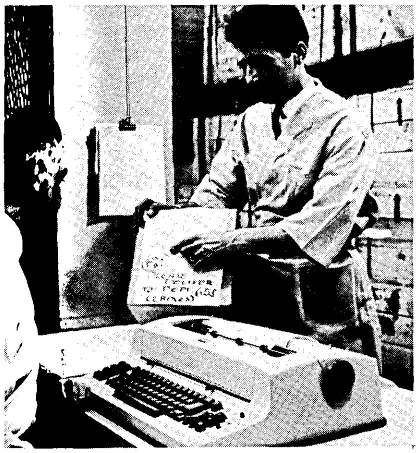
The Monrobot XI system for accountants is available for lease or purchase. The ready-to-use computer system includes programming, installation and operating manuals.
(For more information, designate #47 on the Readers Service Card.)

Data Transmitters and A/D Converters

COMMUNICATIONS TERMINALS ANNOUNCED BY IBM

By pressing a special key on the new, low-cost communications terminals, any person with typing ability can "talk" to a computer. This electronic conversation is possible with either of two low-cost easy-to-operate communications terminals equipped with standard typewriter keyboards. They have been introduced by IBM Corporation, White Plains, N.Y.

The new IBM 2740 and IBM 2741 communications terminals are designed so that anyone who can type can make use of the speed, processing power and large information storage of IBM System/360. When not being used for communications purposes, the terminals can serve as regular electric typewriters.



— IBM 2740 communications terminal is shown in an engineering laboratory being used to exchange data with IBM's System/360 and other 2740 terminals.

Using the terminals, information, inquiries and instructions can be sent to a computer by either typing out English statements or using special codes. The computer is controlled by a program which sees to it that the computer properly interprets these messages and takes appropriate action.

The IBM 2740 and 2741 both are designed to operate in any business, industrial or governmental environment and can exchange information with a computer that is across a room or across a continent.

Although similar in appearance and identical in price, the new terminals are primarily intended for different communication roles. The 2740, which can exchange information with a computer and other 2740 terminals, functions as a sending and receiving station in a computer-controlled communications network.

The 2741, on the other hand, communicates with a computer — not with other terminals — for a specific job: the preparation and revision of text materials that need constant changes.

Other communications products also announced by IBM are: (1) the IBM 1035 badge reader which, as part of a data collection system, electronically gathers information in a plant and sends it to a computer; (2) the IBM 2703 transmission control unit which regulates the flow of data between terminals and a computer; (3) the IBM 2712 remote multiplexor which takes computer-bound data from many low-speed lines and transmits it over a single high-speed line; and (4, 5, 6) the IBM "shared", "local", and "leased" line adapters which connect IBM Tele-processing equipment and communications facilities.

The IBM 2740 and 2741 terminals are manufactured at the company's plant in Lexington, Ky. Deliveries are scheduled to begin in the final quarter of this year. (For more information, designate #49 on the Readers Service Card.)

STELLARMETRICS DDPU-10

A new digital data processing unit (DDPU), to make signals from space understandable to a computer, has been introduced by Stellarmetrics, Inc., Santa Barbara, Calif., manufacturer of aerospace instrumentation and systems.

The new Stellarmetrics DDPU-10 functions as a data processor between a decommutation system and a telemetry data processing computer complex.

Its functions are threefold: frame sync recognition, in which the DDPU recognizes and identifies any two missing channels which could occur in an incoming, non-standard PAM wavetrain, or any one of three subframe sync pulses, thus providing the computer with a time coincident sync signal; displays selected digital data in the form of 8-bit binary words on the front panel; and provides digital data and sync information to a telemetry data processing computer.

DDPU-10 decommutation rates range from 1 pps to 5000 pps. (For more information, designate #48 on the Readers Service Card.)

DIGITAL ELECTRONICS OFFERS NEW A/D CONVERTERS

A new high speed analog to digital converter for general laboratory and on-line data processing applications now is available from Digital Electronics Inc. of Westbury, L. I., New York. The Model 327 Analog to Digital Converter is capable of 15,000 complete measurements per second and has applications in the industrial control field, production testing, data reduction, automatic checkout and computer inputs. It comes complete with its own internal power supply and reference source.

The output code of the converter is bipolar 9 bits or 8 bits plus sign and is displayed on the converter's front panel binary indicators.

Three ranges of input voltages are provided, ±1.024, ±10.24 and ±102.4. Input impedance is 1000 ohms per volt. Output voltage is +10 volts @ 2ma and accuracy is ±0.1%, ±1/2 least significant bit.

The converter is designed for high reliability and uses all solid-state circuitry. Provision for remote control, internal control and manual control of conversion also is included.
(For more information, designate #50 on the Readers Service Card.)

SERIES 6010 SERIALIZER

The Series 6010 Serializer is a flexible device for converting outputs of digital voltmeters, analog-to-digital converters or volt-ohmeters into serial data form. This solid state device, introduced by the Instrument Division of Electronic Associates, Inc., Long Branch, N.J., may be programmed to select eleven input characters, plus up to three internally generated characters, and convert these signals into a form for electric typewriters, paper tape units, card punches and similar print-out devices.

The 6010 Serializer accepts the following parallel inputs: up to five 4-line BCD groups, a 4-line range group and a 4-line mode and sign group. An optional expansion allows the addition of up to four 6-line alpha numeric binary input groups. Features of the Serializer include variations in output sequence or word format, and an optional device that provides a column counter which can be used to generate a carriage return after a predetermined number of words.

The new device is designed to be compatible with the company's line of Series 6000 and 6001 Digital Voltmeters, Series 6020 Analog-to-Digital Converter, and Series 6101 Digital Volt-Ohmeter. (For more information, designate #51 on the Readers Service Card.)

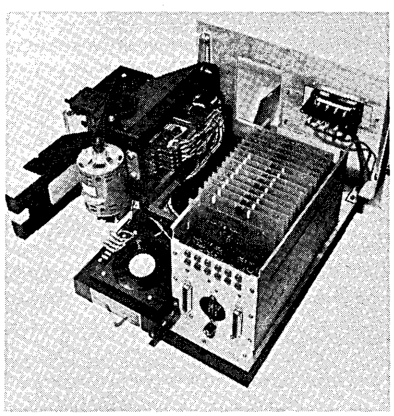
Input-Output

HIGH-SPEED LISTER/PRINTERS BY DI/AN CONTROLS

A new series of lister/printers for the data systems industry has been developed by Di/An Controls, Inc., Boston, Mass.

Series N Lister/Printers can produce up to 2400 32-column lines of numeric printout per minute, or 1200 alphanumeric. Character definition and alignment are such that, even at maximum speed, the printout can be read by commercial optical scanning equipment. Bulk character rate, according to the company, is sufficient to make the machine competitive with high speed page printers at about 1/6 the cost.

An exlusive inking system employs a plastic sponge with an inking capacity of 10,000,000 lines. Cost savings versus ribbon inking systems amount to 50¢ to 75¢ per hour, according to Di/An. The actuator mechanism, a single, sealed module, houses ballistic elements and requires no adjustment. Printing adjustment is achieved by setting a potentiometer with a screwdriver. Paper capacity is four times that of other printers. All-silicon, solid-state electronic components are used.



— Rear view demonstrates the modular construction that simplifies maintenance and makes operation more reliable.

Series N Lister/Printers provide full modular flexibility: in interface electronics, column capacity, and cabinet configuration. Standard options include: data storage with strobe input gates, input data formatting for bit-serial or character-serial inputs and interchangeable code wheel. These machines may be operated either synchronously or asynchronously with the data source. Initial cost of Series N Lister/Printers is low, because modular electronics and mechanics permit tailoring printers to customers' specific needs.
(For more information, designate #58 on the Readers Service Card.)

IQ-10-213 CALCULATOR

A new fully automatic, general purpose rotary calculator called the IQ-10-213, has been introduced by Litton Industries/Monroe International division. The new calculator has keytop instructions that spell out the function each key performs, making the machine easy to learn and operate. Fully powered control keys eliminate the need for minor setup changes encountered in conventional operation.

Monroe said the IQ-10-213 combines in one machine many features never before offered in a calculator in its price range. The device has such features as simultaneous display of all three multiplication factors, accumulation of multipliers, multifactor multiplication with a constant, automatic squaring and multiplication by the smaller of two variables.

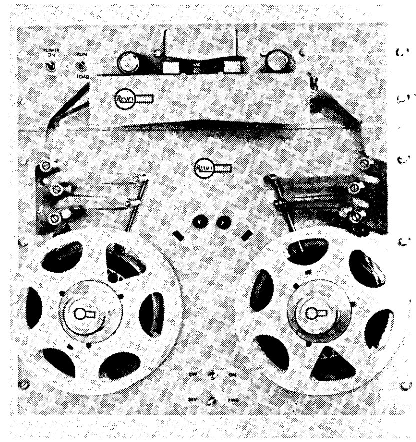
The IQ-10-213 is available for immediate delivery at Monroe's 400 branch offices.
(For more information, designate #56 on the Readers Service Card.)

READER SPOOLER SYSTEM INTRODUCED BY RHEEM

A new model high speed photocell punched tape reader and matching tape spooler was introduced by Rheem Electronics, Hawthorne, Calif., at the Wescond Show in San Francisco, held in August. The new models are the RR-702 Photocell Punched Tape Reader and the RS-702 Tape Spooler.

These new models are specifically designed as input devices for numerical control systems, digital computers, automatic drafting machines, automatic circuit evaluators, or other systems requiring reliable high speed punched tape reading.

The reader is available in either unidirectional or bidirec-



tional models and operate at speeds to 700 characters per second. The spooler has bidirectional rewind from push button or remote control at 200 inches per second.
(For more information, designate #57 on the Readers Service Card.

MANAGEMENT DISPLAY SYSTEM

Up-to-the-moment company operating data can be presented in formats already familiar to company executives on the recently developed Information Displays, Inc. (formerly RMS Associates, Inc.) Management Display System, IDI Type CM10009. The system, operating over Dataphone lines from a UNIVAC 490, can display more than 75,000 characters per second. (Interfaces for other computers also are available.)

Management-computer communication is made possible with the keyboard, light pen, and special pushbutton switches. A large (4096 x 30) self-contained core memory refreshes the display rapidly, while at the same time, accepting low speed Dataphone signals from the computer — which may be many miles from the system. A unique "Jump To" feature allows any portion of the memory to be displayed under computer control.

The Display System is completely solid-state (except for the CRT). It is comprised of (1) the Display Generator containing the core memory, Dataphone-490 interface, function generators, miscellaneous logic, keyboard and pushbutton controls; and (2) the Display Console mounted on casters for ready moveability. The Display Console mounts the 21" CRT and includes the deflection circuits, and display power supplies.
(For more information, designate #52 on the Readers Service Card.)

NEW LITERATURE

MOODY'S COMPUTER INDUSTRY SURVEY

Brandon Applied Systems, Inc., and Moody's Investors Service, Inc. have announced publication of their first issue of Moody's Computer Industry Survey. This new periodical is a technical/financial review of the computer industry on a continuing basis. The industry is assessed from the viewpoint of equipment users and from the viewpoint of investors.

In its initial issue, the Computer Industry Survey describes the background, product lines, and competitive positions of more than 40 companies. These include manufacturers of computers, manufacturers of peripheral equipment and supplies, and software and service suppliers.

Subscription is $95 per year and includes quarterly Surveys, plus Interim Reports and Bulletins. Bulletins will be issued whenever a significant event occurs in the industry and will be mailed within 24 hours after the event.

A free copy of the first issue, Summer 1965, is available on request. (For more information, designate #59 on the Readers Service Card.)

TIME SHARING SOFTWARE BROCHURE

Digital Equipment Corp., Maynard, Mass., has announced the availability of a 20-page, 2-color Time Sharing Brochure.

The brochure describes concurrent operation of several user programs made possible by Digital's PDP-6 monitor. The pamphlet is designed to familiarize the reader with use of the time shared monitor and salient features of the software system, and actually illustrates some of the programming commands.
(For more information, designate #60 on the Readers Service Card.)

FACTS ABOUT PEDESTAL FLOORS

A guide to the selection of surfacing materials for elevated flooring is available from the Armstrong Cork Company's Industry Products Division as an aid to organizations planning to install electronic data processing equipment.

The six-page, full-color brochure describes the importance of pedestal floors and how they differ from other commercial floors. Also described are the types of flooring available and their properties. (For more information, designate #61 on the Readers Service Card.)

BUSINESS NEWS

BURROUGHS UPS EARNINGS 47% IN FIRST HALF

Burroughs Corporation reports net earnings for the six months ended June 30 of $5,889,000 contrasted with $3,998,000 last year, an increase of 47%. Net earnings were $3,111,000 for the second quarter of 1965, compared with $2,088,000 for the same period last year, an increase of 49%.

Revenue for the second quarter was $108,300,000 compared with $96,117,000 last year, and $209,100,000 for the six months versus $183,680,000 in 1964.

Ray R. Eppert, president, said that incoming orders for commercial products and systems in the first six months established a new record for the period. The president added that commercial backlogs are now 15% higher than on January 1.

HONEYWELL'S SALES, EARNINGS RISE

Worldwide sales and rental income of Honeywell Inc. increased to $171,155,868 and earnings rose to $9,900,607 in the three months ended June 30, the company announces. Both set records for the period.

The previous second quarter record was set a year ago, when the company reported sales and rental revenue of $163,144,039 and earnings of $9,130,798.

Chairman James Binger said the company's EDP business continued to make "major progress", with rental income "rising steadily". The percentage of computers shipped for rental rather than sale was greater than in the year ago period, and customer support activities "have been greatly expanded".

The second-quarter results brought Honeywell's six-month sales to $325,226,864 as compared with $320,751,427 in the same 1964 period. Earnings in this year's first six months totaled $16,984,025 as against $17,390,841 in the first half a year ago.

NCR INCREASES NET INCOME 10% IN FIRST HALF

Sales of the National Cash Register Company during the first six months of 1965 rose to $333,359,635, which was a 9% increase over the $305,193,592 recorded for the comparable period of 1964, the company reports.

Net income was $9,599,443 for the period, according to Robert S. Oelman, board chairman, compared with $8,737,508 for the first six months of last year, or an increase of 10%.

Orders for EDP equipment, Mr. Oelman said, were up approximately 55% over the comparable period of 1964 and represented over $50 million in sales value. This was the highest volume of incoming computer business yet recorded by NCR for the period. The rise in computer orders reflected a widespread acceptance of NCR's newest computer family, the Series 500, as well as the company's recently expanded family of 315 medium-size computers, Mr. Oelman said.

NCR has now installed approximately 1350 EDP systems of various types, he added, many of which use NCR sales registers, accounting machines and adding machines for data input.

SDS PROFITS RISE 45%

First half sales and earnings for Scientific Data Systems set new records for the company, SDS President, Max Palevsky reports. Profits in the six months ended June 30 increased 45 per cent to $1,390,000. For the same period in 1964, profits were $935,000. Total revenues also climbed to $22,053,000 from $7,677,000 in 1964.

Mr. Palevsky said that despite a rise in the proportion of leased equipment, "the growth of SDS in all of its significant areas is expected to continue at the present rate". SDS now has 300 digital computers operating in 18 countries and is shipping machines at the rate of one per working day.

MONTHLY COMPUTER CENSUS

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

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

In general, manufacturers in the computer field do not officially release installation and on order figures. The figures in this census are developed through a continuing market survey conducted by associates of our magazine. This market research program develops a documented data file which now covers over 80% of the computer installations in the United States. A similar program is conducted for overseas installations.

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

AS OF AUGUST 10, 1965

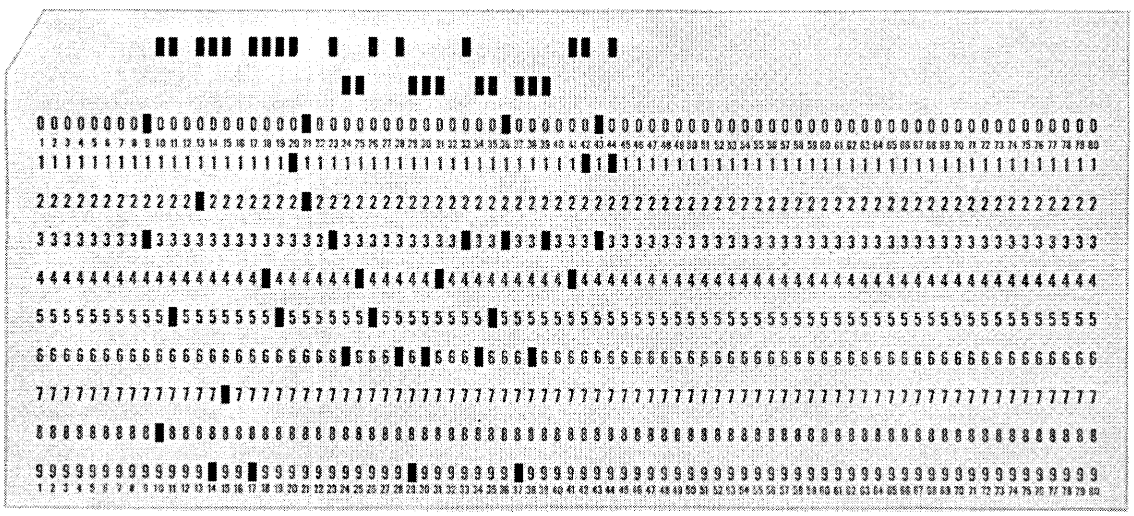
NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTALS	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
Addressograph-Multigraph Corporation	EDP 900 system	Y	$7500	2/61	11	1
Advanced Scientific Instruments	ASI 210	Y	$2850	4/62	23	2
	ASI 2100	Y	$3000	12/63	6	0
	ASI 6020	Y	$2200	4/65	3	4
	ASI 6040	Y	$2800	7/65	1	4
	ASI 6050	Y	$3000	10/65	0	1
	ASI 6070	Y	$3500	10/65	0	0
	ASI 6080	Y	$4000	1/66	0	0
Autonetics	RECOMP II	Y	$2495	11/58	55	X
	RECOMP III	Y	$1495	6/61	14	X
Bunker-Ramo Corp.	BR-130	Y	$2000	10/61	170	10
	BR-230	Y	$2680	8/63	14	1
	BR-300	Y	$3000	3/59	40	X
	BR-330	Y	$4000	12/60	35	X
	BR-340	Y	$7000	12/63	19	2
	BR-530	Y	$6000	8/61	15	X
Burroughs	205	N	$4600	1/54	56	X
	220	N	$14,000	10/58	44	X
	E101-103	N	$875	1/56	163	X
	B100	Y	$2800	8/64	60	35
	B250	Y	$4200	11/61	104	7
	B260	Y	$3750	11/62	205	65
	B270	Y	$7000	7/62	148	25
	B280	Y	$6500	7/62	85	25
	B300	Y	$8400	7/65	2	45
	B5000/B5500	Y	$20,000	3/63	39	11
Clary	DE-60/DE-60M	Y	$525	7/60	325	3
Computer Control Co.	DDP-19	Y	$2800	6/61	3	X
	DDP-24	Y	$2500	5/63	66	4
	DDP-116	Y	$900	4/65	6	45
	DDP-224	Y	$3300	3/65	8	22
Control Data Corporation	G-15	N	$1000	7/55	328	X
	G-20	Y	$15,500	4/61	26	X
	160*/160A/160G	Y	$1750/$3400/$12,000	5/60;7/61;3/64	426	4
	924/924A	Y	$11,000	8/61	28	1
	1604/1604A	Y	$38,000	1/60	60	X
	3100	Y	$7350	12/64	24	35
	3200	Y	$12,000	5/64	76	30
	3300	Y	$15,000	8/65	0	35
	3400	Y	$25,000	11/64	12	20
	3600	Y	$58,000	6/63	42	11
	3800	Y	$60,000	11/65	0	20
	6400	Y	$40,000	1/66	0	3
	6600	Y	$110,000	8/64	4	10
	6800	Y	$140,000	4/67	0	1
Digital Equipment Corp.	PDP-1	Y	$3400	11/60	60	2
	PDP-4	Y	$1700	8/62	55	2
	PDP-5	Y	$900	9/63	112	4
	PDP-6	Y	$10,000	10/64	10	11
	PDP-7	Y	$1300	11/64	14	55
	PDP-8	Y	$525	4/65	45	160
El-tronics, Inc	ALWAC IIIE	N	$1820	2/54	24	X
Electronic Associates, Inc.	8400	Y	$7000	6/65	1	6
Friden	6010	Y	$600	6/63	200	188
General Electric	115	Y	$1375	12/65	0	100
	205	Y	$2900	6/64	28	15
	210	Y	$16,000	7/59	56	X
	215	Y	$6000	9/63	50	5
	225	Y	$8000	4/61	145	3
	235	Y	$10,900	4/64	51	6
	415	Y	$7300	5/64	62	75
	425	Y	$9600	6/64	35	55
	435	Y	$14,000	10/64	11	20
	625	Y	$41,000	12/64	5	22
	635	Y	$45,000	12/64	5	26
General Precision	LGP-21	Y	$725	12/62	130	X
	LGP-30	semi	$1300	9/56	400	X
	RPC-4000	Y	$1875	1/61	80	X
Honeywell Electronic Data Processing	H-120	Y	$2600	12/65	0	160
	H-200	Y	$5700	3/64	555	310
	H-400	Y	$8500	12/61	122	8
	H-800	Y	$22,000	12/60	83	8
	H-1200	Y	$6500	2/66	0	33
	H-1400	Y	$14,000	1/64	12	2

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTALS	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
Honeywell (cont'd)	H-1800	Y	$30,000	1/64	11	9
	H-2200	Y	$11,000	10/65	0	42
	H-4200	Y	$16,800	2/66	0	6
	H-8200	Y	$35,000	3/67	0	1
	DATAmatic 1000	N	$40,000	12/57	4	X
IBM	305	N	$3600	12/57	180	X
	360/20	Y	$1800	12/65	0	2700
	360/30	Y	$7500	5/65	55	2350
	360/40	Y	$16,000	4/65	70	650
	360/50	Y	$30,000	8/65	0	300
	360/60	Y	$48,000	8/65	0	16
	360/62	Y	$55,000	9/65	0	5
	360/65	Y	$49,000	1/66	0	85
	360/67	Y	$49,000	9/66	0	7
	360/75	Y	$78,000	11/65	0	85
	650	N	$4800	11/54	270	X
	1130	Y	$850	11/65	0	1050
	1401	Y	$4500	9/60	7100	300
	1401-G	Y	$2000	5/64	1000	100
	1410	Y	$14,200	11/61	760	50
	1440	Y	$3500	4/63	2000	450
	1460	Y	$9000	10/63	2000	350
	1620 I, II	Y	$2500	9/60	1750	30
	1800	Y	$3500	12/65	0	75
	701	N	$5000	4/53	1	X
	7010	Y	$22,600	10/63	140	60
	702	N	$6900	2/55	8	X
	7030	Y	$160,000	5/61	7	X
	704	N	$32,000	12/55	43	X
	7040	Y	$18,000	6/63	108	22
	7044	Y	$35,200	6/63	55	8
	705	N	$30,000	11/55	61	X
	7070, 2, 4	Y	$27,000	3/60	352	8
	7080	Y	$55,000	8/61	73	1
	709	N	$40,000	8/58	11	X
	7090	Y	$63,500	11/59	56	4
	7094	Y	$72,500	9/62	135	15
	7094 II	Y	$78,500	4/64	77	30
ITT	7300 ADX	Y	$18,000	9/61	9	6
Monroe Calculating Machine Co.	Monrobot IX	N	Sold only - $5800	3/58	155	X
	Monrobot XI	Y	$700	12/60	560	130
National Cash Register Co.	NCR - 304	Y	$14,000	1/60	26	X
	NCR - 310	Y	$2000	5/61	46	1
	NCR - 315	Y	$8500	5/62	330	35
	NCR - 315-RMC	Y	$12,000	9/65	0	75
	NCR - 390	Y	$1850	5/61	960	60
	NCR - 500	Y	$1500	9/65	0	200
Philco	1000	Y	$7010	6/63	16	2
	2000-210, 211	Y	$40,000	10/58	21	2
	2000-212	Y	$52,000	1/63	9	2
	2000-213	Y	$68,000	6/65	0	1
Radio Corporation of America	Bizmac	N	$100,000	-/56	3	X
	RCA 301	Y	$6000	2/61	600	12
	RCA 3301	Y	$11,500	7/64	33	22
	RCA 501	Y	$14,000	6/59	98	2
	RCA 601	Y	$35,000	11/62	5	X
	Spectra 70/15	Y	$2600	11/65	0	60
	Spectra 70/25	Y	$5000	11/65	0	50
	Spectra 70/45	Y	$9000	3/66	0	60
	Spectra 70/55	Y	$14,000	5/66	0	13
Raytheon	250	Y	$1200	12/60	170	10
	440	Y	$3500	3/64	12	5
	520	Y	$3200	10/65	0	8
Scientific Data Systems Inc.	SDS-92	Y	$900	4/65	15	40
	SDS-910	Y	$2000	8/62	140	25
	SDS-920	Y	$2700	9/62	88	15
	SDS-925	Y	$2500	12/64	4	22
	SDS-930	Y	$4000	6/64	54	25
	SDS-9300	Y	$7000	11/64	11	8
Systems Engineering Labs	SEL-810	Y	$750	8/65	0	8
	SEL-840	Y	$4000	10/65	0	3
UNIVAC	I & II	N	$25,000	3/51 & 11/57	29	X
	III	Y	$20,000	8/62	88	5
	File Computers	N	$15,000	8/56	20	X
	Solid-State 80 I, II, 90 I, II & Step	Y	$8000	8/58	310	X
	418	Y	$11,000	6/63	26	12
	490 Series	Y	$26,000	12/61	55	27
	1004	Y	$1900	2/63	2900	250
	1050	Y	$8000	9/63	180	160
	1100 Series (except 1107)	N	$35,000	12/50	13	X
	1107	Y	$45,000	10/62	28	1
	1108	Y	$50,000	7/65	0	15
	LARC	Y	$135,000	5/60	2	X
				TOTALS	28,440	11,939

X = no longer in production.

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

save your punched cards...



they may become collectors' items!

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BOOKS AND OTHER PUBLICATIONS — Reviews

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.**

Corbato, F. J., J. W. Poduska, and J. H. Saltzer / Advanced Computer Programming: A Case Study of a Classroom Assembly Program / M. I. T. Press, Cambridge 42, Mass. / 1963, offset, 192 pp, $5.00

This description of the development an assembler-compiler language, CAP (Classroom Assembly Program), is designed as an advanced programming textbook for those with programming experience. The authors devised their assembler to convince anyone overawed "by the seeming complexities of such programs" that the principles of translators are few and simple. The course in which CAP is used has been given successfully to students from more than 20 departments at M. I. T. CAP is described in the IBM 7090 FAP language, and it is necessary to refer to the IBM manuals on both computer and assembler. Five chapters include "CAP User's Reference Manual" and "CAP as a Laboratory Exercise", appendices include "Listing of the Classroom Assembly Program", "Programs to Allow Use of CAP in the Laboratory", and "Suggested Additions to CAP".

Aeronautical Systems Division et al. / Information Processing by Living Organisms and Machines: 1963 Bionics Symposium / Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C. / 1964, offset, 352 pp, cost ?

Eighteen papers presented at the symposium sponsored jointly by the Aeronautical Systems Division and the Aerospace Medical Division of the Air Force Systems Command, held in Dayton on March 19-21, 1963, are here published. The subject matter is covered from biological, mathematical and engineering viewpoints; many of the papers discuss and try to solve the problem of understanding and simulating the information processing capabilities of living organisms by artificial means. Among the titles: "Systems and Information", "Observations on Color Vision", "Mathematical Models of Neural Activity", "Limits to Animal Discrimination and Recognition", "Realizability of Bionic Concepts", and "Child and SPOCK", where SPOCK stands for Simulated Procedure for Obtaining Common Knowledge". An appendix lists all of the papers presented at the symposium's five sessions.

Hoagland, A. S. / Digital Magnetic Recording / John Wiley & Sons, Inc., 605 Third Ave., New York 16, N. Y. / 1963, printed, 154 pp, $7.50

The principles of digital magnetic recording technology are discussed, with an emphasis on an integrated approach which illuminates the interrelation of design parameters with the storage of digital information. The author declares his book to be anything but a "cookbook" of design techniques. Rather, he chooses, successfully, to provide a comprehensive understanding and to place the technology in perspective. Six chapters include: "Introduction", which discusses the inherent characteristics of digital magnetic recording and defines common terms, "Mass Storage", "Principles of Magnetics", and "Magnetic Heads and Storage Media" References and index.

Ackoff, Russell, and Patrick Rivett / A Manager's Guide to Operations Research / John Wiley & Sons, Inc., 605 Third Ave., New York 16, N. Y. / 1963, printed, 107 pp, $4.25

The aim of this book is "to enable the industrial executive to reduce the faith he requires to undertake operations research in his organization". The reduction of faith is replaceable by an understanding of OR techniques, which the text provides. In five chapters, the present applications of OR to a variety of industries are described and evaluated. Among the titles: "The Nature of OR," "Relationship With Other Management Services", and "Organization and Administration". References and index.

— Notices

Teichroew, Daniel / An Introduction to Management Science: Deterministic Models / John Wiley & Sons, Inc., 605 Third Ave., New York 16, N. Y. / 1964, printed, 713 pp, $10.95

Tou, Julius T. / Optimum Design of Digital Control Systems / Academic Press, Inc., 111 Fifth Ave., New York 3, N. Y. / 1963, printed, 186 pp, $7.00

Stiefel, Eduard L. / An Introduction to Numerical Mathematics / Academic Press, Inc., 111 Fifth Ave., New York 3, N. Y. / 1963, printed, 286 pp, $6.75

Dantzig, George B. / Linear Programming and Extensions / Princeton University Press, Princeton, N. J. / 1963, printed, 625 pp, $11.50

Weintraub, Sol / Tables of the Cumulative Binomial Probability Distribution for Small Values of p / Free Press of Glencoe, 60 Fifth Ave., New York 11, N. Y. / 1963, offset, 818 pp, $19.95

Korn, Granino A., and Theresa M. Korn / Electronic Analog and Hybrid Computers / McGraw-Hill Book Co., Inc., 330 West 42 St., New York, N. Y. 10036 / 1964, printed, 584 pp, $17.50

Ideas for Management: Papers and Case Histories presented at 1964 International Systems Meeting / Systems and Procedures Association, 7890 Brookside Drive, Cleveland, Ohio 44138 / 1964, printed, 376 pp, $10.00 ($7.00 to members of SPA)

Graf, Rudolf F., editor / Modern Dictionary of Electronics, second edition / Howard W. Sams & Co., Inc., Indianapolis 6, Ind. / 1963, printed, 435 pp, $6.95

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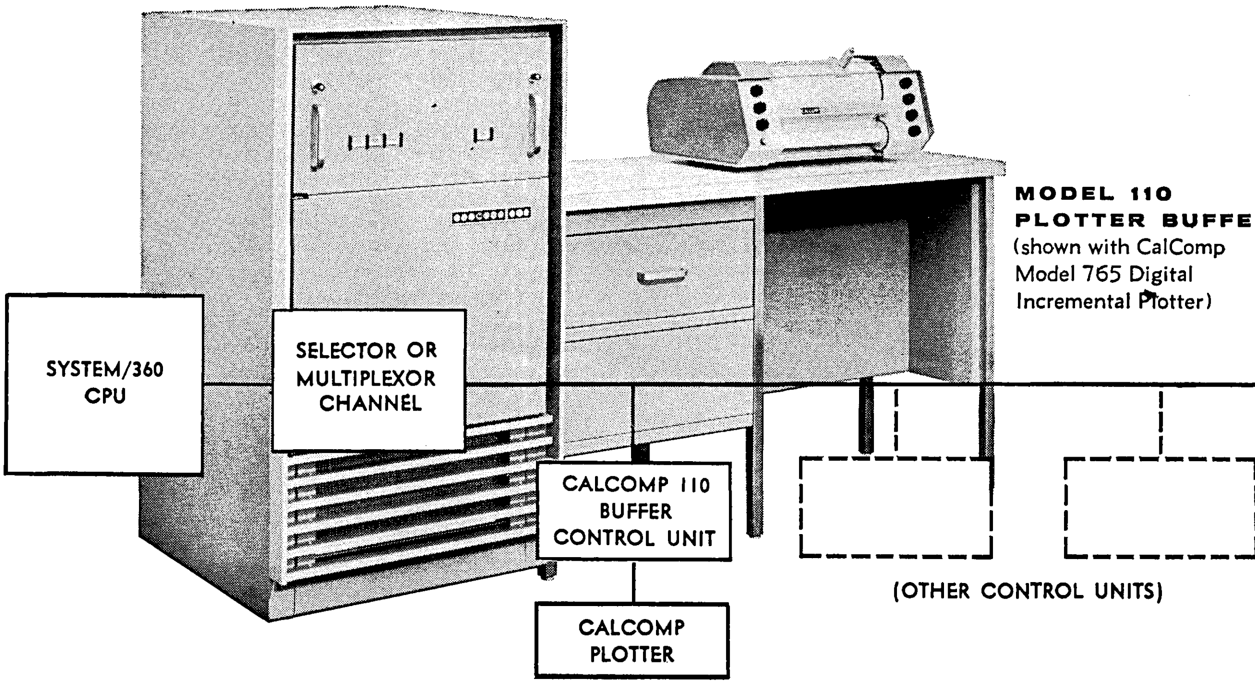

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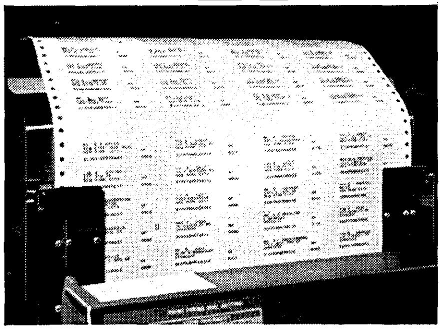
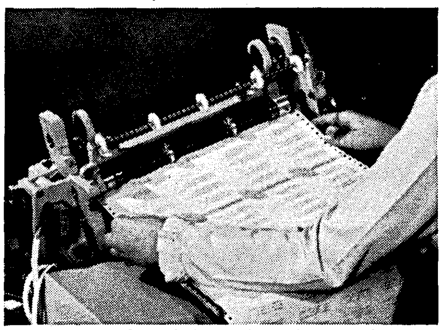
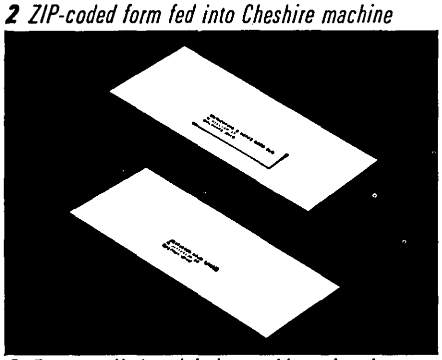


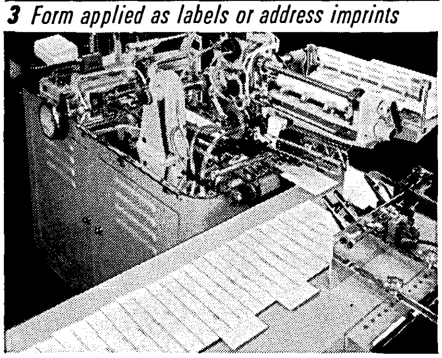
1 Address form 'printed out' with ZIP codes



2 ZIP-coded form fed into Cheshire machine



3 Form applied as labels or address imprints



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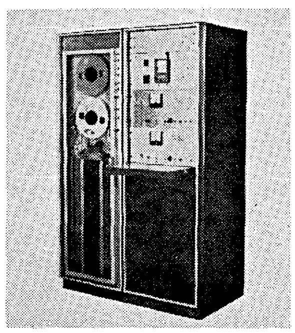

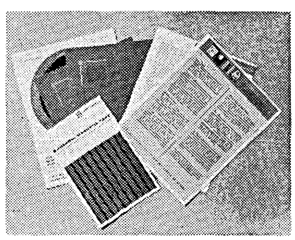

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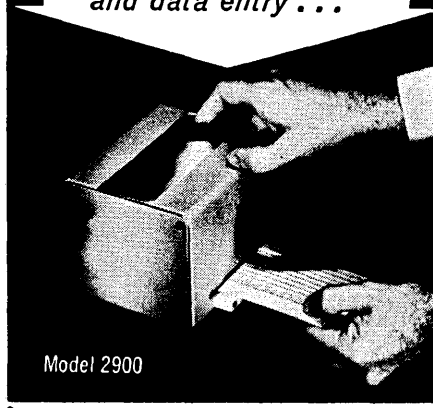

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Circle No. 9 on Readers Service Card

Here's the only advice you need to design your own on-line system: don't

Designing on-line systems is tricky. Nevertheless, do-it-yourselfers often try it, taking twice the time to do it wrong at triple the cost of doing it right. Nobody has that sort of money. Or time. That's why you need an expert to put your system on line. Which expert? We have some advice on that subject, too.

by Richard H. Hill

Would you pilot a commercial jet from Los Angeles to Bangkok? Would you take your wristwatch apart and repair it? If the answer is "Yes" and you aren't a pilot or a watchmaker, read on at your own risk. We're about to shoot do-it-yourselfers right out of the on-line systems design business.

SAYS WHO?

First off, our credentials: At Informatics Inc., we think we have every right to speak on the subject of on-line computer systems. Our justification is simple: we've probably done more work in on-line software than any other group in the field. Fact is, we seem to be the only major programming firm anywhere *specializing* in on-line computer systems implementation. And much of our work has been conducted at the furthest extension of the art (National Military Command System, the RADC on-line computing system and the Mobile Wing Reconnaissance Technical Squadron are a few examples). Do we know what we're talking about? We'd better.

THE MISSING LINK: SOFTWARE

At Informatics, we believe that the computing system exists for the user, not *vice versa.* Consequently we are convinced that the directions of the future point inevitably to direct, on-line user/computer communication. But, if you accept this fact, you also have to accept the problems of putting the user and the computer in direct dialog. How do you do this? It's not easy. Nevertheless, a lot of well-meaning users have tried. And a lot of amoebic monsters have been spawned—so divided and subdivided that any semblance of direct access to the system is lost. That's why the job has to be done by an expert—someone who's had the course in the complexities of on-line programming. Right now, today, all of the equipment and technology exists to put even the most sophisticated system on line. The only missing ingredient is on-line software.

THE WAITING GAME

The essential key to on-line implementation is *time-sharing*. Modern computers—and even those not so modern—are too fast to serve only one person. To make economic sense, the computer must be shared. Segments of the total computing time must be made available to many users. And not all of the users need be humans: regularly scheduled programs can also have their share in on-line systems. For instance, a computer in a medium-sized manufacturing company might service ten or twelve on-line engineering design consoles, concurrently record sales orders and other messages received by teletype from other company offices, and also compute payroll—all on a time-sharing basis. Difficult? Yes. Impossible? No. It can be done by someone who knows how. And knowing how means mastery of a few knowledge areas: Dynamic storage allocation. Interrupt management. Task queuing. Priority level control. Program rollout and rollback. Random access storage management. Time-slicing. Memory protection. And several other odds and ends of programming technology. Knowing how also means experience. Real, practical, working experience. The I've-done-it-before-and-I-know-exactly-how-to-put-the-whole-thing-together-and-make-it-work-type experience. And, on top of this, knowing how means knowing what *not* to do in on-line implementation. Knowing what not to do is every bit as important as knowing what to do if the system is to work, work right and work under all conditions.

WE'RE READY, ARE YOU?

If you've read this far, chances are you need an on-line system. And at this point you should realize that we think we can design one for you. If you'd like to talk over your own on-line systems design requirements or if you think you're qualified to help us solve other people's problems, our number is (213) 783-7500. Ask for me, Frank Wagner, Walter Bauer or any other members of our staff. We also have literature on our people and capabilities which we will be happy to send you. Address Department E, Informatics Inc., 5430 Van Nuys Boulevard, Sherman Oaks, California 91401.

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American Telephone & Telegraph Co., 195 Broadway, New York 17, N.Y. / Page 2 / N.W. Ayer & Son

Benson-Lehner Corp., 14761 Califa St., Van Nuys, Calif. / Page 3 / Leonard Daniels Advertising

California Computer Products, 305 Muller Ave., Anaheim, Calif. / Page 47 / Advertisers Production Agency

Cheshire, Inc., 408 Washington Blvd., Mundelein, Ill. 60060 / Page 48 / Robert W Deitz & Associates

Columbia University Press, 2960 Broadway, New York 27, N.Y. / Page 20 / Franklin Spier Inc.

Computron Inc., 122 Calvary St., Waltham, Mass. / Page 4 / Tech/Reps

Control Data Corp., 8100 34th Ave., So., Minneapolis 20, Minn. / Pages 44, 45 / Klau-Van Pietersom-Dunlap, Inc.

Cybetronics, Inc., 132 Calvary St., Waltham, Mass. 02154 / Page 48 / Stan Radler

Cycle Equipment Co., 17480 Shelburne Way, Los Gatos, Calif. 95030 / Page 50 / Benét Hanau & Associates

Datamec Div., Hewlett-Packard Co., 345 Middlefield Rd., Mountain View, Calif. / Page 46 / Ellis Walker

Digital Equipment Corp., Maynard, Mass. / Page 7 / The Rumrill Co., Inc.

Drexel Dynamics Corp., Maple Ave., Horsham, Pa. 19044 / Page 48 / Benn Associates

Forms, Inc., Willow Grove, Pa. / Page 28 / Elkman Advertising Co., Inc.

Informatics, Inc., 15300 Ventura Blvd., Sherman Oaks, Calif. / Page 49 / Faust/Day Advertising

Memorex Corporation, 1180 Shulman Ave., Santa Clara, Calif. / Page 2A / Hal Lawrence Inc.

National Cash Register Co., Main & K Sts., Dayton, Ohio 45409 / Page 51 / McCann-Erickson, Inc.

L. A. Pearl Co., 801 Second Ave., New York, N.Y. 10017 / Page 50 / —

Wolf Research & Development Corp., P.O. Box 1536, Baker Ave., W. Concord, Mass. 01781 / Page 52 / de Garmo-Boston, Inc.

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