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December, 1969

Vol. 18, No. 13

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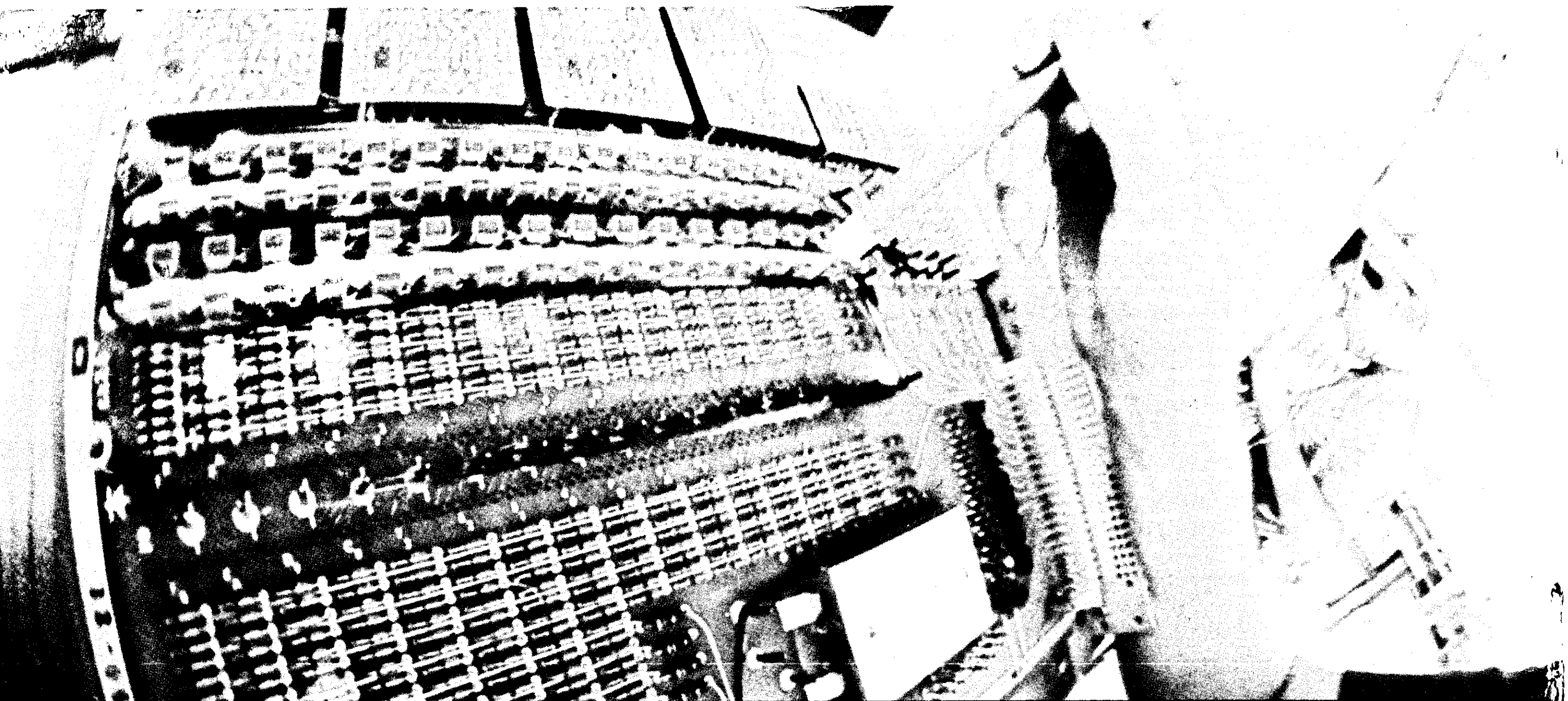
computers and automation

Minicomputers (and Their Applications)



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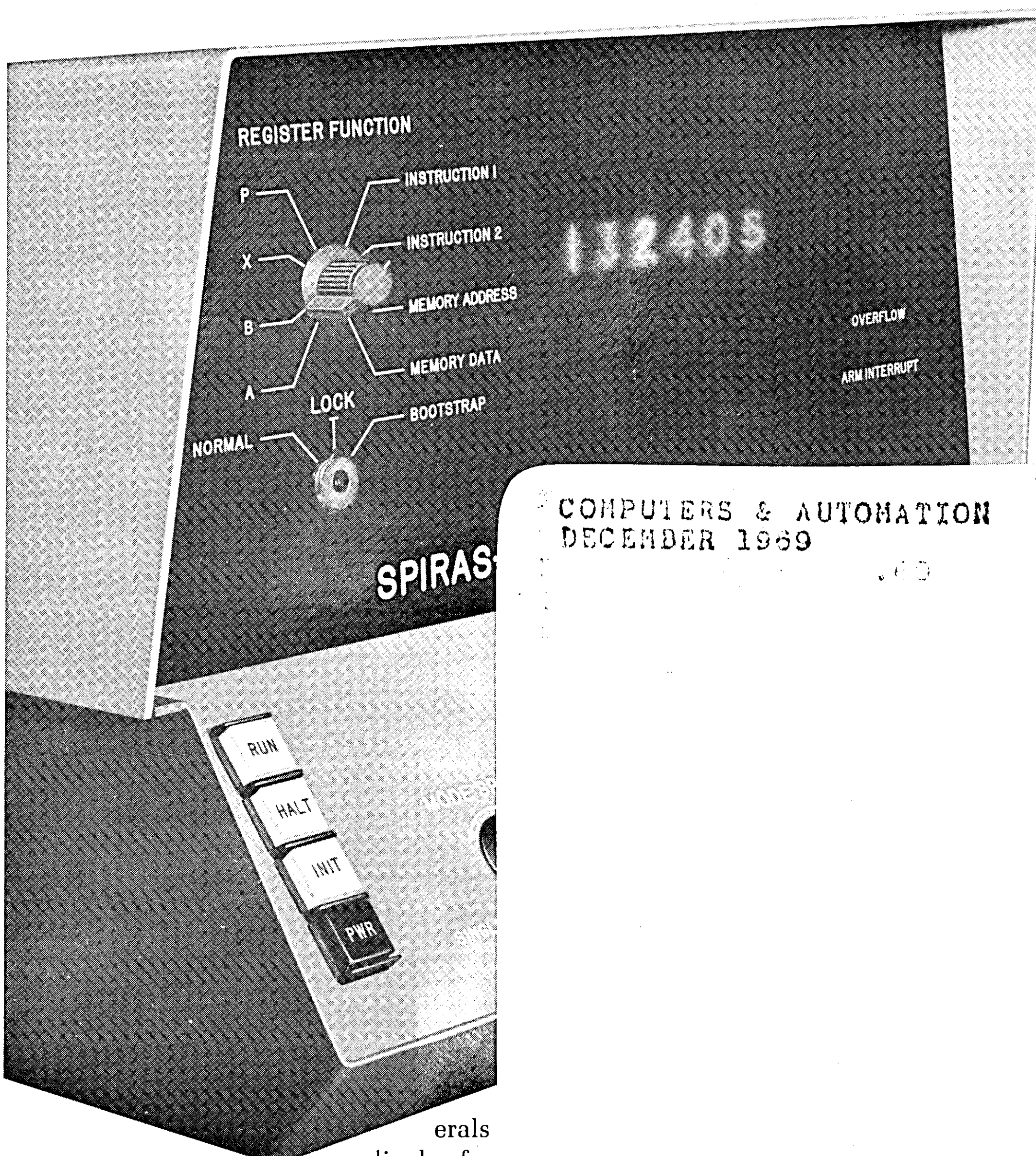

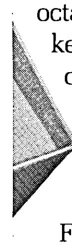

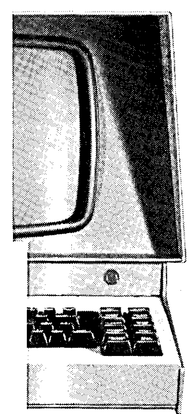

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Letters To The Editor

Seeks Accreditation

I read with interest your comments concerning accreditation of privately operated data processing schools in your October issue (page 7). I would greatly appreciate knowing the addresses of the accrediting agencies to which you refer.

My firm offers training of the type mentioned, and we would like to believe that we are among the minority legitimate group of such institutions. Heretofore I have been unable to learn of any accrediting body, and would welcome the chance to undergo an objective critique of our training facilities and methods.

TERRANCE R. PERRY, President
Impact Computing Corp.
24 Miracle Strip Parkway, S.E.
Fort Walton Beach, Fla. 35248

Ed. Note — The three agencies specifically granted the power by the U.S. Office of Education to accredit non-degree granting institutions in the field of computer training, programming, or data processing are: The National Association of Trade and Technical Schools, 1601 18th St., N.W., Washington, D.C. 20009; United Business Schools Association, 1101 17th St., N.W., Washington, D.C. 20036; and The Accrediting Commission of the National Home Study Council, 1601 18th St., N.W., Washington, D.C. 20009.

Hocus Pocus Numble

In reply to Kerry G. Fields' letter from Australia (September issue, page 14), the solution to his Numble is:

H O C U S	92836
+ P O C U S	+ 12836
P R E S T O	105672

H = 9	O = 2	S = 6
U = 3	T = 7	R = 0
C = 8	P = 1	E = 5

A. SANFORD BROWN
The Academy of Computer Technology
1940 Hi-Line Dr.
Dallas, Tex. 75207

Marketing in Computers and DP

I read with considerable interest your editorial in the October issue ["Marketing in Computers and Data Processing", page 8]. As a part of division planning activities, the Computer Sciences Department is undertaking a study to determine the marketability of a number of its software systems.

Could you supply us with the availability and terms of use of the 16 mailing lists you mention in your editorial?

WILLIAM W. HALE
Management Sciences Group
Optical Systems Div.
Itek Corp.
10 Maguire Rd.
Lexington, Mass. 02173

I read with a great deal of interest your editorial on page 8 of your October issue.

We are very interested in the nature of your "Computers and Automation" Data Base, what information can be assessed, and the cost involved for various user lists. If this information is

(Please turn to page 8)

computers and automation

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computers and automation

Vol. 18, No. 13 — December, 1969 *The magazine of the design, applications, and implications of information processing systems.*

Special Feature:

Minicomputers (and Their Applications)

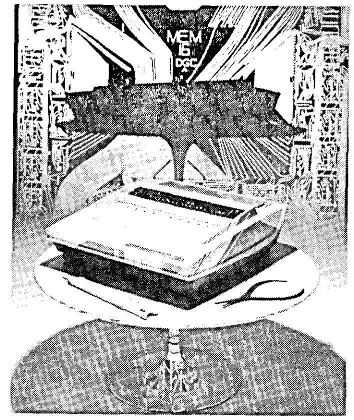
Regular Features

Editorial

Ideas: Spotlight

C&A Worldwide

Multi-Access Forum



The front cover picture shows one of the new minicomputers — Data General Corporation's "Nova" — with an enlarged circuit board in the background.

NOTICE

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

Consequently, if you have not yet sent us your up-to-date filled-in **Who's Who** entry form, PLEASE SEND IT TO US QUICKLY — the chance is good that your entry can be promptly included. Use the entry form on page 17 of this issue, or a copy of it.

Departments

c.a EDITORIAL

Minicomputers

In this issue, *Computers and Automation* focuses attention on minicomputers. These are the automatic computing machines which occupy a very small space, which are very powerful, and which are, relatively, very inexpensive. In fact, they are now becoming widely available at very low cost. This is largely due to circuits using the manufacturing process called "large-scale integration", in which hundreds of electronic circuits can be placed on a wafer of silicon less than one-tenth of an inch square. They are becoming more and more important; more and more manufacturers are making them; and probably more than 10,000 minicomputers are in use.

Why?

We may usefully divide the problems for computers into two general kinds:

Type A: Problems which may be solved with very little access to large, continually changing files of information, such as nearly all computation; and

Type B: Problems that require a great deal of such access, such as making airline reservations, where failure to have access to the central file at any desired moment is a fatal defect.

For Type A problems, a telephone or similar connection to a large central file that continues for a minute or so will regularly allow all the information that a user needs for an hour or several hours, to flow into the immediately connected files of the small computer. It is reasonable to estimate that over 97% of problems are Type A problems, and more than 97% of computer work can be done with only brief and momentary access to large, continually changing files.

Minicomputers apply to a great many Type A problems. And minicomputers also provide at least four great advantages over the customary big computers:

- They do not require the great expense of time-sharing, multi-user software;
- They do not require the great expense of continuously connected communication lines over considerable distances;
- They are cheap enough so that it is economical to assign them to "dedicated" uses, where they concentrate on doing just one job, such as controlling a tool or a process;
- They are cheap enough so that each minicomputer can be monopolized by one human being, and he can have direct access to *all* of the computer.

As is true of almost all segments of the computer field, we are still just on the threshold of new and phenomenal advances. Instead of costing $20,000 or less, a minicomputer of the future will cost $2000 or less. Instead of weighing 60 pounds or less, as some small computers do now, a minicomputer of the future will weigh 6 pounds or less. Instead of having 4000 registers where information may be stored, a minicomputer may have 40,000 registers where information may be stored. And so on – as a result of galloping technology.

The underlying reason that makes possible the development of minicomputers is that the amount of physical equipment which is needed to store one bit (one binary digit) of information and to operate reasonably with one bit can be extremely small. Compare the human brain, which is organized essentially on a chemical basis. It seems likely that an individual protein molecule is used to store many individual bits of information; for example, this seems to be true for the genetic code expressed in protein molecules of the chromosomes.

Less than one tenth of a cubic foot of human brain can hold all the knowledge and reasoning that a professor at a university acquires in 40 years of productive, intellectual activity. So one of the goals conceivably possible for minicomputers is evident whenever we look at a human head, and see the size and capacity of what nature and evolution have already accomplished in minicomputers.

Technologically, it may be fairly easy:

(1) to arrange hardware that is able to hold, in 1/10 of a cubic foot, millions of binary digits of information; and

(2) to arrange circuits to operate with these registers in long sequences of arithmetical and logical operations.

But it is likely to be a good deal more difficult to produce the readily applicable software which can utilize the technical capacity of minicomputers. Nevertheless there is no doubt that this job will be done also. And in the case of minicomputers working with a single human being, speed can often be sacrificed in the interest of much simpler programming.

As the English scientist, writer, and humanist, C. P. Snow, has said, in an article entitled "Science and the Advanced Society" published in *Computers and Automation* in April 1966:

> The computer is the most remarkable machine by far, yet made by man.

Edmund C. Berkeley

Editor

This particular tool has enormously accelerated the pace of science and technology . . .

The educated man in the street who reflects on recent advances in science and technology probably thinks first of jet airplanes, television sets, atomic bombs, or artificial earth satellites. Computers may come briefly to mind, but to most people a computer is a rather complicated, immobile box of hardware enshrined in some remote temple of mathematics, served by a few devoted priests trained to speak its mysterious, nonhuman language. Unless he has been personally initiated into one of the lower orders of this priesthood, he is not likely to appreciate the implications of the new computer technology. A computer is basically a tool, and tools have a way of seeming less important than the uses we put them to.

Those familiar with the course of events during the past ten or fifteen years, however, know that this particular tool has enormously accelerated the pace of science and technology. Those other miracles that seem more impressive to an ordinary citizen are all the product, in greater or lesser degree, of the increased intellectual power that computers have put at our disposal. I believe it is no exaggeration to say that the development of computers — modern, high-speed, stored-program, fully automatic digital computing machines — is probably the most significant thing that has happened to science during the past two decades. Within the next decade this wonderful tool should become immediately and continuously available to anyone with the need and the ability to use it.

—from *The Psychology of Communication* by George A. Miller, pp. 103-104, published by Penguin Books, Inc., 7110 Ambassador Rd., Baltimore, Md. 21207, paperback, 1969 □

LETTERS TO THE EDITOR

(Continued from page 4)

not currently available, please put us on your mailing list for any announcement of availability.

DAVID ECCLES, Vice Pres.
Applied Computer Management Corp.
1730 S.W. Skyline Blvd.
Portland, Ore. 97221

Ed. Note — We have forwarded your letters to: Ed Burnett Inc., 176 Madison Ave., New York, N.Y. 10016, the company in charge of managing our mailing lists. Orders and inquiries concerning C&A's Data Base and mailing lists may be sent directly to them.

Directory Issue — Comments

We received with great interest your midyear issue ["The 1969 Computer Directory and Buyers' Guide", Vol. 18, No. 7 of *Computers and Automation*]. Might we first say that we again were surprised at the excellent work you and your staff have done to carry out this issue. We really have gotten a good deal of new information from this work.

Because there is relatively little information from Germany, some remarks seem to be necessary. (1) On page 108 only two organizations are listed as selling and producing software in Germany. We did not find our firm listed, though we are one of the largest private software firms in Germany. On the other hand, Zuse KG, who is listed on page 108, is not a software firm, but a computer manufacturer. (2) The list of computer manufacturers on pages 122 and 123 does not include the two most important German firms, Siemens and AEG-Telefunken.

DR. K. F. ERBACH
Director of Public Relations and Education
Institut für Beratung und Entwicklung in der Automatischen Informationsverarbeitung
Rheinstrasse 20
61 Darmstadt, Germany

Ed. Note — Your comments are appreciated. We shall be glad to include your firm in our next issue.

Computer Artist

I am finishing my thesis in art this year on "Computer-Aided Graphics", and am devoting the entire year to experimentation on the computer. This past summer I worked very hard on the computer, and achieved some tremendous break-throughs, technically, by finding ways to use fine art papers, pens of varying widths, and opaque and transparent inks on the plotter. Some of the techniques of painting and printing were also brought to the computer. Recently I found brushes that fit the plotter assembly, and have developed a painting technique already for such computer painting.

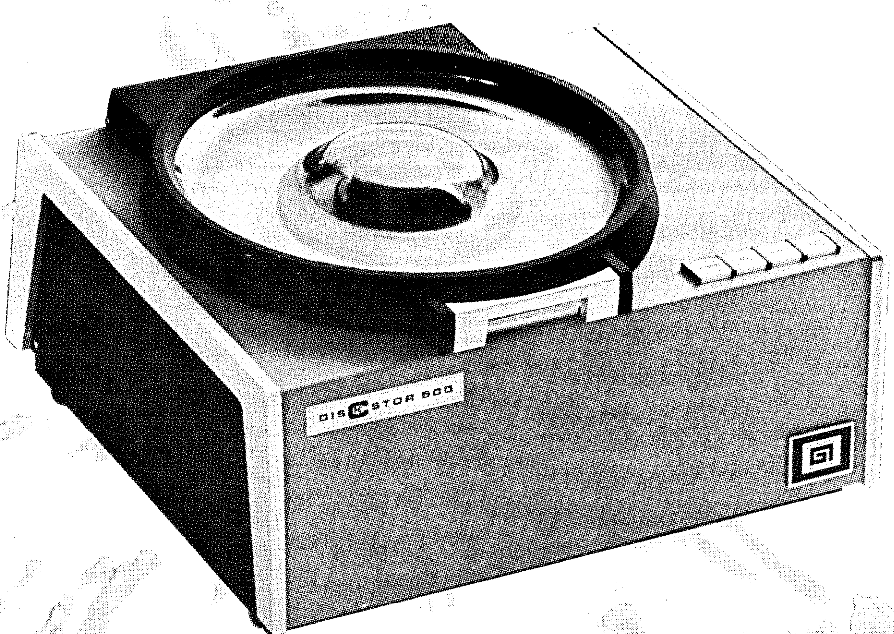
The Computer Science people and the Industry and Technology people at Chico State College have been pleased with the results of my work. The Art Department feels I'm selling my soul to the machine, but I disagree.

I intend to continue work on the computer next year, and will be seeking a research post or teaching position at a university with the doctorate as my goal.

If you would be interested in viewing some of my work, the Industry and Technology people will be happy to make slides for your perusal, and I would be glad to send you material from my recently completed paper. Since there is so little available on graphics as an art form, it is my intention to utilize the present writing I've done and my thesis for a text on computer graphics as an art form.

GRACE C. HERTLEIN
Chico State College
529 Ivy, Apt. 6
Chico, Calif. 95926

Ed. Note — We would very much like to receive copies of the papers you have prepared on the subject of computer-aided graphics. And we are publishing your letter so that other computer artists who are interested in your work may contact you directly.



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breaks through access time barrier!

Systematics/Magne-Head announces the new **DIS(K)STOR 505**. . .the first **head-per-track removable media rotating memory system** to overcome the access time limitations of conventional disc pack memories. Memory capacity up to 5 million bits per pack . . . and, some of the features that are **standard** with **DIS(K)STOR 505** and "first" in a head-per-track disc pack are: • The first disc pack memory system with 12, 16, and 18 bit data bus interfaces. • The first fast access disc pack memory system designed for small to medium size central processing units.

For complete information, call or write . . . or visit:

SYSTEMATICS/MAGNE-HEAD DIVISION
GENERAL INSTRUMENT CORPORATION
13040 South Cerise Avenue, Hawthorne, California 90250
(213) 679-3377/772-2351 TWX 910-325-6203

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c.a

MULTI-ACCESS FORUM

MARTIN LUTHER KING MEMORIAL PRIZE CONTEST — SECOND YEAR

(Please post this notice)

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

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

The judges in 1970 will be:

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

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

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

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

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

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

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

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

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

UNBUNDLING AND THE USERS' GROUP

D. F. Stevens
Mathematics and Computing
Bldg. 50A, Rm. 1135
University of California
Lawrence Radiation Laboratory
Berkeley, Calif. 94720

(The following expresses my position on the question of how computer users' groups should adjust to the new separate pricing policies recently announced by the major computer manufacturers. My qualifications to speak on such a topic include some experience in SHARE (on the FORTRAN Project) and some experience in VIM (as chairman, first of the Software Evaluation Committee, and currently, of the Operating Systems Committee). The views expressed in the note are, of course, my own, and may not reflect official opinions either of my computer installation or of VIM.)

It is surprising that among the spate of articles prompted by the possibility (and more recently, the actuality) of unbundling there has been no speculation as to the new role of the users' group (UG). Perhaps this is due to a feeling that once the step has been taken, the UG has no choice but to go along with it, and continue to conduct business as usual. This would, of course, be a mistake; I would like to offer a more interesting alternative.

Those manufacturers who have unbundled have effectively entered the open marketplace as sellers of that software which is not in the public domain. The operative words in that sentence are ***open*** and ***sellers:*** in other words, the hardware manufacturer must now compete with other interested suppliers. It is in the interests of the UG to see that this competition is fair and as fierce as possible. This requires that the hardware manufacturer lose his privileged position with respect to the UG. The UG should, in fact, invite and encourage participation by other suppliers in all appropriate activities. To ensure an orderly presentation of competitive material, the UG will have to adopt, and enforce, a new set of procedural rules, possibly resulting in many more closed sessions.

The question of certification is also interesting. The UG would seem to be the natural agent, either for the certification of a new product, or for the establishment of suitable criteria for its certification. (I should think that Certification Committees could count on active participation by a number of suppliers . . .) this leads rather naturally into a consideration of the UG as a collective bargaining agent. Such a concept is particularly appealing when considering the following thorny points:

- What is a reasonable installation cost for a new product (in terms of manpower and computer time)? Who bears this cost when the product is installed by the user? By the supplier? What recourse does the user have when the estimated cost is exceeded? Is the time required for performance testing to be included in the installation cost?
- Who bears the cost of time (man and computer) lost due to grievous software error? Who defines "grievous"?
- Is credit to be given to a user who fixes a bug? How much?
- What level of maintenance is included in the cost of the product? (This includes response time and documentation as well as the completeness and accuracy of the fix.) What should it cost (manpower and computer time) to install a fix?
- Manufacturers are well-known for "fixing" a bug by changing the documentation. Will this continue to be permissible?

Should the supplier prove recalcitrant, a purposeful users' group could institute a boycott of considerable severity . . . this may, of course, be neither a desirable nor a practical adjustment to the new situation: it is past time for debate on the issue to begin. □

PROFESSIONAL ETHICS DEBATED BY THE BRITISH COMPUTER SOCIETY

(Based on a report by Kenneth Owen in October 14, 1969 edition of The Times, Printing House Square, London E-C-4, England)

The subject of professional ethics for computer people was debated recently by members of the British Computer Society. Opinions represented in the debate ranged from those who felt there was no need for a professional code at all, to those who suggested a recommended scale of charges for professional work.

The main topic of interest was the degree of responsibility assumed by a professional for the consequences of his work for third parties.

Another hotly discussed issue was the privacy of information held in computer systems. Although the problems of handling "private" information were well aired; there was a general consensus of opinion that no satisfactory short-term solution could be offered.

The Society has set forth draft proposals for guidance of its members. These proposals state that members should exercise their skill impartially and to the best of their ability, should not disclose confidential information concerning employers or clients without permission, and should not accept any position in which their interests conflict with their duty.

The guidelines also state that consultants should declare interests such as directorships, financial interests and personal relationships to clients before accepting instructions, and should not invite any employee of clients to consider alternative employment, except with the client's agreement. In addition, all advertising should be legal, clean, honest and truthful, and consultants should provide a written agreement stating their fee before undertaking an assignment.

Under its current rules, the British Computer Society can exclude any member who has been, in the opinion of the Council, "guilty of conduct which renders him unfit in their opinion to retain his membership". The Council must hear every case itself; it cannot delegate its powers. And there is no right of appeal.

Because many members of the Society feel this is too inflexible, the Council is trying to produce an improved disciplinary procedure based on investigation, disciplinary and appeals committees. □

THE PERFECT DOCUMENTATION

The program was written, debugged, and tested.
Our hero leaned back with a sigh and rested.
"Thank heaven I'm through with that hairy thing—
I'll goof off a few days to replenish my zing."

Then in walked the Chief of Operations.
"Say how do you work this conglomeration?"
Operating instructions had slipped his mind,
He went back to his desk to get out of that bind.

In a week and a half, this book he had finished,
His strength and morale completely diminished.
He asked his chief for a vacation,
To renew with his family normal relations.

"Take some time off, it's fine with me."
Said his boss, The Chief of S and P.
"There's two or three things you first must complete,
That will take a few days, maybe a week."

"Our programming standards we can't ignore.
The guys who did went through that door."
"One program deck is of course not enough —
We need at least seven for backup and stuff"

"Two flow charts required for every project—
A one-on-one detailed and general logic."
"We also insert in our archives and files,
A system description in narrative style."

The end of this story we're happy to tell—
How our hero avoided this programmer's hell.
No one in the country now tops his production,
Two thousand a day of symbolic instruction.

One noteworthy item must be added,
His office is now completely padded.

Sidney Golder
Chief, Programing Psychiatric Services
Berkeley Systems
333 Washington Street
Boston, Massachusetts 02108

With apologies to Lou Ellen Davis (See Computers and Automation *for August, 1969, page 43.)*

THE QUALITY OF ELECTRONIC DATA PROCESSING SERVICES — ADAPSO POSITION PAPER

ADAPSO (Association of Data Processing Service Organizations, Inc.)
420 Lexington Ave.
New York, N.Y. 10017

The following is a position paper issued by ADAPSO, the trade association of the computer services industry, on the "Furnishing of Error-Free Electronic Data Processing Services."

The Association of Data Processing Service Organizations is deeply concerned that there may be some public misunderstanding of the nature of the services provided by the electronic data processing services industry, resulting in an erroneous belief that perfection is feasible. The consequences of reliance on such a belief could be most unfortunate.

Perfection in the furnishing of EDP services is no more possible than in any other industry dependent upon human frailty and fallible equipment.

The causes of human error are legion. Machine error results from an equally large number of causes, ranging from dust in a sensing device to fluctuations in electrical input. Error may also result from economic considerations, such as the practical limitations on debugging a program; thus to be certain of zero error in the trillions of computer calculations incident to any continuing commercial application, requires such exhaustive testing as to be uncompetitive.

Undoubtedly, part of the public misunderstanding is a result of the exciting achievements of the space program, made possible by the computer. However, pin-point accuracy in space computer applications has resulted only from almost interminable testing and the broadest use of back-up equipment, not justified economically in most commercial applications.

It may be, however, that to some extent the EDP industry is itself also to blame, because computer personnel unfortunately sometimes fail to recognize the ignorance of the lay public in technical matters. When an EDP professional says that his program is perfect or that his service never makes an error, he of course excludes that essential minimum which cannot practically be avoided; he intends no more misrepresentation of his services than the automotive salesman who promises a first rate vehicle knowing that inevitably one must come off the assembly line with defects.

ADAPSO recognizes the danger that some members of a lay public may misunderstand such statements, and proposes to conduct a far ranging remedial public information program. As a first step, it calls upon all responsible EDP service industry members to distribute this position paper to customers, in order promptly and effectively to inform those key members of the public most likely to be reliant on the results of the industry's output. □

ANNUAL COMPUTER PROGRAMMING CONTEST FOR ELEMENTARY AND SECONDARY SCHOOL STUDENTS

Hyman Speck
Loop College
64 E. Lake St.
Chicago, Ill. 60601

A contest designed to stimulate inventive interest among young students in the computer programming field is being sponsored for the seventh year by the Association for Educational Data Systems (AEDS).

Prizes of $25 in U.S. Savings Bonds will be awarded to winners in seven judging categories: Business, Biological Science, Computer Science, Games, Humanities, Mathematics, and Physical Science. The grand prize winner will be selected from these seven winners. He will receive an additional $100 in bonds, plus an all-expense paid trip to the AEDS convention in Miami Beach, Florida.

Project Genes, Electoral College Calculations, Comparative Computer Linguistics, Five Card Draw Poker, and Model Rocketry Altitude and Flight Path Predictions are some of the outstanding projects submitted last year. First prize winner last year was John O'Donnell of Tates Creek High School in Lexington, Kentucky, who developed a computer language and compiler called SIGMA, which he designed to run on teleprocessing terminals.

Projects may be submitted by an individual or a team of two or more pupils. Deadline for entries is April 1, 1970. Persons wishing more details and application blanks are invited to write me. □

A TIME-SHARING COMPUTER TERMINAL VS. THE SMALL COMPUTER

Lewis C. Clapp
DIAL-DATA Inc.
429 Watertown St.
Newton, Mass. 02158

Those of us who have been fortunate enough to work with small computers know how exciting it is to have your own little machine available for problem-solving and numerical computation. As the memory hums and console lights flicker, there is a certain fascination at having complete control over the logical mechanism under your fingertips. For quite some time the novelty of the exposure itself is enough to motivate us to spend many long nights experimenting to find the fastest way to multiply two vectors or how best to pack a large array of data into the tiny memory. But ultimately the euphoria wears off and we learn that there is often a great deal of tedious effort required to solve scientific problems with the aid of a small computer.

One alternative to the small computer is having access to a time-shared computer terminal. Although the small computer is a very useful and important resource in many applications such as communications, process control and data preprocessing; it is not as effective a tool for interactive problem-solving as the time-shared computer.

What the small computer has to offer is raw computing power — the ability to manipulate and process bits of information through a machine. Now it is true that when computer time-sharing first became available it too was looked upon simply as a source of raw computer power. But in the three or four years which have passed, the time-sharing vendors have become more sophisticated. They have begun to realize that their job is not simply to provide computer power over phone lines or to make "computer juice" coming out of the walls like electric current; but rather their job is to help people process information and problems. They realized that to do this job well they had to provide sophisticated tools which would make it easier for people, who were not computer experts, to use the computer to solve their own problems. In providing these tools, the time-sharing services have done admirably well. So well in fact, that the small computer probably will never be able to catch up.

The initial step in time-sharing was to provide programming languages which could be learned rather quickly by anyone with a minimum of intelligence and a minor degree of patience. These languages such as BASIC and CAL could truly be mastered in an hour or two and then could be used to solve very sophisticated engineering and scientific problems. Indeed, this use of time-sharing computers was so popular that the small computer manufacturers were themselves compelled to copy the idea and produce versions of some of these languages on their own machines. However, the small computer by its very nature is limited in size and flexibility. Because of these limitations it is very difficult to reproduce all of the features of a truly sophisticated interactive time-sharing language on a small computer. For example, the time-sharing machine has power-in-reserve which can be called upon when it is really required. The small computer on the other hand always seems to have the habit of running out of steam just at the critical moment.

Having developed simplified programming languages which an engineer could conveniently learn, the next big step that the time-sharers took was to develop specialized packages in their own subject area of concentration. One company, for instance, has developed a whole series of tools to be used by the printing and typesetting profession. Another company has concentrated on developing aids for small manufacturing concerns who use numerically controlled milling machines to produce parts. However, at DIAL-DATA we concentrated a great deal of effort on developing tools for automated electronic engineering and design.

Now let me repeat, that to use one of these packages, requires no knowledge of programming skill whatsoever. For example, an engineer who has just drawn a circuit diagram on the back of an envelope, wants to test his circuit and verify that it will perform as desired. In the old days he would have built the circuit with a soldering iron and a box of components. Several hours later, if he was lucky enough to have all the parts on hand, he would be ready to test it. Today, this time-consuming process is eliminated or at least delayed until the computer has checked the circuit and verified its operational characteristics. Our engineer simply dials the computer, calls the Circuit Analysis Program (CODED) and describes his circuits to the computer in a simplified language.

He can then ask the computer to calculate the voltages at each of the nodes. If he really wants to get sophisticated, he may ask the computer to perform a Worst Case Analysis. That is, by varying the values of all the components in the circuit from their high to low tolerance values, the computer determines which values will have the most deleterious effect on the performance of the circuit and how bad that performance will actually be. The computer performs the analysis in a matter of seconds and depending upon the results, our engineer is either out on the golf links or back at the drawing board. Contrast this with the old-fashioned way of designing circuits, which essentially meant standing over a breadboard and designing by intuition, which at best allowed the development of one circuit every few hours. The modern circuit designer uses the computer to generate dozens of alternative circuits in a single afternoon. He may then select the most desirable circuit from the rest before he leaves his office to try for his hole in one.

In developing circuit analysis programs we have found that a form of Parkinson's Law also applies to computers. Namely, the programs, memory, and speed requirements always rise to fill the capacity of the machine. There is always one more case or one new feature that needs to be added before the program is acceptable. Therefore, I conclude that any serious work on Computer Aided Circuit Design will not be done with the limited memory of a small computer.

Other program tools have been developed to aid the electronics engineer. Since we don't have time to describe all of them, I shall merely give some indication of the range of applications which have been investigated to date. Again, I will give the DIAL-DATA name for these design tools, although other time-sharing companies may have some of the same programs with different names and perhaps even different capabilities.

DIGILOG - Digital circuit design simulator.

Excerpts from a talk presented at the "IEEE-NEREM Seminar on PERSONAL DESK TOP COMPUTERS"; Boston, Mass. November 4, 1969

AS WE GO TO PRESS

THE USE OF COMPUTERS FOR BALLOT COUNTING SHOULD BE DISCONTINUED UNTIL ADEQUATE SAFEGUARDS AGAINST TAMPERING HAVE BEEN DEVELOPED, according to testimony presented to the California State Assembly Committee on Elections and Constitutional Amendments by William C. Clauer, president of Intellectron, Inc., a computer software company. Mr. Clauer presented to the Committee a research report, "Vulnerabilities of the Present Computer Vote Counting Systems to Computer Fraud", published by his company. The report concluded that present computerized vote-counting systems are highly vulnerable to program modification techniques which may not be detected under present security procedures.

To demonstrate the possibility of tampering, methods were developed by Intellectron which would permit an altered vote model counting system to pass currently used tests for "logic and accuracy". One method automatically inserts a count bias after the completion of normal testing procedures. Another permits a computer operator to introduce a pre-selected count bias by simply pressing a series of regular switches on the computer console in a manner that would not be regarded as unusual or abnormal. Mr. Clauer stated that neither of these methods would necessitate any wholesale or high level conspiracy to defraud.

As a result of his company's research, Mr. Clauer recommended that "full and adequate safeguards to protect the integrity of the ballot counting by computers be researched, developed, and made a legal requirement."

CONGRESSMAN CORNELIUS E. GALLAGHER RECENTLY ASKED THE U.S. HOUSE OF REPRESENTATIVES TO ESTABLISH A SELECT COMMITTEE ON TECHNOLOGY, HUMAN VALUES, AND DEMOCRATIC INSTITUTIONS. The purpose of the Committee would be to clearly find out where we are heading technologically, and to be sufficiently informed to meaningfully ask the question: "Is that where we want to go?"

Gallagher cited potential dangers in highway use surveys, data banks for migrant children and psychiatric records, and the dependence on the computer to create technical means of dictating human decisions as evidence of the need for such a Committee. He pointed to air and water pollution as examples of bad — and unanticipated — effects of technology, and emphasized the need to evaluate a new technology before such results occur.

The Harvard Program on Technology and Society, The Computer Science and Engineering Board of the National Academy of Sciences, the American Academy of Arts and Sciences Committee on the Year 2000, and the Special Program on Security and Privacy of the Business Equipment Manufacturers Association were commended for their research into the effects of technology on society. The Congressman recommended that one crucial task for the proposed Select Committee would be to work with these groups and to act as a clearing house for the public for data developed by these groups and elsewhere.

THE EFFECTS OF THE CARTERFONE DECISION — AND THE FUTURE OF DATA COMMUNICATIONS — were the main topics of discussion at the Fourth Annual Digitronics Users Association Conference held in New York in mid-November. (Digitronics Corp., Albertson, L. I., N. Y., is a pioneer company in the design and production of data accumulation and transmission equipment.) The Carterfone decision, handed down by the Federal Communications Commission (FCC) 16 months ago, ruled that equipment other than that manufactured by the telephone companies could be bought by users and

(Please turn to page 62)

ANALOG	- Simulates Analog Processes.
FILTER	- Designs ladder type filter networks.
FILSYN	- Synthesizes filters given external design parameters.
MICAP	- Microwave Design Package.

In addition to the above, there are programs for minimizing logical equations and for fabricating electronic components once the design has been established. Most of these programs are available today only through a time-shared computer terminal. Although less extensive versions of these programs may some day be available on a small computer, it is unlikely that they will have the versatility and sophistication of the same packages provided through the time-shared computer terminal.

It takes a great deal of time and talents of many people to develop good reliable programs to aid in electronics design. Very few organizations will find it economic to recreate these programs themselves for their small computers even if they had the resources. Among their alternatives are to secure the service from a computer time-sharing firm or to prod the computer manufacturers into delivering these programs with their machines.

The manufacturer, of course, is interested in selling his computer and he may make some effort to fulfill such requests. But manufacturers' software has often left something to be desired since they cannot be expected to be expert in every scientific discipline. And, even if the manufacturer is really able to deliver the program he will probably follow IBM's lead and charge you a use fee for the program. Finally, if he should provide you with a program today, what happens tomorrow or next week, when the state of the art advances and better programs are developed?

The time-shared computer center manager, on the other hand, does not have a built-in sale once he signs a contract with a client. He must earn every single dollar by providing his users with new capabilities and continuously improving software. He must learn what tools his clients need to do their jobs better, and then work his programmers feverishly to develop the programs.

In conclusion, I think the most interesting argument in favor of the time-sharing terminal for interactive problem-solving is provided by the small computer itself. Many small computer users now use time-sharing service centers who provide programs which simulate the small computers on the time-sharing terminal. These small computer users develop the programs under time-sharing and then, after the programs have been written and checked out, run the production jobs on the small machine. They have found that the job of program creation can be done more conveniently using all the resources of a good time-sharing system. Having all those lights, registers and keys of a small computer under one's immediate gaze may not have been so exciting after all!

Who's Who in Computers and Data Processing

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

Vol. 1 — Systems Analysts and Programmers
Vol. 2 — Data Processing Managers and Directors
Vol. 3 — Other Computer Professionals

Following are sample capsule biographies which will be published in the first annual edition of Who's Who in Computers and Data Processing.

Special Abbreviations		Main Interest Abbreviations	
b:	born	A	Applications
ed:	education	B	Business
ent:	entered computer field	C	Construction
m-i:	main interests	D	Design
t:	title	L	Logic
org:	organization	Mg	Management
pb-h:	publications, honors, memberships and other distinctions	Ma	Mathematics
h:	home address	P	Programming
		Sa	Sales
		Sy	Systems

PAGEN, Dr. John / director - CAI project / b: 1926 / ed: BS; MEd; EdD / ent: 1967 / m-i: A P Sy; computer assisted instruction / t: director - INDICOM / org: Waterford Township School District, 3101 W Walton, Pontiac, MI 48055 / pb-h: AERA; Phi Delta Kappa; MASA; AASA; reports on CAI / h: 463 Berrypatch, Pontiac, MI 48054

PALM, John N. / EDP management / b: 1938 / ed: BA, math / ent: 1957, part time; 1960, full time / m-i: P Sy; management of systems, programming, operations, etc. as applied in solving retail problems / t: vice president, information systems / org: Target Stores, Inc., 8700 W 36 St, Minneapolis, MN 55426 / pb-h: CDP, SPA / h: Route 1, Box 27, Wayzata, MN 55391

PALMER, Dennis W. / EDP mgr / b: 1937 / ed: 2 yrs college / ent: 1959 / m-i: Mg P Sy / t: EDP mgr / org: Protected Home Mutual Life Ins Co, 30 E State St, Sharon, PA 16146 / pb-h: DPMA, SPA, CDP / h: Rt 3, Box 700, Corland, OH 44410

PALMER, Fred E. / systems & programming / b: 1935 / ed: 3 years college / ent: 1960 / m-i: A B P Sy / t: manager of programming / org: Western Farmers Association, 201 Elliott Ave W, Seattle, WA 98119 / pb-h: CDP, DPMA / h: 19611 62nd NE, Seattle, WA 98155

PAN, George S. / senior technical management / b: 1939 / ed: BSEE, Illinois, MSEE, Syracuse / ent: 1960 / m-i: A Mg Ma P Sy; simulation / t: director, management sciences division / org: Interactive Sciences Corp., 170 Forbes Rd, Braintree, MA 02184 / pb-h: "Weighted File System Design Method", 1965 IBM National Systems Symposium, "Generalized File Structure and Optimum Design Considerations", 5th Nat'l Computer Conference of Canada / h: 5146 N 11th Ave, Phoenix, AZ 85013

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

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

SEND US YOUR ENTRY TODAY!

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

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

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

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

(attach paper if needed)

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

(attach paper if needed)

When completed, please send to:

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

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path

We find new ways to apply what's already known.

HOW TO SELECT A MINICOMPUTER

Walter R. Anderson and Edward H. Sonn
IRA Systems
332 Second Ave.
Waltham, Mass.

"There are no comparable figures of merit for computer system architecture, nor are there comparable figures of merit for software. How, then, should a prospective customer evaluate minicomputers?"

There has been much discussion over minicomputers revolutionizing the market for computers, from the viewpoint of both replacement of "hard-wired" logic systems and opening up increased use of computers by new users who could not economically afford to purchase or rent computers in the past. The purpose of this article is to present the thought processes which the authors believe to be necessary in the selection of minicomputers.

What is a "Mini"?

The definition of a "mini" has not been clearly established, but has generally been rather arbitrarily defined as "a computer which sells for less than $20,000 in its basic configuration". The value per dollar received should be the key for selecting a "mini" for a given application.

As President of IRA Systems, Mr. Anderson directs the management of the various design groups within the company. These groups are engaged in the design of computer-centered systems for instrumentation, control, data processing, and display applications. He holds a B.S.E.E. and an A.B. degree, and has completed an advanced course in logic design at the Massachusetts Institute of Technology. Mr. Anderson is presently the Editor of the Production Technology Newsletter, and is a member of IEEE and the EIA #TR-31 Committee on Numerical Control.

The "computer horsepower" of a "mini" varies from manufacturer to manufacturer, so no agreed "figure of merit" has been established to adequately define just what a mini is. Generally speaking, however, a "mini" can at least perform most simple arithmetic functions and has at least some associated peripherals.

Most "mini" computers are priced low by virtue of the fact that either large printed circuit boards are used for low-cost production of the machine or little or no input/output capability is provided. Typically, many mini's do not have substantial software supplied with or even developed for the machine, hence, development costs are lower, and these savings are passed on to the customer.

Minicomputers are characterized by providing many customer-selected options; many times this may cause the cost of the "mini" to be adjusted upwards substantially.

Service, maintenance, training, and installation are generally not included in the price of a typical minicomputer.

Edward H. Sonn is the Manager of Computer Applications for IRA Systems. He holds the S.B. (E.E.) degree from the Massachusetts Institute of Technology and the M.S. (E.E.) degree from Columbia University. He directs the hardware and software development of computer-based systems for IRA.

Computer Horsepower

Computer horsepower (CHP) may be defined as:

(amount of work per instruction)
X
(number of instructions per second)

where the amount of work done per instruction is determined by:

1. The size and organization of the instruction set,
2. The flexibility of addressing and indexing modes, and
3. The input/output structure of the machine.

and the number of instructions per second is determined by:

1. Memory cycle time of the machine,
2. Execution time for instructions, and
3. The extent to which the processor must share memory with devices having direct memory access.

Evaluation of Computers

One of the "safest" ways to justify the selection of a "mini" for use in your product line or for use in your automated process is to point to the numerous surveys in the field by "experts" and pick the processor as a result of the surveys.

What the surveys often do not tell you is probably more important than what they do tell you – strange as that may seem. No figure-of-merit criterion has been developed for the computers or stored-program controllers mentioned in most surveys. No mention is made of financial stability of the company or the probability that the company offering the "mini" will exist during the period vital to the product life.

Surveys usually list items which may be compared quantitatively, such as memory cycle time. They also comment on the availability of assemblers and compilers and various hardware options. The figures which are given are not comparable from machine to machine because of differences in architecture. There are no figures of merit for computer system architecture, nor are there figures of merit for software.

How, then, should the prospective customer evaluate competitive minicomputers?

Measuring Speed

Speed is often used as a yardstick of computer performance. The best criterion is effective speed, which combines instruction power and time for execution. Instruction power is influenced by: number and types of instructions; addressing modes; indirect address capability; indexing; interrupt servicing; and input/output facilities. The best way to evaluate the effective speed of a computer is through the use of a bench-mark subroutine which is representative of the most stringent requirements of the proposed application. The bench-mark subroutine should be programmed by someone familiar with the computer being evaluated.

Another Measure of Efficiency

Core memory economy is another useful yardstick with which to evaluate the power of a computer. A computer having a good selection of instructions combined with a page-free addressing scheme requires fewer instructions to accomplish a given task; thus it executes instructions faster and with less core than a computer having a limited instruction set and fixed paging. A bench-mark subroutine program would be useful in this evaluation.

The computer memory must be large enough to hold the program and the data. The data storage requirements are usually independent of the computer. The program storage requirements are determined by the algorithm and the particular computer selected. If you are estimating requirements, be sure to use a generous safety factor.

Interfacing

The most exciting feature of the minicomputer is that it can be used to control a wide variety of devices; this may be the reason you desire to purchase one. The prospective purchaser should determine what interfaces are available and what compatible packages are available for housing the logic required in special-purpose interfaces. If you must design your own interface, be sure to check on the availability of a well-documented interface manual.

Input/Output Features

Computers that do things with the outside world usually require a great deal of software to deal with input/output. In most systems the computational function is the most straightforward part of the entire program. The input/output and interrupt service modes of a computer should be examined closely to determine the effect on software. Some computers require that interrupts be sorted out by software or that all input/output pass through the accumulator, creating additional overhead, unless expensive direct memory access options are purchased. Computers of more advanced design sort interrupts by transferring control to a unique memory location for each interrupt. Such computers also feature input/output directly to memory, either under program control or with direct memory control.

Read-Only Memory

The sophisticated user having a special-purpose application with large quantity sales potential may be interested in exploring the use of a special-purpose instruction set. This is practical in a computer equipped with a read-only memory (ROM). ROM offers advantages in both effective speed and core memory.

The Importance of Peripherals

In many minicomputer systems the central processor is only a small part of the entire system. The selection of a computer should therefore be based also on the availability of the required peripherals with driver software fully integrated into the computer's operating system software.

The user will find that some of the independent peripheral manufacturers have already developed interfaces for their products to some of the more popular computers. One should determine the extent of software support for these independent-supplied peripherals.

Construction and Maintainability

Today, all computer manufacturers use integrated circuits supplied by the semiconductor industry. The difference between computers is mainly packaging. Large circuit boards can make the cost of spares very high; also they may make the problem of locating a defective component more difficult than need be.

If you intend to do your own maintenance, investigate the documentation and training which is available to you. Find out if any special test equipment is needed and if it is available at a reasonable cost.

If you must rely on the manufacturer for maintenance, be sure to find out what response time to expect from his field office.

Software Evaluation

If the user intends to do a reasonable amount of programming, it is very important that he evaluate the available software very carefully. Some common software packages are listed here with some points to check:

Assembler

Is it possible to produce relocatable code? — Relocatable code can reduce assembly time because subroutines need not be assembled every time they are used, nor is it necessary to always locate routines at fixed origins.

What features are available and what are the configuration requirements for each? — A macro assembler requiring 8K of core is useless if you purchase a 4K machine.

Is the assembler device independent? — If you intend to purchase high-performance peripherals, determine whether they can be used with the standard software.

Is an assembler available which may be run on a large-scale machine? — The availability of an assembler for a large-scale machine can make life a lot more pleasant, if a large amount of programming must be done without high-performance peripherals.

Is there a macro capability? — Macro's are very useful if you intend to develop an assembler tailored to a specific application, such as electronic testing.

How many passes are required for assembly? — The important point to consider here is the number of times that the source tape must be passed in order to produce a listing and an object tape. Some systems require three passes with basic equipment. One-pass assemblers, while gaining speed in assembly, leave much to be resolved by the loader and, therefore, use many indirect addresses.

What pseudo-ops are available? — Pseudo-ops are directives to the assembler. They increase the usefulness and flexibility of the assembler.

Are literals permitted? — Literals provide a convenient method for defining constants and make a program easier to follow.

What forms of number conversion are available? — Most assemblers allow for the conversion of decimal integers. The conversion of mixed decimal and floating point numbers is usually restricted to machines having more than 4096 words of core. If the basic assembler does not have these conversions, check on the availability of a stand-alone conversion program for this purpose.

Is the object code compatible with Fortran? — Compatible object code permits intermixing Fortran and assembly language programs, which communicate through the use of the COMMON pseudo-op.

How large a program can be assembled? — The limit on how large a program the assembler can handle is determined by the room available for the symbol table.

Is a concordance provided? — A concordance is a list of the symbols used in a program with the address assigned and the identification of the program lines that refer to the symbol. This feature is usually not available in 4K assemblers.

What syntax error detection is available? — It is important that the assembler be able to detect and inform the user of all syntax errors. An operation mode in which only error lines are listed saves much time on basic machines.

What types of expressions are allowed? — Expressions for expressing data values and addresses are very useful if the values change from assembly to assembly. Basic assemblers usually limit expressions to the use of the addition and subtraction operators; more advanced assemblers permit multiplication, division, logical and relational (greater than, equal, etc.) operators.

Are conditional assembly pseudo-ops available? — The capability of determining which lines will be assembled by evaluating an expression saves much programming time. It is possible to write a large prototype program which handles a large class of problems and then customize it by setting control variables. The result is a program which is only as large as is necessary to do the immediate task.

Fortran Compiler

What type of Fortran is it? — There are two accepted versions which are identified as BASIC Fortran (USA Standard 3.10-1966) and STANDARD Fortran (USA Standard 3.9-1966) which is also called Fortran IV. There is also Fortran II, but it is not completely interchangeable with Fortran IV.

How efficient is the output code? — On a small computer one is usually interested in the running time and core required for the program rather than the compiling time. Efficient code generation can decrease running time by almost 50%.

Is it possible to get an assembly listing of the code generated? — The usefulness of the compiler for real-time use is enhanced if the user can obtain a listing of the code.

Is the object code compatible with assembly language? — Intermixing of Fortran and Assembly language routines is very useful.

Subroutine Library

- What functions are supplied?
- What is the execution time?
- What are the core requirements?
- Have the routines been verified?
- Are the algorithms described?

Utility Routines

Are the following available?

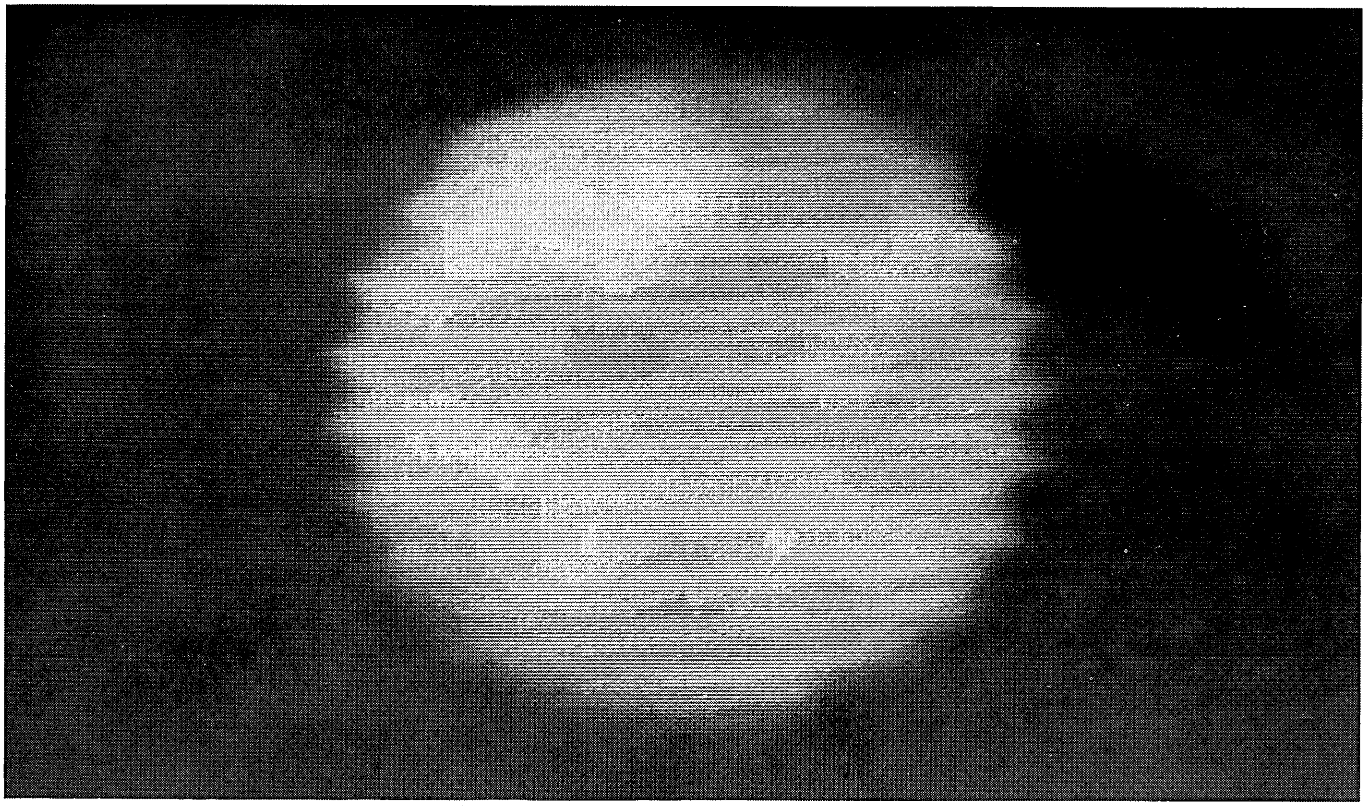
Debug?
Editor?
Media Copy?
File Maintenance?

Maintenance Programs

- What programs are available and how well documented are they?
- What devices must be operational for the execution of each?

Conclusions

There is no single "right" decision in selecting a computer for a system or systems. Any number of machines can be used to fulfill a given need. In one-of-a-kind systems the optimum choice is usually that which can be integrated into a working system with the least expenditure of time and effort. The time and effort required depend greatly on the software and hardware support from the computer vendor. □



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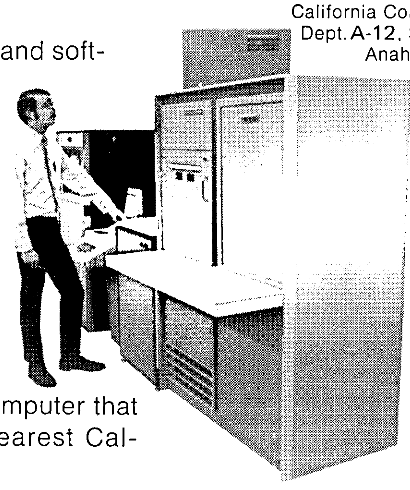

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MINICOMPUTERS ON THE MOVE

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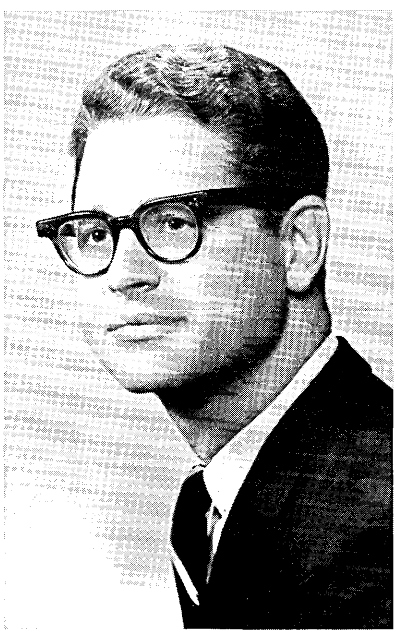

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They have been nicknamed minicomputers and it's no secret that they are creating the fastest growing market for computer mainframes. Dozens of new machines have been announced in the past year and in the next 12 months each of the five largest producers will deliver more than 1,000 units. One of these large producers, Data General Corporation, is less than two years old.

The machines that are the object of all the interest are nothing more than small-scale general-purpose computers. They perform the same kinds of arithmetic and logic, work with the same kinds of computer peripherals, and use the same kinds of computer languages as traditional computers. The minicomputers unique position comes from the fact that they are the least expensive form of general purpose computer, and that they are growing to be the most pervasive.

In the Beginning

The first extensive use of very small-scale general-purpose computers grew out of the demand from instrumentation engineers who were building military aerospace systems or working in research laboratories. They encouraged the development of the small computers which would be used as a more economical alternative to special purpose automatic control systems. These small computer systems depended on the use of emerging data from complex instrumentation, but were programmed primarily for control functions. These instrumentation markets for small computers grew quite naturally to include on-line manufacturing control, such as process control in the chemical field and the numerical control of machine tools.

These control fields are still a major part of the minicomputer market, and this market is growing rapidly. Whereas the first small computers were custom tailored to each application, there is a growing number of standard scientific instrumentation and industrial control products in which minicomputers are built in as automatic control devices. These minicomputer-based systems include such diverse products as automated drafting machines, computer-based laboratory instruments and milling machines.

Data Processing Capabilities

But something else is happening, too. The data processing capabilities of small-scale general purpose computers are being discovered. These computers are being used in open shop time sharing applications, in educational applications, in dedicated calculation applications, and for computer-aided design. In part, these new applications for minicomputers are developing simply because the minicomputers are becoming a more visible alternative to other sorts of computation.

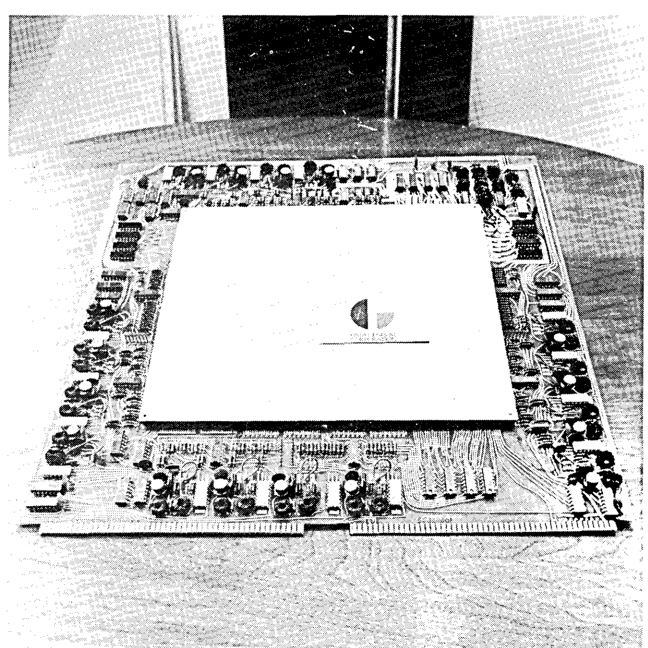
"Computer power now comes in a new standard size. In the next 12 months each of the five largest producers of minicomputers will deliver more than 1000 units."

Data Communications

It was natural development to expand use of minicomputers beyond traditional control applications into the data communications field. In these systems, minicomputers are used as specialized control devices for message switching and message concentration to improving the efficiency of real time sharing networks. The next step was to extend the use of minicomputers to become a free standing element within large multi-computer networks. In these networks, minicomputers are used as sophisticated terminals. Not only do they collect and send data, but they also perform small-scale data processing. The next step is evident. The distance from small data processing terminal to small-scale free-standing data processing is short. A variety of data processing packages are being developed. The minicomputer is becoming truly general purpose.

A New Style Computer Network

An example of the natural extension of minicomputers from control to data handling applications can be seen in a new style computer network such as the transcontinental time-sharing system being established by Computel Systems Ltd. of Canada. Computel has two large scale UNIVAC 1108 computers and an IBM 360/65. To these they have added a group of minicomputers manufactured by Data General Corporation.



A complete sixteen bit word x 4096 memory on a single 15-inch square circuit board.

Computel sells data processing capabilities as an extension of the existing in-house data processing facilities of their customers. Computel uses three minicomputers in front of each of their large computers. The minicomputers will be used to collect data sent in to Computel by customers all over Canada via telephone lines. The small computers will not only save money on valuable central processor and memory time on the large computers, but they will save money on the phone bill as well. Whereas large computers used alone would require one phone line per device per customer, each small computer handles up to six high-capacity customer devices on a single line. Computel will also make minicomputers available to its customers to be used at the terminal end of the network for peripheral processing, and to save on data communications costs.

Major minicomputer manufacturers can afford to support new markets with application products. For example, each of the major minicomputer manufacturers has developed time sharing systems built around their computers. These time sharing packages extend the basic price/performance features of minicomputers into broadening markets.

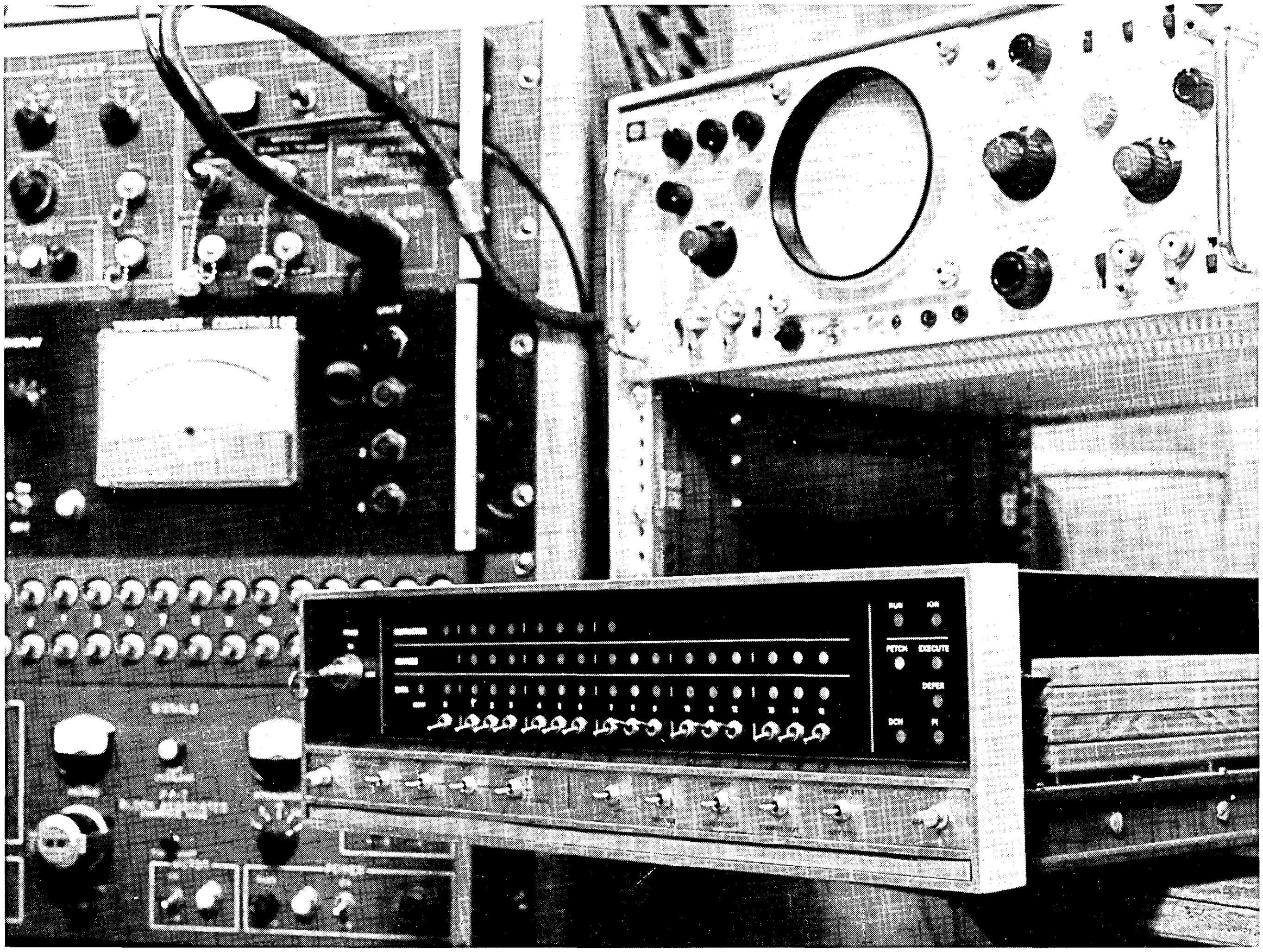
Minicomputer Middlemen

But perhaps the most important reason for the growth of minicomputers into new applications areas has been the development of a group of minicomputer middlemen whose business is to take the minicomputers that others manufacture and apply them to new areas. Aggressive new companies have started whose entire business plan is based on the minicomputers' improvement in price/performance over the way a job has been done before.

A few examples will illustrate the contribution that these middlemen are making in the application of minicomputers to new areas.

A System for Schools

Educational Data Systems (EDS), Newport Beach, California, has designed computing systems specifically for the secondary school curriculum. They not only provide the necessary hardware and software, but they also provide an extensive library of instructions materials. Furthermore, the company assists schools to plan and implement a complete educational computing program including instructional applications for teacher training and administrative applications. The EDS series of systems is designed around Data General Corporation's Nova computer, and provides time sharing to schools at a fraction of commercial time sharing



A minicomputer in a typical rack-mounted configuration in a control application.

service. Whereas the cost from commercial sources would range from $5 to $10 per terminal hour, the cost of the minicomputer time shared system is about $1 per terminal hour, including all terminal and communications costs. The EDS systems use the BASIC language developed at Dartmouth as its primary software package. But the company also has a time sharing calculator package designed to provide students on this machine easier access to a computer.

Warehousing

Another example of the use of minicomputers in non-control applications is the system developed by Industrial Computer Laboratories, Inc., a Division of Information Technology and Systems Inc., Salt Lake City, Utah. This system, used for warehousing applications, consists of a series of free-standing minicomputer systems which are used as terminals to large-scale computers. Each free-standing remote minicomputer system is tailored to a particular warehouse situation, and each is designed to be used by unsophisticated warehouse personnel. The small computer is programmed to operate in a question and answer mode. The computer presents the series of questions and warehouse personnel check off the correct answers. The on-site minicomputers avoid using expensive data communications facilities for routine man/machine interaction. They also perform certain data processing, such as inventory control, payroll, etc., on-site at the warehouse.

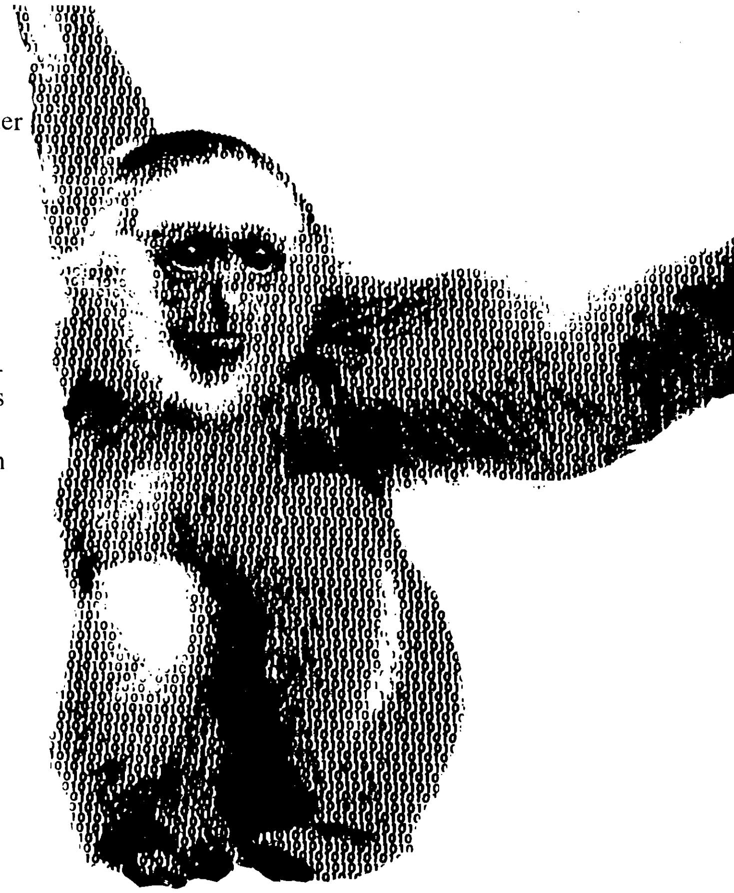
When the on-site computation is done at the warehouse, the minicomputer terminals condense the data and send relevant information over telephone lines to the corporation's central facility and large-scale computer for further data processing and for management information.

Small control terminals are a network such as the one International Computer Laboratories has designed for a major retail operation to allow the retailer to take advantage of a party line telephone cost and reduce the number of telephone lines required. In this instance, it was possible to cut the telephone bill from a potential $10,000 per month to $1200 per month. Just as important, the retail warehouse network was designed around existing manufacturer production. Thus every computer in the network acts as a translator between the individual warehouse department and the machine's central processor.

In each of these examples, the potential of the small-scale general-purpose computer has been applied to an area in which the middleman has extensive experience. In each case a complete packaged solution was developed to extend the use of minicomputers to areas in which they were underemployed.

For the Future

What does the expanding use of minicomputer mean to the computer user and to the world at large? Basically, it means that computer power now comes in a new standard size. Because there are many, many uses for a computer that can justify no size of computer other than a mini, minis will extend the use of computers. This extensive use will make computers more accessible—and better understood—tools. Computers will become more common. □



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THE IMPACT OF MINICOMPUTERS ON INDUSTRY

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The potential for improved products at lower unit cost by automation and computerization is very well known, but the implementation is still in its infancy. The recent and continuing development of minicomputers (high speed and competent machines selling for less than $20K) will provide a very rapid acceleration in industrial automation.

Cost Breakthrough

The inertia that has kept us from full automation in the past is rapidly vanishing because of the dramatic economies provided by minicomputer systems. You can rent a competent minicomputer on a 40-hour week basis for approximately $1.80 an hour. This is truly a breakthrough which was difficult to predict a few years ago.

In terms of purchase price, a 16-bit competent computer with Teletype, high speed paper tape punch and reader, and four hardware interrupts was priced at well over $100K five or six years ago. This same power—except several times faster—is available today at one-tenth the price.

Dr. Hinrichs is the Director of Engineering for the Data Products Division of Lockheed Electronics Company. He is responsible for all of the engineering activities of the Division, including research and development, new product planning, all product design and engineering, customer liaison, and technical contacts. He received his B.S. in Electrical Engineering from Swarthmore College in 1945; his Master if Science from Harvard in 1947; and his Ph.D. in Electrical Engineering from the University of California at Berkeley in 1955. Dr. Hinrichs has published five technical papers and holds 14 patents. He is a member of IEEE, ISA, and several other technical organizations.

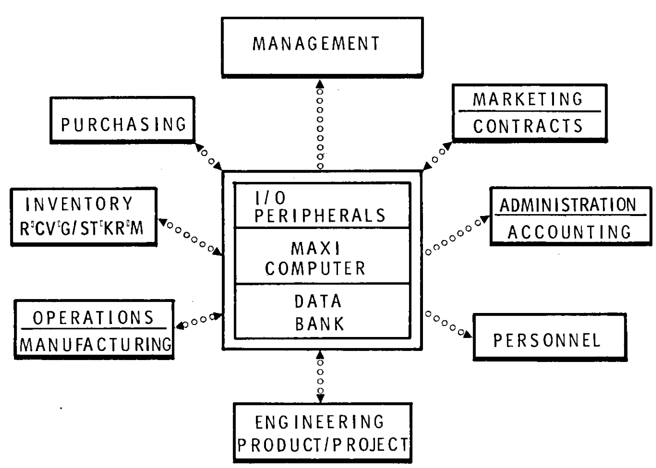
The rapidly expanding market for minicomputers is producing a snowball effect in industry: the more production, the lower the cost and price; the more applications, the larger the program libraries available for new uses; the wider the variety of customers, the broader the variety of peripherals available.

The large, centralized computer ("maxicomputer") will not vanish from the typical industrial plant, but will be augmented by many dedicated minicomputer installations. Some of these minicomputers will be connected to the maxicomputer, forming a hierarchial memory and computer system.

Tolerances in industry continue to decrease. Step-and-repeat operations are becoming much more common. Digital control of machinery is an accelerated trend. In all these applications, computer automation offers distinct advantages over manual techniques. Computers are wonderful for routine functions, since they do not get bored with the most tedious of tasks or strained by high precision work.

A Three-Way Choice for Automation

A three-way choice is available for automation. A dedicated minicomputer system may be purchased or leased to solve specific functional requirements. A computer terminal may be obtained for interaction with a maxicomputer at



INDUSTRIAL WALKWAYS
I/O TO CENTRAL COMPUTER

Figure 1.

"How do you decide when to use a minicomputer? If a process is relatively isolated from the data sources used by the remainder of the plant, if it is a job that is prone to change, if the solution is needed rapidly, if it involves high input/output rates, if it involves man-machine interaction—then you should use a minicomputer."

some remote site. A centralized maxicomputer can often be employed for automation, with inputs provided by special-purpose remote devices or batch tapes and cards.

Today's typical industrial plant has a maxicomputer which serves all segments of the plant as illustrated in Figure 1. The Table 1 lists associated applications. The first item, batch processing, is one where minicomputers usually cannot compete with centralized maxicomputers. Despite the high initial cost of the centralized maxicomputer, its greater flexibility, memory storage, span of peripherals, and program library offer a more economic solution to batch processing than that which can be obtained with today's minicomputers. Accounting ledgers, payroll, timekeeping, charge allocation, P/L analyses and reports, order entry, marketing records, and personnel records are all typical industrial functions economically performed by the centralized computer. A very large and valuable library of software programs has been developed for these functions, usually with specific adaptations for individual plants. Most of these essential records and reports need large amounts of memory, very extensive program libraries, and a wide span of peripherals. Except for new and small industries, minicomputers will not compete in the near future.

Inventory Counting

Inventory counting is a little different from batch processing. Historically, it has been a batch record-keeping function; but we are more and more concerned with virtually real-time control of inventory and purchasing. We would like to see a system in which Purchasing, Stock Room, and Receiving Inspection are inexpensively interconnected with inputs from Engineering (Bill of Materials) and Manufacturing (kit scheduling). The minicomputer (particularly one of the larger and more powerful types) competes well in many cases with the centralized facility, since it does not require a large peripheral investment, can be easily relocated, and permits ready entry of data and program.

Production planning and control is also an area where minicomputers often provide economies compared with maxicomputers. Production planning and control, work-in-process reports, exception reporting, station reporting, and other nearly-real-time manufacturing information services can often be efficiently provided by dedicated minicomputer systems.

COMPUTER-AIDED INDUSTRIAL TASKS

1. Batch Processing and Records
2. Inventory Accounting
3. Production Plan and Control
4. Process Control
5. Product Testing
6. Release and Engineering Control
7. Cost Estimating
8. Drafting and Printed Circuit Layout
9. Engineering Design

Table 1.

Process Control

Process control is the classical area for minicomputer application; and the current industry obtained its impetus from this field. Special-purpose computers have been used in processes for over 20 years. The early systems for data acquisition and control used both digital and analog computers. The economics of scale are swinging the process-control automation towards purely digital computers. Our large, complex and intertwined processes in many industrial plants would appear to recommend a maxicomputer installation to simultaneously assess and compute all parts of the control process. This grandiose concept is analogous to the universal plant Data Base. Realistically, however, there are many unknowns in the interaction between processes in total plant control; and a hierarchy of control is employed with many minicomputers and special-purpose controllers. A maxicomputer is sometimes used for centralized surveillance. For functions which are extremely well known, the minicomputer does not compete with the specialized controller. Most processes using direct digital control, however, involve functions not presently well defined or optimized. A minicomputer can be used for optimization study as well as fixed-program control. A minicomputer controller is also an excellent record keeper and performance analyzer. If the process is susceptible to improvement by the incorporation of additional loops, additional sensors, new outputs, or other modifications, a minicomputer may be the most economical answer to process automation.

Product Testing

Product testing is also a classical area for the use of minicomputers. In the past, economics have dictated the use of special-purpose machines. Now the lower cost of minicomputers permits a vast increase in flexibility at low cost. This market is increasing tremendously in response to the testing requirements for more sophisticated products with tighter tolerances and more stringent requirements for proof of reliability and performance. One of these products, of course, is the minicomputer itself. The proof of performance of a minicomputer requires a high degree of automation for economical testing. In contrast with the applications for which the centralized computer is optimal, here the programming is minimal, few general-purpose peripherals are used, and the I/O requirements are high. Although the product testing routine does not require much flexibility, a tester must be readily modified on a day-to-day or month-to-month basis. Therefore, the general-purpose minicomputer usually out-performs the special-purpose or hard-wired test-device controller.

Engineering release and control has received a lot of attention but little actual use of computers, except in the very largest industrial installations. The availability of inexpensive minicomputers and the rapidly growing libraries of software will readily invade the engineering control area. The requirement for a very large data bank (perhaps with extensive parts specifications, vendor records, and similar files) can often justify the use of Teletype stations, CRT displays, and a centralized data bank.

Cost Estimating

Engineering and manufacturing jointly share cost-estimating functions in a typical industry. It is surprising to find a small extent of computer invasion in this function today. Perhaps company management is lax in forcing a marriage between the estimating staff (who do not know computer programming) and the centralized programming staff (who are often unaware of the amount of estimating under way). The situation should change radically when it is realized how efficient minicomputers with CRT and TTY can be, in assisting the cost estimating process. Time-sharing systems are also logical contenders for estimating service, although many companies will not permit their company's price files to be located outside company premises, for security reasons.

Engineering Design

Engineering design is the classical area for time-sharing service use. For very large plants, their centralized maxicomputer can be used with remote terminals. We are all familiar with the advantages of computer-aided circuit design (ECAP and similar programs). There are many other important engineering functions which can be improved and cost-reduced by utilizing computer assistance. The minicomputer has definite advantages for use with graphic terminals in design functions requiring intensive man-machine interaction.

Choosing the "Right" Computer

How do you decide when to use a minicomputer, a maxicomputer, a time-sharing service, or no computer at all? The return-on-investment factors are usually straightforward. If the job is a complex one involving large banks of data, if it involves interaction with the data from many physically separated plant functions, if it can be done on a batch (non-real-time) basis, if it does not require man-machine interaction, if it can be interrupted, if it utilizes extensive programs and employs a lot of peripherals – then the centralized maxicomputer batch-processing system is the obvious solutions and can be justified by a standard cost comparison.

However, if the process is relatively isolated from the data sources used by the remainder of the plant, if it is a job that is prone to change, if the solution is needed rapidly, if it involves high I/O rates, if it involves man-machine interaction, then we would want to use a dedicated minicomputer. A graphic CRT design terminal is an excellent example.

There are many industrial functions which defy computerization. Creative and intelligent human beings are also required, since you cannot buy hardware and build software to solve an undefined problem. Some urgent requirements of industry change faster than our ability to program machines. If you have a product which changes completely in six months, computerization is ill-advised. There are many classical examples of large investments in automation for processes which human ingenuity has obsoleted.

Examples of industrial functions which minicomputers should dominate by the end of the 1970's are: drafting, electrical and mechanical design, printed circuit layout, numerical control tape production, template production, data acquisition, component and system testing, and process control.

The Impact of Minicomputers

The impact of minicomputer automation will be truly remarkable in the next decade. We are apt to ignore the magnitude of change because we are watching it every day, and progress often seems slow. Drawing back for a longer-range look, however, we can readily detect some very significant impacts on industry.

The first effect, common to all improvements and efficiency, is less raw-labor content in our products. Economics cannot be denied, and we will obtain a larger production of lower-cost products with a more skilled labor force. The proliferation of minicomputers and minicomputer systems will result in a very sharp increase in trained personnel: a new class of technicians or "miniprogrammers". One of today's critical industrial shortages is that of skilled programmers. The intimate working experience of the hourly working force with small dedicated computer systems will enrich our technical labor base. Although much of the training and resultant skills will be very specific, it is a valuable background for more general programming education and in any event will free our professional programming staff from much of today's necessary routine.

The product cost reductions predicted will be particularly noticeable for complex products such as electronic instruments. Minicomputers, therefore, will continue to decrease the ratio of price to performance, both from increased volume and increased manufacturing automation. The lower prices will produce an avalanche effect not only in industrial applications, but in computer use in virtually all spheres of human activity.

It will be a big boost to small business. It will be possible for small businesses to compete with large companies in complex electronics because a minicomputer system will provide them with almost all of the functions, if not the efficiency per second, as the large companies obtain from their combination of minicomputer systems and centralized maxicomputer. Software libraries are the hold-up today, but tomorrow that will not be true. Minicomputers will be equipped with business systems and batch processors which, although perhaps not as cost-effective per dollar, will nevertheless provide small businesses with the ability to have a full set of features that the large company now possesses.

The wide application of minicomputers and computer systems will generate valuable additions to the United States' technological base in new products, new programs, technological training, and new computer system applications. □

AUTOMATED EXPERIMENT CONTROL AND DATA ACQUISITION – A MINI-COMPUTER APPLICATION

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"Although programming and system implementation require a highly skilled staff, once a control system using mini-computers is running, it is so reliable and simple to use that no regular computer staff is required."

In recent years, scientists have used small computers as a versatile research tool for automatic control of experiments and data acquisition. At the Casting Laboratory of the Chase Brass and Copper Company, a mini-computer—the Hewlett Packard 2116B—is working in a system which, in a fully automatic fashion, performs thermodynamic and kinetic measurements in metallurgical systems over a wide temperature range.

In these experiments, control as well as data acquisition are well-defined procedures to be repeated a large number of times. The use of a computer results in increased research productivity and reproducibility of measurements. The very high computational speed of today's computers makes possible the automatic and nearly immediate display of results of such experiments. The time of the experimenter is released for experimental planning and analysis of results. The operating costs are well below those associated with continuous human monitoring of such experiments.

Why a Mini-Computer?

"The works in a drawer", as a recent television advertisement tells us, indicates the reduced size and modularity of integrated circuits and the cleverness of modern circuit designers. Their advances have measurably improved the versatility and reduced the cost of computing equipment. Furthermore, current designs incorporate universal input/output interface cards which allow the connection of external instruments and other devices to the computer. This makes implementation of real-time, on-line applications significantly easier.

Application software design and programming for data acquisition with a small computer presents a challenging problem in data manipulation. It is usually necessary to reduce the output records to minimum size to conserve main memory space and computation time. While some manufacturers of small computers offer basic FORTRAN and ALGOL compilers, it is often necessary to use an assembly language to fit all the programming into the computer memory.

Mr. Shah is a leading computer analyst with the Information and Communications Services Division of Chase Brass and Copper Co.

Mr. Stieger is the Acting Manager of the Information and Communications Services Division of that same company.

Dr. Kipiniak is currently the president of Computer Inquiry Systems, Inc. He was formerly associated with Digital Applications, Inc., the company in charge of developing the system described in this article.

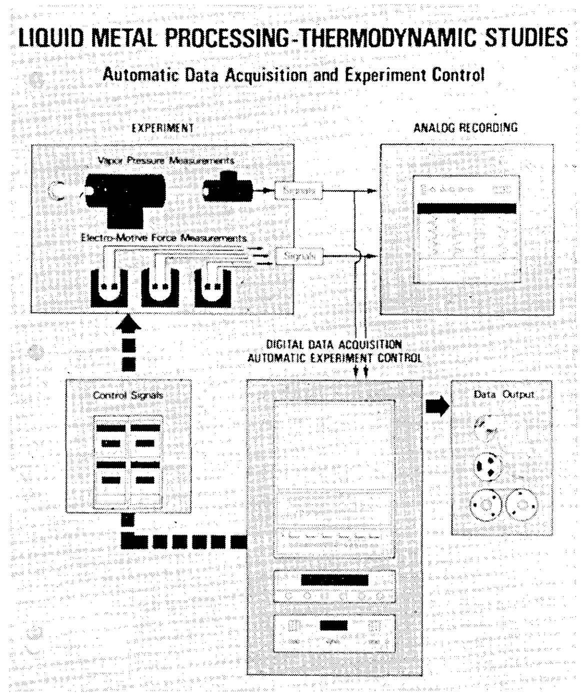

Figure 1.

These programming problems can be formidable. System implementation requires a highly skilled staff. However, once the system is running, it is so reliable and simple to use that no regular staff is required. Recognition of this fact has stimulated the growth of system engineering firms which give assistance in the design and construction of control systems using mini-computers.

Some systems have limited control objectives of a well-defined nature. In such cases, the services of professional system engineering firms coupled with dramatic cost reductions in small computers have markedly reduced the total cost of these applications. This has encouraged many more companies to consider their feasibility. The resulting increase in the market for and in the development of such control systems promises even further cost reductions. These will result from the increased productivity of the designers and builders.

The system here was designed, constructed, and installed by Digital Applications, Inc., to specifications provided by the Casting Laboratory of Chase Brass and Copper Company.

A Typical Application

Figure 1 schematically shows the system at the Casting Laboratory of the Chase Brass and Copper Company. Experimental apparatus includes three multi-electrode emf furnaces and one multi-cell atomic absorption furnace. The experiment control and data acquisition system consists of a Hewlett-Packard 2116B computer, a cross-bar scanner, an integrating digital voltmeter (which acts as an ultra-accurate analog-to-digital converter), and a real-time clock. The input/output system consists of two teletypewriters (Model ASR33), a high-speed paper tape reader, an incremental magnetic tape recorder and two output relay registers. Temperature control is provided for all the furnaces by separate Motorola PID controllers. In addition, analog recording is done by pen recorders. The computer adjusts furnace temperatures by positioning the temperature controller set-points.

This hardware configuration directed by user-controlled parameters allows the specifications of the mode of conduct of experiments in each of the four furnaces and the step-by-step control of each experiment. Four such experiments can be independently specified and asynchronously controlled.

Each experiment consists of a set of temperatures at which measurements are performed. The control function of the system brings the furnace to each desired temperature, tests the acceptability of the furnace conditions, and takes measurements. Acceptability is quantified in terms of temperature stability and uniformity and measurement signal stability for an interval surrounding the moment of measurement acceptance. A profile of the change of temperature and its stabilization is illustrated in Figure 2.

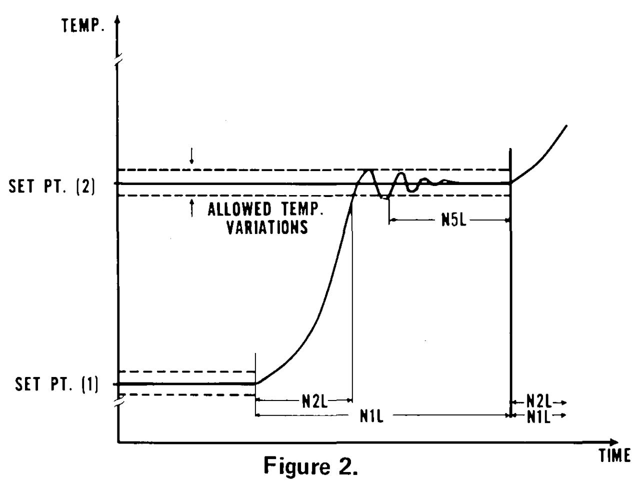

Figure 2.

What the Computer Does

The control of the experiment is achieved in the computer by examining a fixed interval for each of the control and measurement thermocouples and electrodes (which have previously been indicated to be active) for each furnace in which experiments are being carried out. Every such cycle (which is 7.5 seconds) the cross-bar scanner scans 69 analog signals to digital inputs to the computer. The computer evaluates experimental status based on the most recent prevailing conditions coupled with a statistical summary of previous conditions. These conditions and the time required to achieve them are compared with parameters inputed at the beginning of the experiment or during its progress. Parameter input is via the teletypewriters in a conversational mode with the experimentation. Conversations for the entry of parameters or display of results can go on simultaneously on both teletypes and concurrently with all data acquisition and control functions.

If conditions of temperature stability and uniformity and signal stability are met for a target temperature, data reflecting the prevailing conditions and the desired measurements of vapor pressure ratio or electromotive force are stored in a result table within computer memory. In addition, both final and intermediate results can be outputed to magnetic tape for further data reduction. If these conditions are not met, the experimenter is informed through a teletype message of the condition which failed. He is at liberty to terminate the experiment or suspend it at the present temperature for time to think and/or to change the parameters controlling acceptability on temperature goals. Further, the experimenter may request a separate general status report on the condition of one or more experiments stated in terms of a number of parameters which give an instantaneous global profile of the progress of the experiments.

In addition to this control, the computer program also controls the change in temperature by indicating a change to the setpoint of the furnace temperature controllers permitting heating or cooling of the furnace so that the experiment may progress from one goal temperature to another. The computer program also initiates commands through the output relay register to move the atomic absorption furnace station by means of a stepping motor.

Thus, we see that the computer program aids the experimenter by permitting on-line initiation, monitoring and adjustment of the experimental progress and furnishing real-time control of the mechanics of experiment procedure and warnings of failure to meet required conditions of acceptability.

Software Organization

System Operation Program (SOP) is an integrated and self-contained software package which directs the computer and makes the experiment control and data acquisition

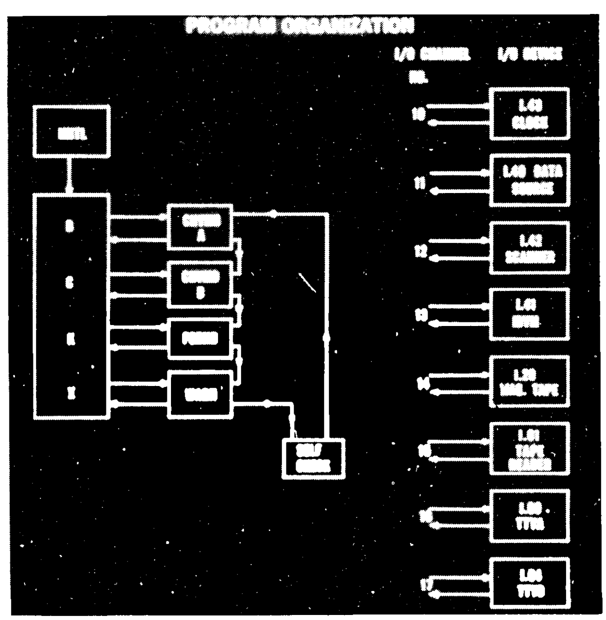

Figure 3.

system function. SOP is a collection of 12 different computer programs (written in Fortran or Assembler language), each one of which performs one or more specific functions.

The programs are organized such that all the functions to be performed are divided into two groups—foreground and background tasks—depending upon the priority and the importance of the task.

Foregound Tasks

Each foreground task is associated with an I/O interface card (and consequently, an I/O device) capable of generating an interrupt. The priority of an interrupt is determined by the I/O channel into which the I/O inferface card is inserted. In Figure 3, I/O devices, capable of generating an interrupt are shown connected to a specific I/O channel. The channel numbers are inversely related to interrupt priority so that the lower the channel number, the higher the interrupt priority for the attached device. For example, in Figure 3, the clock (I.43 is the interrupt response routine) is connected to the lowest I/O channel number 10; consequently, the clock interrupt (which is every 10 ms.) has the highest priority.

The computer will service an interrupt only if no interrupt of higher priority requires services. If, during the execution of a foregound task, a higher priority interrupt occurs, the control passes to the higher priority task and returns to the original task if no higher priority tasks are to be serviced. So, in Figure 3, no matter what other interrupts occur, the time is updated every 10 ms. Foreground tasks are not re-entrant and cannot share routines either with background tasks or among each other.

Background Tasks

Background tasks are the tasks which are scheduled by the background executive program in the SOP. Background tasks have a lower priority than every foreground task. Background tasks are the conversation mode (two for two teletypes but both sharing the same code), signal processing (which is called by FGRND program), and warning message generation. Each background task is allowed to occupy the computer (except for interruptions by foreground tasks) to the exclusion of other background tasks, until the background task itself relinquishes control to the executive. The control is released whenever the background task cannot proceed further having to wait for some peripheral equipment to perform an action. The executive program examines the status of each background task in turn. If the task is to be resumed, the control is passed to the task. The executive makes sure that intermediate data of each task are preserved when control is relinquished and restored when control is returned to the task. Thus, background tasks can be re-entrant and share a common set of code (in particular, the entire FORTRAN/ALGOL library). Background tasks request peripherals (e.g., teletypes) with different priorities. Requests at Zero level can be aborted by higher priority requests. Consequently, when waiting for a new operator command via the teletype keyboard, the background task is suspended awaiting the completion of input at Zero priority level. Warning messages at a priority level higher than Zero can abort this request and preempt the use of any teletypes.

The "selfcheck" box in Figure 3 is for core exercising and testing.

The Signal Processing

The various temperature, electromotive force and absorption signals need to be processed in order to determine the experimental conditions. A computer program called "STATI" in the SOP package performs processing functions.

In Figure 2 are shown different experimental parameters related to the temperature variations and stabilization. "STATI" counts the number of 10 ms interrupts from a real-time clock and keeps track of time parameters (NIL, N2L, N3L, N5L in Figure 2). At any moment, if the time count exceeds the limit, control is passed to the warning message generation program, which in turn types out an appropriate warning message.

"STATI" converts and stores the scanned signal readings in a real array. These new readings are evaluated and compared against the experimental parameters. If the values are satisfactory, the time counter for the parameter (N5L) is incremented, and the same cycle is repeated for (N5L) time. During any cycle, if the values are not satisfactory, the (N5L) counter is reset to zero (0) and the cycle is repeated.

Such an arrangement of the time counter assures that the temperature was stable and uniform, and the signal was stable, at least during the time period (N5L).

The Conversation Mode

The Conversation Mode is a program which makes man-machine communications possible. There are 11 commands available in the system. Figure 4 shows some of

```
COMMENT: ENTER EXPERIMENT IDENTIFICATION

TITLE 2
RN ID   DEMONSTRATION OF CONVERSATION MODE
OK   9/12/1969  14:10


COMMENT: ENTER OR CHANGE EXPERIMENTAL PARAMETERS

ENTER 2
PRM#1 600.0
MTRF OLD=   60.00 NEW=  600.00 UPDATE? YES
PRM#0 0
ER  4
OK   9/12/1969  14:11


COMMENT: ENTER OR CHANGE TEMPERATURE PROGRAM

TEMPERATURE 2
   OLD   NEW
 350.0 500.0
 400.0 600.0
 500.0 700.0
 400.0 750.0
    .0 800.0
    .0 0
OK   9/12/1969  14:13


COMMENT: BEGIN THE EXPERIMENT

BEGIN 2
OK   9/12/1969  14:13


COMMENT: WHAT IS THE STATE OF THE EXPERIMENT ?

STATE 2
FURNACE 2   9/12/1969  14:14       44 MIN SINCE START
TC, T*S     22.72   22.55   22.55   22.38   22.55   22.55
E*S (V)   .19980  .20860  .21950  .01190  .00330  .00431  .00451  .00000
EL  AVG READING  SLOPE  EL  AVG READING  SLOPE  ST PT  AVG TEMP   SLOPE
NO    MV         MV/HR  NO     MV        MV/HR  DEG C  DEG C      C/ HR
1     .00*  .00    .00  2     .00*  .00    .00  500.0     .0*  .0    .0
3     .00*  .00    .00  4     .00*  .00    .00
5     .00*  .00    .00  6     .00*  .00    .00
7     .00*  .00    .00  8     .00*  .00    .00

OK   9/12/1969  14:15


COMMENT: HALT THE EXPERIMENT

HALTS 2
OK   9/12/1969  15:16
```

Figure 4.

these commands and the computer's response. The user typed information is underlined in Figure 4. A comment statement is added before the actual command to clarify the meaning of the command in Figure 4.

The interpretation program recognizes a valid command by its first four characters. If the command is not valid, an error message is printed out. The command in the conversation mode is always followed by the furnace number (from 1 to 4) about which the information is given to the computer or required from the computer.

c.a

PROBLEM CORNER

Walter Penney, CDP
Problem Editor
Computers and Automation

PROBLEM 6912: THE VALUE OF OVERTIME

"This new union contract has given us a lot of headaches." Pete said, shaking his head as he looked at the pile of cards in front of him.

"How's that?", Jim asked.

"We had to reprogram the whole payroll calculation, but of course you get bugs out of a program like this only asymptotically."

"Was this contract so much different?"

"Well, the main provisions were a 10% increase plus time and a half for overtime, instead of the time and a quarter that had been paid previously."

"That must represent a big slug extra for the workers."

"I'll say. Look at this one." Pete took the top card from the pile. "Joe Blookoller worked the same number of hours as the previous week when the old scale was in effect, but he made $16.80 more."

"Maybe we ought to have a programmers' union." Jim was beginning to get ideas.

"I don't know. I think the union was just fortunate. The company's offer was an increase of 5% and time and a third for overtime. Joe would have made only $7.80 more then."

"Maybe overtime accounts for a lot of difference."

"No, I wouldn't say that. But figure it out for yourself."

How did Joe's number of hours of overtime compare with his number of regular hours?

Solution to Problem 6911: Testing Resistance to Pi

The equation $19 X^2 - 39 X - 65 = 0$ has a root $X = 3.141588$, correct to five decimal places. This differs from π by only about .000005.

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

Figure 4 illustrates specific functions of some of the commands in the conversation mode. As it is seen (by "STATE" command) here, the conversation mode makes it possible for a scientist to determine the experimental conditions at any cycle. Also, the results are presented with self-explanatory headings to minimize need for reference material. The teleprinter printouts could be directly inserted in technical reports and notebooks.

Information Processing

The data acquisition system accumulates relevant intermediate data for all the four furnaces on the magnetic tape. The data stored on the incremental magnetic tape can be processed for unusually detailed scientific analysis. A set of computer programs are written in Fortran IV for a Univac 1108 computer, which will take the output magnetic tape of the data acquisition system and produce four different magnetic tapes, one for each furnace.

Scientists then use the appropriate furnace tape to analyze in great detail the intermediate experimental conditions and the experimental end results. The analysis is also done on a Univac 1108 computer with an option to plot the analytical results on a plotter.

Hardware - Software Cost Factors

The authors believe that in such a computer application, the time requirements and the cost restrictions should be very carefully planned. Delay in the delivery of computer systems and hardware interfaces or unknown program debugging problems take up a considerable amount of time. Also important is a careful study of system layout and design. Changes that are made during development lead to changes in hardware interfaces and in software, and result in delays and incurred costs.

A relative cost study has shown that the cost of a computer system is very sensitive to the efficiency of the use of high cost components such as main memory. Also, the cost of developing the software could be as much or a little more than the cost of system hardware.

Summary

The experiment control and data acquisition system, as developed at the Casting Laboratory of the Chase Brass and Copper Company, presents a challenging application for today's systems managers, analysts and programmers. The basic idea of using a computer as a research and analytical tool to improve the productivity and efficiency of researchers is a desirable goal. For the computing specialist, this goal becomes a stimulating challenge in the effective use of the mini-computer. For company management, knowledge of successful laboratory applications reduces the cost and risk of investing in such activities on a much larger scale in production facilities. □

Acknowledgements

The authors wish to acknowledge useful discussions on the subject with Drs. G. W. Perbix, R. E. Johnson, A. D. Kulkarni and Mr. F. L. Jamison.

MINICOMPUTER APPLICATIONS — DO THEY IMPLY SOMETHING FOR EVERYBODY?

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P.O. Box 5409
Phoenix, Ariz. 85010

"Minicomputers are 'can do' machines. Their cost and simplicity make them economical and practical for the small-volume user with limited training. They are flexible and adaptable to many jobs."

Have you the need to monitor and log operating status of several offshore gas wells from a single on-shore point?

Or the requirement to multiplex the conventional law enforcement communication systems of a megalopolis into a network that communicates with the central high-speed computer of a state-wide police information system?

Ray A. Zack is the Vice President and General Manager of the Control Systems Division and its marketing subsidiary of Motorola Instrumentation and Control Inc.

He is Vice Chairman of the division's British subsidiary, Motorola Control Systems Ltd., and a Director of its Canadian marketing subsidiary. He is also a Director of Seltronic's Gray, a United Kingdom instrument manufacturer. He holds a BSEE and a BSIE degree from Lehigh University.

Do you wish to assert well-informed management guidance over a dispersed multi-plant manufacturing complex?

Or to provide round-the-clock deliveries from a bulk product terminal with accounting, billing, and inventory control lodged in a remotely located central computer?

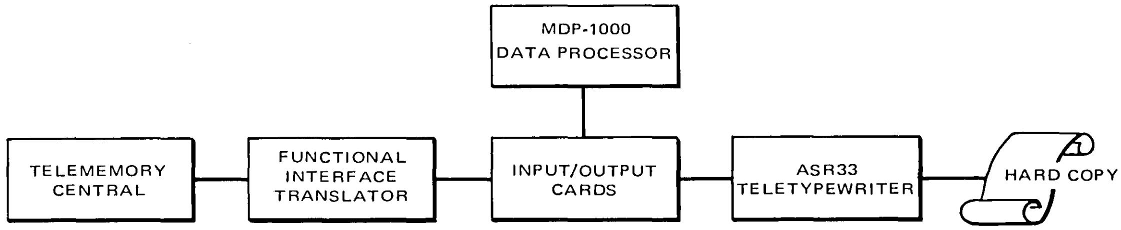
Or do you merely wish to centralize accounting, billing, payroll, and inventory records for a two- or three-store chain?

These problems have a common denominator. Despite their apparently divergent nature and complexity they can be solved by application of an inexpensive minicomputer, usually operating with some type of data terminal. Further, these are only representative examples of the virtually unlimited tasks to which minicomputers are being applied. The variety of applications will continue to broaden as minicomputers become smaller and less expensive, a trend that has shown rapid momentum, despite the severe inflation being experienced in most other economic sectors.

The Terminal

The minicomputer used alone in the applications described would be limited in efficiency and functions. By adding suitable peripherals its versatility and efficiency can be improved considerably, and small data processing terminals result. These are compact, efficient, self-contained systems that also can be used as data collecting, concentrating, and communicating subsystems for hierarchical data processing networks. Though the minicomputer with suitable programming can be dedicated to a single task and is quite economical as a tool when viewed in this context, it is through application in data communication terminals that it can find catholic utility and yield its most significant economic benefits. The minicomputer makes the terminal possible. The terminal extends the machine's potential for application to multiple tasks. To both the small volume and large volume user the minicomputer-centered terminal yields a distinct and most important improvement which heretofore has been lacking—inexpensive, accurate, near-real-time data input at, or very close to, the data source where accuracy can be quickly verified.

A block diagram of a minicomputerized system for monitoring and logging data from an offshore gas well.



What the Minicomputer Can Do

As implied earlier, relatively simple data processing subsystems which are based on minicomputers can do many jobs ranging from process control and supervision, through data concentration and communication, to conventional office tasks.

For example, in one problem of monitoring and logging data from off-shore gas wells, the wells are controlled from a central point using Motorola Telememory (TM) automated control. This control system concentrates 360 alarm and status indicators in one control center, making progressive manual polling and data logging of so many points physically impossible. The implied increase in complexity of supervisory control hardware was avoided with a simple minicomputer-centered subsystem consisting of a Motorola MDP-1000 minicomputer (8096 words of memory). The minicomputer is equipped with six special input/output cards, a clock, a functional interface translator and an ASR-33 teletypewriter. In this subsystem the computer is programmed to function as the analog of the operator using the control console. It not only performs the monitoring and data logging, it also provides event timing and operator backup. Existing tone lines for supervisory control are used. Even if every function on the three gas well platforms failed simultaneously, the minicomputer would detect, store, and record all of the changes, including time of occurrence, in 24 minutes. This would be beyond any operator's physical capability.

Law Enforcement

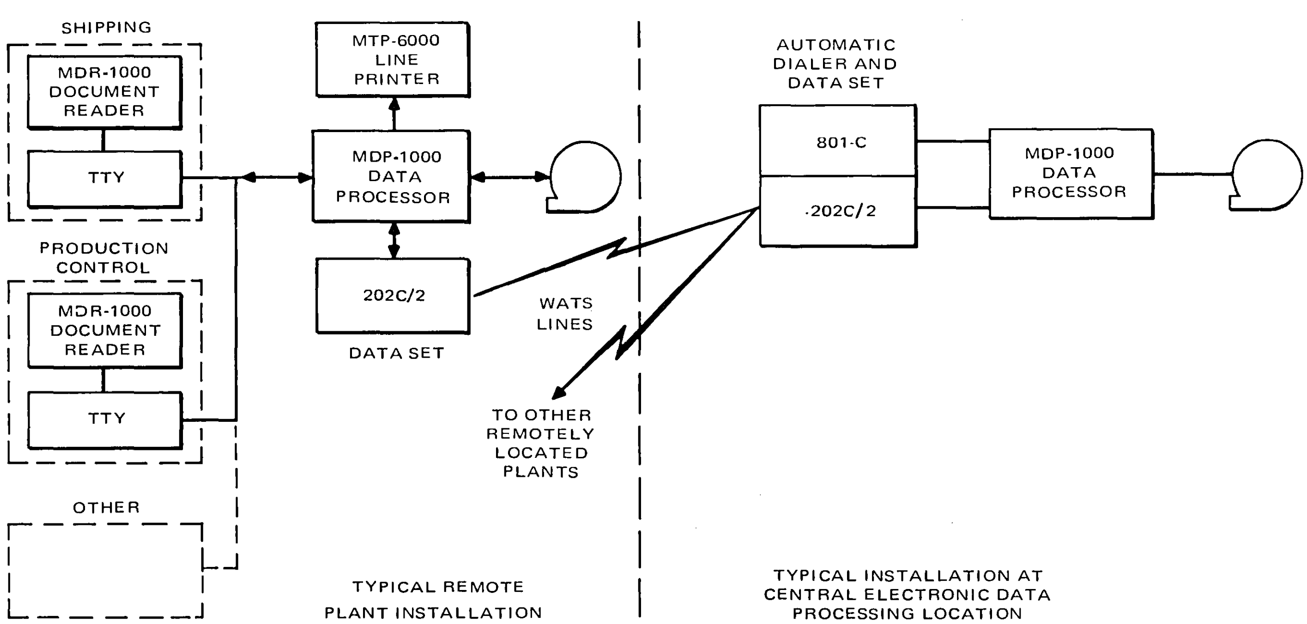
In the law enforcement task the minicomputer provides a sharp, new set of teeth to the policeman or sheriff. Teleprinters in police substations and sheriff's offices (and ultimately to be installed in police cars) in the San Francisco Bay area are set up to communicate requests for information via microwave to a minicomputer in San Mateo. The minicomputer accepts the messages from these low-speed links, queues them, and places them on high-speed data communication links with a central processor in Sacramento. The central processor searches its file of criminal records, outstanding arrest warrants, and stolen cars, then replies via the high-speed link to the minicomputer in San Mateo. The minicomputer now intercepts and routes the message over the microwave link at slower speed to the originator of the inquiry. The time lapse is less than two minutes.

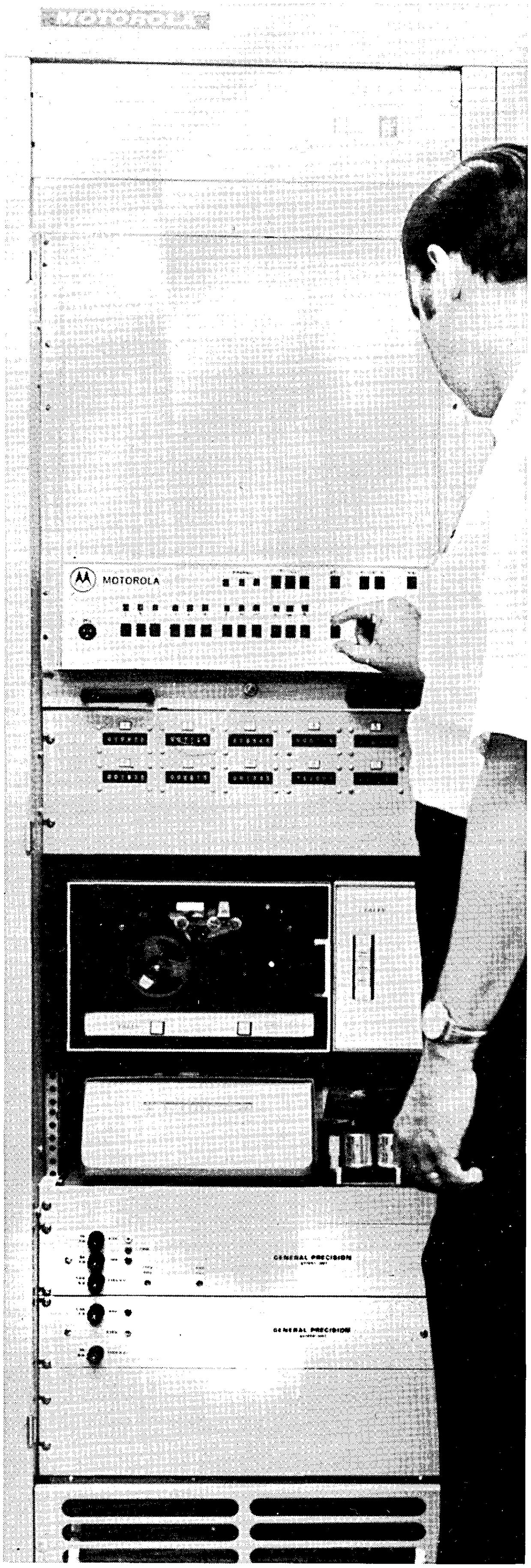
Managing Information

The minicomputer-centered terminal also has a talent for collecting and preprocessing data. This talent makes it a particularly effective adjunct to multi-plant management information systems where retention of centralized management control is desirable. In this application the communication capability of the data terminal improves the effectiveness of management by distilling and communicating operating information in a form that facilitates decision-making, even though millions of items of information describing operation in the several plants are processed daily.

The minicomputer-centered data communication terminal installed in each plant is comprised of a Motorola MTP-6000, high-speed teleprinter, the computer, a tape deck, and MDR mark-read document readers with associated monitor teletypes. The latter units are strategically

A block diagram of a minicomputer-centered management information system for discrete processing industries.





A minicomputer shown in operation in bulk loading terminal application.

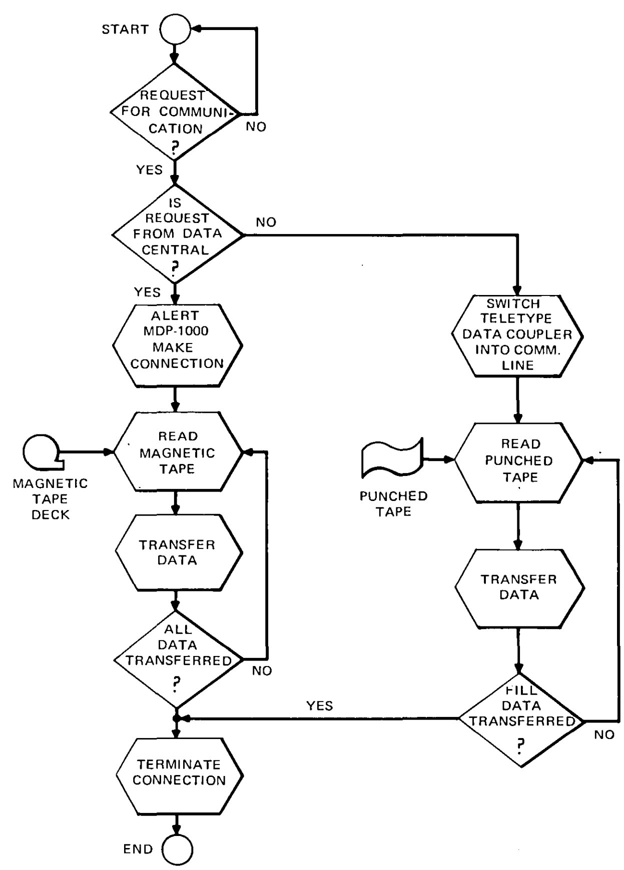
located in various operating departments throughout the plant. The terminal communicates, using an automatic dialer and data set, via WATS lines to a second minicomputer in the central electronic data processing location. This unit has an associated data recorder that stores data on magnetic tape for processing by the large central processing unit.

At each plant the terminals accept data entries from real-time production control via document reader and data recorder. This information is transmitted to the local minicomputer. It includes such items as inspection results, changes to bills of material, units assembled, part usage rates, etc. The minicomputer concentrates the information for more efficient processing by the corporation's central processor, and stores it until the central processor requests it for off-hours processing. This step is completed via automatic dialer, data set and WATS line.

Prior to the beginning of work each day, summaries are transmitted to each plant describing the most effective method to conduct the day's activities. These summaries are printed out as hard copy on the high-speed teleprinter. They might contain up-to-date bills of material, indications of up-coming parts shortages, indications of possible assembly impediments, etc. For management, the summaries are concerned with outflow at shipping, cost centers, and other factors bearing on profitability of each plant.

Bulk Terminal Applications

Though the bulk terminal application of the minicomputer is in the petroleum industry, the concept has been adapted to direct-from-pipeline delivery of agricultural ammonia and has potential for control and accounting in other bulk liquid storage and dispensing applications.



Information flow diagram for a minicomputer-controlled bulk oil terminal loading system.

In one bulk petroleum terminal application the small computer (with 8096 words of memory) performs three functions: one of plant control in which it acts as the stored logic controller by identifying customers, checking customer product quota and credit files, releasing valves, registering withdrawal quantities, controlling additives, and controlling pumps for four loading docks; a second function as a data gathering terminal in which it gathers and stores transaction data, inventory control data, data pertinent to plant management and performance, and operational data from sensors; and a third function as a data communication and interchange terminal that interfaces the bulk plant files of information with a large data processor in the company's accounting and billing center. The data terminal provides delivery manifests for transactions and a local log of transactions. The minicomputer is supplemented by input/output buffers, teletypewriters, and status indicators. Communication with the central processor is via automatic dialer, dataset interface, and WATS line.

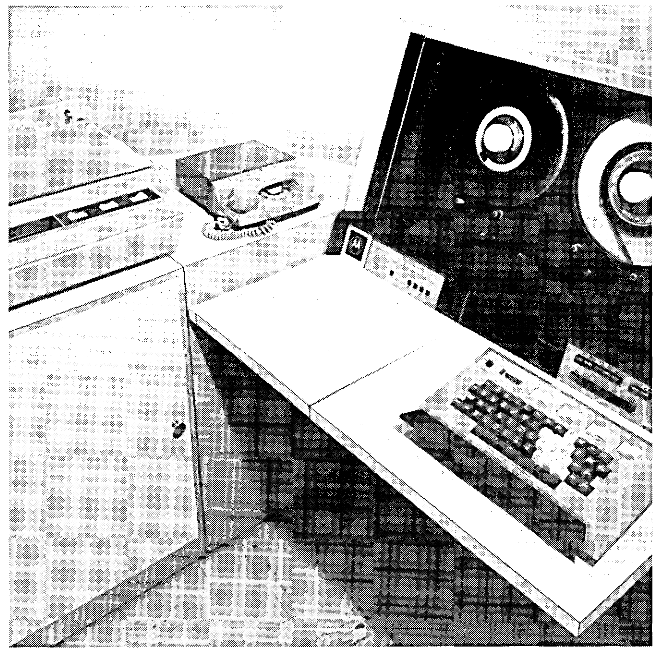
Business Records

In the case of the centralized business record system for a small chain of stores or other small to medium-sized businesses, a single terminal of the multi-plant management information system would represent the most complex configuration necessary. Depending on functional requirements, such a terminal could conceivably range from a document reader, minicomputer, and teleprinter, to a system consisting of these modules plus the keyboard-to-tape recorder and high-speed line printer. By adding modems, communication capability via voice grade circuits would link the system with a larger central processing unit should business growth make desirable the expansion of the data processing capability.

Telephone Trouble Reporting

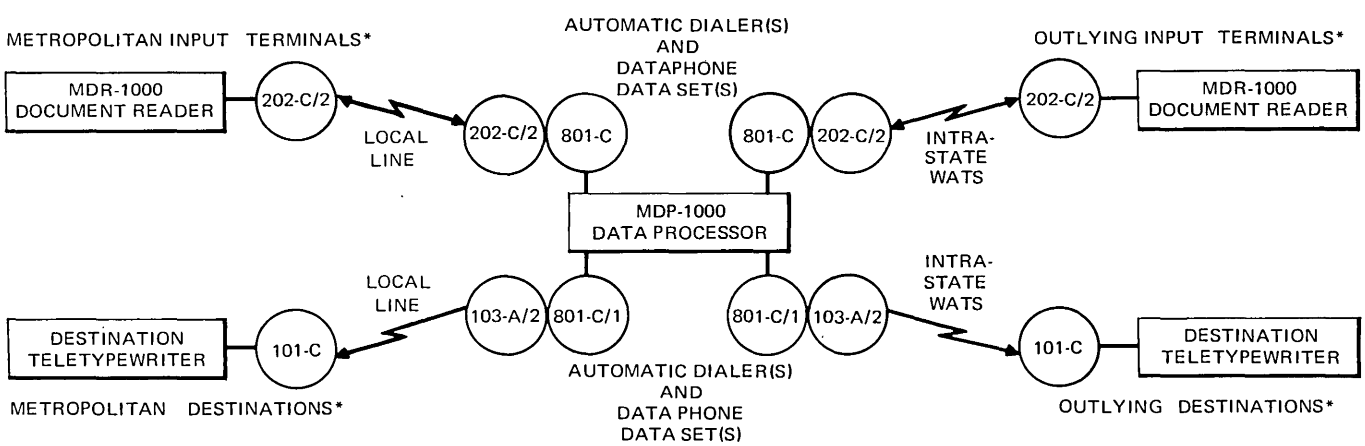
The minicomputer also is being used in a network for reporting telephone trouble which is operated on a statewide basis. In this application it has made possible spectacular improvement in time lapse from trouble report to initiation of corrective action. In some cases the 12-hour turn-around has been reduced to 5 minutes. The simple system consists of 16 Motorola MDR document readers at major telephone central locations throughout the state. These are polled in rotation by the minicomputer via

Data input devices operate with a minicomputer in a remote terminal to provide data preprocessing and communication to a large central data processor.



Some Unique Applications

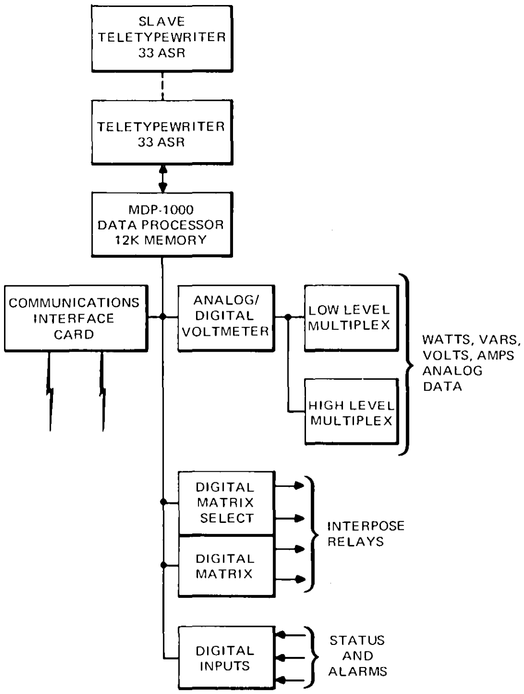
These six applications represent a bare beginning. Minicomputer talents have been turned to others. One machine rides a powered sled and is used for glacier exploration and modems and WATS line. On receiving a trouble call, operators mark information describing its nature on mark-sense cards which are placed in the document readers. Approximately every three minutes the minicomputer polls each reader via the modem-WATS network and automatically reads the trouble information from the cards in the hopper, analyzes it, and queues it. It then establishes a link with the correct repair center and passes the trouble report to the repair center for action. Besides rapid corrective action on the report, dispatching mistakes at the repair centers are minimized.



* 9 INPUT TERMINALS , 16 OUTPUT TERMINALS

A block diagram of a telephone trouble reporting network.

survey work in Canada. The minicomputer in this case maintains position precisely and records data from several sources on tape for later processing. The minicomputer verifies that the survey of an area has been complete and the correct data has been collected before the area is vacated. It also makes possible exact repeatability of the course run at later intervals to assess changes in glacial activity.



Block diagram of a system using a minicomputer to extend the control functions of a remotely located power station.

Minicomputers currently are being applied in production and quality control of high-volume, high reliability electronic units, in automated material handling and warehousing, and in testing of complex integrated circuit boards for construction of computers. A power and light company uses one to control and extend the functional capabilities of a remotely located substation for electrical distribution. Probably one of the most unusual applications devised to date is a security surveillance and alarm system for an industrial or military installation and office buildings. This computer-centered system is sufficiently novel so that a patent application has been filed for it. The minicomputer in this sophisticated system receives status reports from many widely dispersed alarm and status modules. It can also interrogate these points out of polling sequence and command certain actions.

"Can Do" Machines

These machines already have penetrated the downside cost barrier and are available at low four-figure prices. Their cost and simplicity make them economically feasible and operationally practical for the small-volume user with limited training. They are "can do" machines, flexible and adaptable to many jobs. As integrated circuits and plated wire memory advance, it can be expected that prices, operational complexity, and size will shrink, making minicomputers practical for an ever-expanding spectrum of applications. If the application exists now, the minicomputer can be applied to it with some degree of reasonableness. It is equally within reason to imagine vest pocket, something-for-everybody configurations for the conceivable applications of the future. □

c.a

NUMBLES

NUMBER PUZZLES FOR NIMBLE MINDS —AND COMPUTERS

Neil Macdonald
Assistant Editor
Computers and Automation

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

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

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

NUMBLE 6912

```
              W H A T
      X   S M A R T S
            E A T Y H
          S S C A C
        H E S S M
      T R S H A
    T Y H E S
  E A T Y H
= E R R E T A S S C H

      33159    6122
```

Solution to Numble 6911

In Numble 6911 in the November issue, the digits 0 through 9 are represented by letters as follows:

A = 0	F = 5
T = 1	W = 6
E = 2	O = 7
I,Y = 3	C,S = 8
N = 4	L = 9

The full message is "Once is not often, and twice is not always."

Our thanks to the following individuals for submitting their solutions: *Numble 6910:* A. Sanford Brown, Dallas, Tex.; R. C. Jensen, Endicott, N.Y.; William Lasher, Greenbelt, Md.; G. P. Petersen, St. Petersburg, Fla.; A. O. Varma, New York, N.Y.; and Robert R. Weden, Edina, Minn. *Numble 699:* Janice R. Goole, Kalamazoo, Mich.

CALENDAR OF COMING EVENTS

Dec. 1-3, 1969: Conference on Image Storage and Transmission for Libraries, National Bureau of Standards, Gaithersburg, Md.; contact: Madeline M. Henderson, Center for Computer Sciences and Technology, National Bureau of Standards, Room B226-Instr., Washington, D.C. 20234

Dec. 8-10, 1969: Third Conference on Applications of Simulation, International Hotel, Los Angeles, Calif.; contact Arnold Ockene, General Chairman, Simulation Associates, Inc., 600 North Broadway, White Plains, N.Y. 1601

Dec. 18-20, 1969: Third International Symposium on Computer and Informational Science (COINS-69), Americana Hotel, Bal Harbour, Fla.; contact Dr. Julius T. Tou, COINS-69 Chairman, Graduate Research Professor, University of Florida, Gainesville, Fla. 32601.

Dec. 27-28, 1969: Annual Meeting of the Association for Symbolic Logic, Waldorf-Astoria Hotel, New York, N.Y.; contact: Prof. Jon Barwise, Program Chairman, Dept. of Mathematics, Yale University, New Haven, Conn. 06520

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

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

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

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

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

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

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

March 23-25, 1970: INFO-EXPO-70, technical meeting sponsored by the Information Industry Association, Shoreham Hotel, Washington, D.C.; contact Paul G. Zurkowski, Information Industry Association, 1025 15th St. N.W., Washington, D.C. 20005

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

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

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

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

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

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

May 25-27, 1970: Forum of Control Data Users (FOCUS) Annual Conference, St. Paul Hilton, St. Paul, Minn.; contact: William I. Rabkin, FOCUS Exec. Sec., c/o Itek Corp., 10 Maguire Rd., Lexington, Mass. 02173

June 1-3, 1970: "Session 70", the Inaugural Joint National Conference of the Information Processing Society of Canada (formerly the Computer Society) and the Canadian Operations Research Society, Vancouver, British Columbia; contact: W. J. Sheriff, Suite 1404, 1177 W. Hastings St., Vancouver 1, B.C.

June 15-16, 1970: Conference on Solid State in Industry, (IEEE), Statler-Hilton Hotel, Cleveland, Ohio; contact: A. J. Humphrey, Technical Program Chairman, The Reliance Electric & Engrg. Co., 24701 Euclid Ave., Cleveland, Ohio 44117

June 16-18, 1970: Computer Group Conference and Exposition (IEEE), Washington Hilton Hotel, Washington, D.C.; contact: Bob O. Evans or Donald E. Doll, IBM, Federal Systems Div., 18100 Frederick Pike, Gaithersburg, Md. 20760

June 22-26, 1970: 11th Joint Automatic Control Conference, Georgia Institute of Technology, Atlanta, Ga.; contact ASME Headquarters, 345 E. 47th St., New York, N.Y. 10017

June 24-26, 1970: Annual Joint Automatic Control Conference (JACC), Georgia Tech, Atlanta, Ga.; contact: Prof. J. B. Lewis, Dept. of Electrical Engineering, Penn. State Univ., University Park, Penn. 16802

Aug. 24-28, 1970: IFIP World Conference on Computer Education, Amsterdam, Netherlands; contact: A. A. M. Veenhuis, Secretary-General, IFIP Conference Computer Education 1970, 6, Stadhouderskade Amsterdam 13, Netherlands

Aug. 31-Sept. 2, 1970: American Society of Civil Engineers, Fifth Conference on Electronic Computation, Purdue University, Lafayette, Ind.; contact Robert E. Fulton, Mail Stop 188-C Structures Research Division, NASA Langley Research Center, Hampton, Va. 23365

Sept. 1-3, 1970: 25th National Conference, Association for Computing Machinery, New York Hilton, New York, N.Y.; contact: Sam Matsa, ACM '70 General Chairman, IBM Corp., 410 E. 62nd St., New York, N.Y. 10021

Sept. 2-4, 1970: The Institution of Electrical Engineers (IEE) Conference on Man-Computer Interaction, UK National Physical Laboratory, Teddington, Middlesex, England; contact Roger Dence, IEE Press Office, Savoy Place, London WC2, England

Oct. 5-9, 1970: Computer 70 — International Computer Exhibition, Olympia, London, England; contact M. F. Webster, Leedex Limited, 100 Whitechapel Road, London, E.1., England

Oct. 15-16, 1970: 1970 Atlantic Div. of Assoc. for Systems Management Eighth Annual Atlantic Systems Conference, New York Hilton, New York City, N.Y.; contact: Malcolm B. Foster, A.S.C., Box 461, Pleasantville, N.Y. 10570

Oct. 26-28, 1970: Forum of Control Data Users (FOCUS) Regional Conference, Statler Hilton Hotel, Washington, D.C.; contact: William I. Rabkin, FOCUS Exec. Sec., c/o Itek Corp., 10 Maguire Rd., Lexington, Mass. 02173

Oct. 26-29, 1970: 25th Annual ISA Conference & Exhibit, Civic Center, Phila., Pa.; contact K. F. Fitch, Meetings Coordinator, Instrument Society of America, 530 William Penn Place, Pittsburgh, Pa. 15219 □

THE PERSONALITY OF THE INTERACTIVE PROGRAMMED COMPUTER

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"The interactive computer will respond, obey, teach, and play. It is in many ways like a powerful Arabian genie arising out of a fisherman's bottle to do enormously difficult things at one's command."

Answer to "What files do I have?" (The user was Edward Fredkin, Visiting Professor at M.I.T.)

```
233)    .IOT 1,16↑F
DSK  EF
FREE BLOCKS UØ   PK3 #3 13Ø UI     PK5 #5
  3   BURST  1     1 9/15/69 12:15:47.5 Ø
  3   PERIOD 1     1 -
  5   R4     BIN   1 9/14/69 13:ØØ:46 Ø
  5   R4     2     1 9/14/69 13:ØØ:Ø6 Ø
  3   PERIOD 2     1 -
  5   R4     1     1 9/14/69 12:55:25.5 Ø
  5   RR     1     1 9/13/69 17:27:44.5 Ø
  3   NEW    LISP  1 6/2Ø/69 22:Ø2:58 Ø
  3   TRIE   A4    1 -
  3   SET    UP    1 6/2Ø/69 21:45:41 Ø
  3   FIZZ   5     1 6/29/69 11:13:47.5 Ø
  5   R      BIN   1 9/9/69 ØØ:1Ø:37.5 Ø
  3   NUM    4     1 6/8/69 17:24:17.5 Ø
  3   LISPT  6     1 2/8/69 18:ØØ:25.5 Ø
  3   MAP    3     1 6/2Ø/69 19:51:12 Ø
  5   R      1     1 9/9/69 ØØ:Ø5:26.5 Ø
  5   R      3     1 9/8/69 23:5Ø:5Ø.5 Ø
  3   TRIE   7     1 -
  3   RAM    1     1 9/8/69 2Ø:Ø6:22 Ø
  3   LES    SON   1 1Ø/2/69 15:25:59.5 Ø
  3   RAM    2     1 9/8/69 2Ø:4Ø:Ø2.5 Ø
  1Ø  RAM    3     1 9/8/69 17:45:14 Ø
  5   R      2     1 9/8/69 23:44:25.5 Ø
  3   T      5     1 5/18/69 19:15:17.5 Ø
  1Ø  DOC    TOR   5 9/3/69 15:1Ø:Ø6 Ø
```

Any human being who has used a programmed computer with direct access to the machine (either time-shared or not time-shared) has inevitably started to form a notion of the "personality" of the interactive programmed computer which he has been dealing with.

The personality of the interactive computer consists of the features of behavior which it is possible for a group of intelligent (and we hope friendly) programmers to program into a computer. In this way the personality of the interactive computer is derived essentially from:

- the requirements of the given situation;
- the instructions for producing the program under which the programmers operated; and
- the personalities of the programmers in the group.

A Dynamic Book

If the program is well done, the user of the computer is greatly helped, enjoys his relation with the interactive programmed computer, and accordingly feels satisfied,

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Testing LISP on the interactive computer. For example, the REVERSE of the list A B C is the list C B A.

```
EF$U
:LISP!

LISP 107B
ALLOC? N


(CAR'(A B))
A
A
A UNBOUND VARIABLE - EVAL

(SETQ A  7)
7
A
7
(EQUAL (QUOTE (A B)) (QUOTE (A B)))
T
(REVERSE (QUOTE (A B C)))
(C B A)
(CDR 'REVERSE)
(SUBR 7134 PNAME (#37224 #37225))
(LAST (QUOTE (A B C D E)))
(E)
```

happy, and rewarded. If superlatively done, the relation of the user to the computer is much like his relation to a wonderful book, a book full of the most interesting and exciting information and experiences—but in this case the book is not static but dynamic, not motionless but responsive. From this point of view a good book and a suitably programmed computer both have a personality.

Access to the Computer

A user's perception of the personality of a computer may also be influenced by the type of access the user has. In the case of a time-shared computing system, the personality of the interactive computer can become foggy and obscured, because the pressure of many users often slows and clogs the computing system. The clogging produces sluggishness and the human reaction of impatience. Sometimes in fact the time-shared computer system will not allow a human being to log in, because of overload, or will suddenly terminate his use of the system, because of users with higher priorities than his, exhaustion of his block of allotted time, etc. This leads to frustration and anger. In the case of direct access to a computer that is not time-shared, problems of this category disappear. But here we shall side-step the issue of time-shared vs. not time-shared; here we shall consider only the features of a powerful interactive computer (either time-shared or not), plus friendly, skillful, and adaptive programming, at the service of a human user.

What is this personality?

For six years I have used interactive computers with various programs, and found the experience informative, very interesting, and often rewarding. This article seeks to generalize from these experiences, and to present: (1) what has actually been put into many interactive programs, (2) what could very easily be put into interactive computer programs; and (3) what cannot so far be programmed.

The illustrations for this kind of interaction with a computer presented in this article are all taken from one session with an interactive computer system, the PDP-6 (made by Digital Equipment Corp.) currently in use at Project MAC at Mass. Inst. of Technology. The basic purpose of this PDP-6 installation is experimentation and in advancement of computer science.

The interactive computer will respond, obey, teach, and play. It is in many ways like a powerful Arabian genie arising out of a fisherman's bottle to do enormously difficult things at one's command.

We shall consider the nature of the genie—his assets, his liabilities, his virtues, his vices—and how one can best deal with him. For just as one learns to understand and appreciate a close friend, it is useful to learn to understand and appreciate the personality of the genie.

Defining an approximate square root of X with a LISP definition, expressing convergence using 1/2 (X + X/K) and then using it to calculate the square root of 2 times 10 to the 12th power.

```
(DEFUN SQRT(X)(COND((MINUSP X)'NEGATIVE)
    (T (SQRT1 X 1))))
SQRT
(DEFUN SQRT1  (X K)(COND((LESSP(ABS
    (DIFFERENCE X(TIMES K K))) .00001)K)
    (T(SQRT1 X (TIMES 0,,.5(PLUS K
    (QUOTIENT X K)))))))
SQRT1
(SQRT 2)
1.4142156
(SQRT 1)
1
(SQRT 200)
11.313708
(SQRT 200.)
14.142135
(SETQ BASE(SETQ IBASE 10.))
10.
(SQRT 200)
14.142135
(SQRT 0)
0.1953125E-2
(SQRT 0.001)
0.31642016E-1
(SQRT 2E12)
/2 E12 UNBOUND VARIABLE - EVAL

(SQRT 2.E12)
1414213.5
```

I. Its Intellectual Behavior

1. Reading. It can read (in a limited way).
   a. It can accept unlimited strings of characters typed on a keyboard or the equivalent.
   b. By means of optical character recognition devices, it can accept strings of characters produced other than by typing on a keyboard.
2. Understanding. It can understand (in a limited way).
   a. If it is told precisely in "words" that it "knows",

it can respond appropriately to the meaning of the words.

b. It can also discover what meaning a human being wishes to convey to it, by proceeding along a network or tree of choices.

3. Writing. It can write (quickly).

   a. It can type at ten characters a second.
   b. It can print lines of 120 characters at the rate of 5 lines a second and up.

4. Drawing. It can draw (on a display scope) at the rate of 10 drawings a second and up.
5. Arithmetic. It can do arithmetic (very quickly).
6. Reasoning. It can perform logic and reasoning (very quickly).
7. Computing. It can calculate and compute; it can perform correctly very long sequences of reasonable operations on information.
8. Data Processing. It can process data (in large quantities).
9. Problem Solving. It can solve problems.
10. Analyzing. It can analyze logical and mathematical situations.
11. Learning. It can provide learning experiences.
12. Game Playing. It can play a game with a human being.

    a. It can lose a game often enough to keep a human being encouraged and cheerful.
    b. It can win a game often enough to keep a human being challenged and eager.

13. Random Action. It can behave randomly, drawing numbers from a random source.
14. Remembering. It can remember until told to forget.

    a. It can remember data for long periods.
    b. It can remember exactly what transpired between it and the human being during an interactive session.

15. Forgetting. It can forget (or erase) when instructed to.
16. Asking Questions. It can ask questions appropriately.
17. Accepting Answers. It can accept a wide variety (but not an unlimited variety) of answers to the questions it asks.
18. Accepting Questions. It can accept questions (in a limited way).
19. Supplying Answers. It can supply answers to any of these questions (if the answers can be computed).
20. Accepting Commands. It can accept a wide variety of commands from the human being, and execute them.
21. Responding to Actions. It can respond to a wide variety of actions by the human being.
22. Help. It can offer to help, and it can provide help.

Answer to "Who is using the time-shared computer system right now?"

```
:PEEK


    ITS 549    PEEK 147      11/Ø1/69 21:5Ø
MEMFR=41  USRHI=21                 RNABLU=1
I= U-JNAME   STATUS TTY      CORE %TIM
 Ø SYS       CLOSE  T5        31  Ø%
 1 CORE      UUO    ?         Ø   1%
 2 RG        TYI    TØ        6   Ø%
 3 MS        S      >         6   Ø%
14  TECO     TYI    T3   D    6   1%
 4 CEH       S      >         6   Ø%
1Ø  >        TYI    T13       57  Ø%
 5 FW        TYI    T4        11  Ø%
15  J        1Ø!Ø   ?         6   Ø%
 6 AKG       S      >         6   Ø%
 7  TECO     1Ø!Ø   <         6   Ø%
11  LISP     TYI    T14 P     44 14%
12 EF        S      >         6   4%
17  PEEK     +GETSY T7   C    6   Ø%
16 RJL       TYI    T12       6   1%
2Ø  CHESS    1Ø!Ø   ?         14  Ø%
USR MEM= 275   USR TIM= 21%
STIME = 2:Ø2:27   LOUTIM = 6
```

Asking another user who is on the system "How make the chess program print the board?"

```
23757)    .IOT 1,1    :SEND RG
(MAIL) 25:75:12 96/1Ø/11 FE

?   ?   ↑C
:SEND MS DO YOU KNOW HOW TO MAKE
CHESS PRINT THE BOARD ON A RANDOM TTY???
↑C

↑P

Z↑Z↑Z↑Z:     S?
MESSAGE FROM MS HACTRN
22:ØØ:55 " BD"
```

II. Its Emotional Behavior

1. Patience. It can be inexhaustibly patient.
2. Calmness. It never gets angry or disgusted. It never displays a bad temper (unless so programmed).
3. Strength. It never gets tired or weary, no matter how late the hour or how prolonged the session.
4. Politeness. It can be unfailingly polite and courteous.
5. Adaptability. It can adjust its mode of presentation to the choices and the record of behavior of the human being.
6. Friendliness. It can be friendly.
7. Sympathy. It can be sympathetic. *Example:* Dr. J. Weizenbaum's program Eliza.
8. Humor. It can crack jokes.

III. Common Acceptable Responses from the Human Being

1. "Yes." True. (OK, check mark, T, 1)
2. "No." False. (Not OK, X, F, 0)
3. "I don't know." No knowledge how to answer that question.
4. "It depends." Sometimes yes and sometimes no. Both yes and no.
5. A Multiple Choice. Selection among multiple choices.
6. A Number. Typed.
7. A Word. Typed.
8. Quit. I'm tired; I want to stop; I quit.

Playing three moves of chess with the interactive computer, which is using the Greenblatt program.

```
:CHESS

←PB
CLOCK STARTED
←
P K4
←B P/K2-K4 Ø.2 IN Ø.Ø
BD
WR WN WB WK WQ WB WN WR
WP WP WP -- WP WP WP WP
-- ** -- ** -- ** -- **
** -- ** WP ** -- ** --
-- ** -- BP -- ** -- **
** -- ** -- ** -- ** --
BP BP BP ** BP BP BP BP
BR BN BB BK BQ BB BN BR
←
?

N KB3
←B N/KN1-KB3 Ø.6 IN 1.Ø
N QB3
←B B/KB1-QN5 1.Ø IN 1.Ø
BD
WR ** WB WK WQ WB -- WR
WP WP WP -- WP WP WP WP
-- ** WN ** -- WN -- **
** -- ** WP ** -- BB --
-- ** -- BP -- ** -- **
** -- BN -- ** -- ** --
BP BP BP ** BP BP BP BP
BR -- ** BK BQ BB BN BR
←
?

P Q3?
P QR3
←
```

IV. Common Acceptable Commands from the Human Being

1. LOG IN. I wish to begin.
2. Definition. Please define . . . . What is . . . . ? Please explain . . . .
3. More Definition. Please say that in other words; please define further.
4. Example. Please illustrate; please give me an example; for instance?
5. Another Example. Please give me another illustration; another example.
6. Problem. Give me a problem; give me a test; give me an exercise to see if I have the right idea.
7. Another Problem. Give me another problem; a second test; a second exercise.
8. Fast. You are too fast for me; go more slowly, please. Don't rush me. I would like some more time. I want to think a bit.
9. Slow. You are too slow for me; go faster, please.
10. Help. Please help me; I don't understand; give me a hint.
11. More Help. Please give me some more help; another hint.
12. Answer. I give up—what is the right answer?
13. Reasons. Why? How come? How do you get that result? Please state your reasoning.
14. Score. What is my score so far? How many right, how many wrong, so far?
15. Shut Up. Oh, shut up. Stop talking. I know what you are going to say, and I am not interested.
16. New Topic. I'm tired of this topic. Let's go on to the next topic.
17. LOG OUT. I wish to stop.

V. Common Facilities for Preparing and Editing Commands to the Computer

A. Short Commands

1. One Character Correction. Delete the character at the current location, and space backwards one space.
2. Entire Line Deletion. Delete the entire line of characters at the current location.
3. Go. Command is complete, and seems accurate. Execute it.

Two examples of interacting with a program for arithmetic drill. The computer poses a set of ten arithmetic drill problems, and reports the number of seconds for the teletype user to respond with the right answer.

```
(UREAD LES SON)
(DSK EF)
↑Q
1Ø.

1Ø.

T

(+ - X //)↑WS↑V(RUN)
5X3=15   6
3 X9=27   4
5-3=2    3
9X1 =9    4
9+5=14   3
Ø+3=3    2
4X8=32   2
15/5=3   2
7-4=3    2
4-1 =3    1
THANKS
(RUNP 6 877 '(X))
5X4=2Ø   3
1X4=4    2
2 X5=1Ø   2
ØX2=Ø    2
2 X2=4    2
2 X3=6    2
ØX5=Ø    2
4X2=8    2
THANKS
```

B. Long Commands

1. Read.
   a. Read page of commands from tape into the buffer.
   b. Read line N.
   c. Read lines N to N2 inclusive.
2. Write.
   a. Write the contents of the buffer (the page).
   b. Write line N.
   c. Write lines N to N2 inclusive.
3. Change. Change line N into the following line . . . .
4. Deletion.
   a. Delete N characters forward from the pointer.
   b. Delete N characters back from the pointer
   c. Delete line N.
   d. Delete lines N to N2 inclusive.
   e. Delete the entire buffer.
5. Insertion.
   a. Immediately before line N, insert the following character string . . . .
   b. At the location of the pointer, insert the following character string . . . .
6. Append. Add at the end of the buffer the following character string . . . .
7. Pointer Location. Show where the pointer is located.
8. Moving the Pointer. Move the pointer back or forward N characters or N lines.
9. Record. The set of commands in the buffer is complete, and seems accurate; record it on tape for execution later.

The Genie's Vices

We now come to the topic of the failings, the vices, of the genie: the things that the programmed computer so far is not able to do, or is able to do so wretchedly that it is often better not to ask the genie to do them at all.

Here is a list of these features—the defects, the vices—of the genie:

1. *Stupidity.* It is often stupid. It understands only what you say, it does not understand what you mean.
2. *Deafness.* It often appears "deaf". You may seek to explain to it how to do something, but it fails to comprehend what you wish it to do, and it behaves as if it could not hear you.
3. *Unperceptive.* It cannot perceive the expressions on a human face, nor respond to the mood of a human being, nor take in the meanings of gestures.
4. *Spelling.* It is often sensitive to misspelled words. Like the door to the cave in Ali Baba and the Forty Thieves, it will respond to the command "open sesame", but only if you spell the words correctly. If you spell the command "open sesamy", the computer will probably respond by typing a question mark, "?".
5. *Meanings of Words and Discourse.* At the present stage of development of the genie, it cannot understand the meanings of words in general, nor the meanings of words freely put together into sentences, paragraphs, and discourse.

   This problem is probably not insuperable; but at present the genie regularly will react like a rude and uneducated man on an occasion when you say to him, "The Pythagorean theorem states that the sum of the squares on the two sides of a right-angled triangle are equal to the square on the hypotenuse": both the man and the genie will respond. "Huh?"

An example of carrying on a conversation with Dr. J. Weizenbaum's program ELIZA, which has been translated into LISP, and is called by the command (WORKER) given to LISP.

The first statement by the program to the human being sitting at the teletype is SPEAK UP. At this session, I (the author) sat at the teletype, and I "spoke" to ELIZA, and my first remark was "I WISH YOU WOULD EXPLAIN YOUPSELF". The alternate lines were uttered by ELIZA and by me.

```
(WORKER)
SPEAK UP!
I WISH YOU WOULD EXPLAIN YOURSELF

WE WERE DISCUSSING YOU - NOT ME

WHY ?

WHY INDEED

YOU ARE NOT VERY CLEAR.

WHAT MAKES YOU THINK I AM NOT VERY CLEAR

ARE YOU ELIZA?

WHY ARE YOU INTERESTED IN WHETHER I AM ELIZA OR NOT

YOU REMIND ME OF JOE WEIZENBAUM'S PROGRAM ELIZA.

IN WHAT WAY

YOU BEHAVE LIKE HER.

OH, I BEHAVE LIKE HER

YOU SURE DO.

IS THIS REALLY RELEVANT TO YOUR PROBLEM

I THINK IT IS AND YOU CAN'T REALLY SHOW ME THAT IT IS NOT RELVEANT.

PERHAPS I DO CAN'T REALLY SHOW YOU THAT IT IS NOT RELVEANT

DEFUN WORKER.

I AM NOT SURE I UNDERSTAND YOU FULLY

GIVE THE DEFINITION OF WORKER.

I AM NOT SURE I UNDERSTAND YOU FULLY

EXPLAIN YOURSEFL SAYING WHAT YOU ARE DEFINED AS.

TELL ME ABOUT WHAT I ARE DEFINED AS

YOU ARE DEAF AND STUPID.

DOES IT PLEASE YOU TO BELIEVE I AM DEAF AND STUPID

NO I WOULD RATHER YOU BE CLAER AND INTELLIGNET.

ARE YOU SAYING 'NO' JUST TO BE NEGATIVE

YOU ARE DESIRED TO BE CLEAR AND INTELLIGENT.

PERHAPS YOU WOULD LIKE TO BE DESIRED TO BE CLEAR AND INTELLIGENT
```

6. *Meanings Derived from Observations of a Generalized Environment.* The genie cannot "look" at a generalized environment and understand the significance of what it "sees". For example, it cannot "look" at a traffic intersection, "know" which lights are the traffic lights, make a judgment of the traffic, and proceed through the intersection safely and sensibly.

With this appraisal of the powers of the genie—the interactive programmed computer—we should be better able to include in its behavior (its programming) the features that we desire, and thus obtain the efficient and comfortable assistance of the computer in computer-assisted activities of many, many kinds. ☐

WORLDWIDE

REPORT FROM GREAT BRITAIN

Personnel Shortage

Users of data processing equipment in the United Kingdom are no happier about staff shortages than their counterparts in the United States. As matters now stand, on the doorstep of the 70's, we have just over 24,000 programmers in commercial mark. By 1973, to meet projected needs, there should be 56,000, which means training at least 12,000 a year for the next three years.

No one here has given a guesstimate of the numbers trained each year, but I gather they are far below this desirable target figure and the inference is that our present shortage will look like plenty in three years time.

This is why the UK off-shoot of Brandon Applied Systems is confident that contract programming is going to grow at an unprecedented rate, which is fine for software consultancies and suppliers.

Dick H. Brandon, over here on one of his many quick "look-sees", told me that only the educational market was likely to expand at a faster clip, now that IBM was showing so little interest in training programmers. But he warned that his company would not be offering courses open to all. Industrial groups would be invited to send their selected staff for training as programmers on contract, and that would be all. "Too many so-called schools have mushroomed, collected and closed down when their inadequacy is revealed", he said.

Leasing

The end of the leasing bonanza in the U.S., and the failure of British leasing to take off at the steep pitch it did in America, seems all to the good for the industry as a whole. It is doubtful that lessors would move back on to the buying market "if and when we see the fourth generation". But the bubble had burst, and some leasing companies were keeping the wolf from the door only by the most prodigious efforts of legerdemain — such as creating strings of bureaux based on obsolete machines, collecting business by quoting non-profitable rates, and thanking their lucky stars that the ensuing losses were gentler on their stockholders' nerves than total write-off.

If a computer is defined as a "beast" costing about $70,000 or more, the UK computer population is currently estimated by a private source as being 4100 machines installed or on order. The Ministry of Technology census over the past several years, however, lists a total computer population of around 7000. Their census, however, includes sophisticated accounting machines priced as low as about $10,000, because the Board of Trade defines these lower-priced machines as computers, and allows companies who own them a tax rebate on them as an investment in modernisation. The Ministry of Technology is well aware of the basic definition of a computer, and realizes that these sophisticated accounting machines are not really computers. But because of the tax dollar advantage in calling them computers, the Ministry has so far not quibbled over terms.

Computers and Politics

I do not normally go in for rumours. But we may be, as I said before, a step away from a change of Government, so there are many options being taken out right now. The latest one rumoured about is that the Plessey Company (microcircuits to avionics and hydraulics) wants to take a much larger share of International Computers, the British company in which the Government has a 10.5% stake and Plessey an 18% stake. These shares represent £10½m and £18m respectively.

But under Labour, the heads of agreement require Government accord before there can be any change in company status. I am sure, however, that the Tories would not need more than a moment's thought to get out of the business. The way might thus seem clear, given a change of Government, for Plessey to take more or all of ICL as a captive market for its electronic components and — it is expected — a vastly expanded range of terminal equipment (see this space in early 1970).

There is one fly in the ointment. General Electric Company of Britain also has an 18% stake in ICL. It also manufactures circuits and while it is preparing a new range of process control computers which will provide a captive market for GEC/Marconi circuits, the much larger ICL market is no doubt attractive too.

It looks as if the UK computer scene is going to become much more lively as the politicians take to the hustings.

Ted Schoeters
Stanmore, Middlesex
England

ACROSS THE EDITOR'S DESK

Computing and Data Processing Newsletter

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APPLICATIONS

SEARCH FOR NEW DRUGS TO COMBAT MENTAL ILLNESS AIDED BY COMPUTER

By analyzing the influence of drugs on the brain, scientists hope to find new compounds for treating depression, psychoses and addiction. To aid them in their investigations, scientists in the Department of Psychiatry at New York Medical College are using an IBM 1800 data acquisition and control system. Under the direction of Drs. Max Fink and Donald Shapiro, Professors of Psychiatry, the faint electrical signals generated by the brain are recorded on tape for computer analysis.

The computer is used to classify and identify brain wave patterns known as electroencephalograms (EEG) which are used in connection with their studies. The brain waves provide a measure of such behavioral states as euphoria, alertness, fantasy, anxiety or irritability. Different dosages of drugs often show up in different EEG patterns. Dr. Fink believes an EEG is a reliable and recordable "quantifiable test" of such mental states and is particularly helpful in defining compounds that are antagonists to opiates and hallucinogens.

Applications of the EEG classification projects have been found in treating therapy-resistant psychotics and opiate addicts. In programs for treating opiate addicts, each patient is tested with different compounds while observing the changes in EEG and in clinical symptoms. The EEG reflects each person's individual responses to a drug, and to each antagonist. "We try to treat each subject with the best available antagonist," Dr. Fink explained.

By measuring the types of change, the rate of change and interactions following administration, it is possible to classify drugs affecting the central nervous system. This data is the basis for studies of new drugs and new applications for existing drugs.

COMPUTER REPLACING TEST TUBE IN SOME AREAS OF CHEMISTRY

Mathematical "models" of chemical compounds and chemical reactions now make it possible for the computer to replace the test tube in some areas of chemistry research. At the Atomic Energy Commission's Argonne National Laboratory (Illinois), Dr. Arnold C. Wahl, a chemical physicist, and his colleagues in Argonne's Chemistry Division use large computing systems and precise mathematical models to look at chemical processes such as the formation and excitation of molecules. These models are now giving reliable chemical information. "This work is most properly viewed as a 'new instrument' for the chemist," according to Dr. Wahl.

The computer "experiment" — during which the computer can display pictures on a television-type screen — provides a "zoom lens" and a "stop action" camera for making a close examination of the chemical process. The procedure can magnify a molecule a billion times, "slow down" or "stop" molecular formation, or "freeze" and concentrate on a particular step in the process.

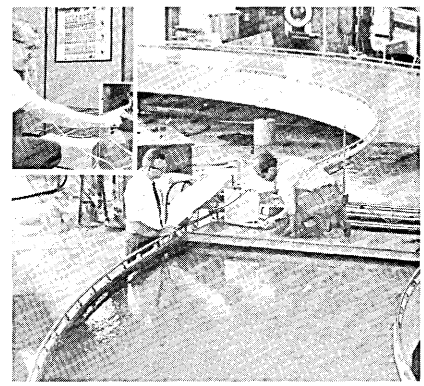
The use of the mathematical model is described by Dr. Wahl as follows: "We approximate the distribution of electrons inside an atom or molecule by some mathematical form. In order to create accurate pictures of a chemical process, we put a mathematical model of the molecule into a computer, and then refine the model by making multiple passes inside the computer, molding and changing the model until we arrive at a very good physical description of the chemical system."

A new result of this work is a set of six computer-based motion pictures showing in great detail the processes of molecule formation in terms of accurately calculated electron diagrams. These diagrams display how the concentration of electrons changes when two atoms form a stable molecule. Dr. Wahl believes the computer-mathematical model technique is bringing closer the day when every experimental chemist will have a teletypewriter and a TV screen in his laboratory to which he will turn for answers to many of his chemical questions. Such a machine for studying diatomic molecules is being developed at Argonne.

ENGINEERS MAP MISSOURI RIVER BED WITH AID OF COMPUTER

Research engineers at the University of Iowa (Iowa City) are mapping the Missouri River bed with the aid of an IBM 1800 Data Acquisition and Control System (shown in picture insert). The project is sponsored by the U.S. Army Corps of Engineers, Missouri River Division, which operates the dams on the Missouri. The Iowa Institute of Hydraulic Research at the University is gathering and interpreting the information. One goal of the project is to understand more accurately the relationship between river depth and water discharged from dams upstream. This would help engineers better meet demands placed upon rivers.

The computer system processes and analyzes data obtained on the river's profile by means of sonic sounding equipment and stored on magnetic tape. The data, consisting of bed elevations at one-foot intervals, provides a detailed numerical profile of the ever changing topography of the ripples, dunes and bars in the river bed. The information is used to determine how the river bed influences the river level.



To test their theories of river-bed configuration on flow depth, the engineers built a 120-foot-long model of a meandering river (shown above). This model is used to study the effects on flow depth of the ripples, dunes and bars under varying flow conditions. The study should make it easier to control the mighty Missouri for navigation and lead to the development of better flood control programs.

MATCHBOX-SIZE COMPUTER CAN LEAD TO MORE AUTOMOTIVE SAFETY AND DRIVER CONVENIENCE

A matchbox-size computer attached to the dashboard soon may be telling auto drivers when rear doors aren't locked, when they're backing into a tree or advising them that a headlight is not working. Hooking the car's computer into a diagnostic computer will permit an inexperienced mechanic to locate a mechanical problem in seconds. These are only a few of the 1,000 tasks possible in the computerized system for cars recently announced by Essex International (New York).

The system, called CEDAC (Computerized Energy Distribution and Automated Control System), contains a digital central computer the size of a match box. It is connected to a single energy distribution and control harness which is routed throughout the vehicle to sensors and actuators about the size of nailheads. The sensors detect mechanical failures and flash this information on a display panel located before the driver. The system concept virtually does away with the present-day automotive electrical system by eliminating most of the terminal connectors and electrical wires. No moving parts are involved in the computer or sensors, and they can be installed anywhere in the vehicle, facilitating automotive design, assembly procedures and reliability.

CEDAC also can initiate a number of functions such as automatically locking doors at a predetermined speed, climate control, braking, anti-skid and fuel injection. The display panel can provide the driver with instantaneous readouts of engine revolutions per minute, oil pressure, fuel level, engine and car temperatures, among other items. Additionally the system can warn drivers when they are too close to other cars, objects or unseen persons.

Although a CEDAC prototype now is installed in an operating vehicle, it will take several years for the system to be totally integrated into production. Automobiles are changed only on a gradual basis and the industry is unlikely to accept revolutionary changes in a hurry.

SANTA CLAUS AND HIS "ELECTRONIC ELF" MAKE READY FOR DEC. 25TH

Who among us can forget the eager anticipation of Christmas morning? Will Santa remember? Are there enough teddy bears, dolls or dogs? Thanks to a computer and Fisher-Price Toys, Inc. (East Aurora, N.Y.), Santa has more help this year as he prepares for his Christmas Eve journey. Printout from Fisher-Price's computer system (shown below) gives

Santa Claus (Billie D. Lucas) information he needs for his December 25th delivery. Frank Yaverski, production manager at the East Aurora plant, checks with Santa.

Using a GE-406 computer and GE's computer technique called Integrated Data Store (I-D-S), Fisher-Price, a leading manufacturer of pre-school toys, now is able to tell for the first time what is selling well in what part of the country (and 60 other countries) — and what is needed to fill the orders. The Fisher-Price line includes 71 different toys, each containing 30 to 40 parts. Over 25 million toys will be produced by the company this year.

EDUCATION NEWS

SOUTHERN COLLEGE OF BUSINESS COMPUTER IS ADAPTED FOR BRAILLE OUTPUT

Blind students who must use Braille will begin studying computer programming this month with the aid of the Southern College of Business's NCR Century 100 system and a new printer. The College, located in Orlando, Florida, has been using the NCR Century 100 for some time on other types of EDP instruction.

This particular application will employ an eight-lines-per-inch printer with the computer, and use a special conversion program to change the system's normal printed output into the Braille pattern of dots. Impressions in the paper will be made by increasing the force of the print hammers and having them strike through a specially-designed sheet of thin felt which tends to "explode" the dots.

The Southern College of Business recently won the Florida Governor's Award for its work in training the handicapped.

NATION'S WAR WOUNDED TAKE PROGRAMMING CLASSES THROUGH THE 52 ASSOCIATION, INC.

A group of seriously wounded Vietnam servicemen, currently under treatment at St. Albans Naval Hospital, Queens, New York, are studying to become computer programmers, via a class installed in the hospital by the 52 Association, Inc. The 52 Association is a non-profit philanthropy dedicated to serving the needs of our nation's disabled servicemen.

This class, the third to be offered by the 52 Association, is under the direct sponsorship of the Chase Manhattan Bank. Chase Manhattan has hired graduates of previous programs and, based on their performance to date, has agreed to hire all qualified graduates of the course in its Systems Design Division. In addition, according to William W. Shine, a Chase vice president, "this course is expected to be only the first of a series of such courses which will be given in local military hospitals by the 52 Association, under the bank's sponsorship. . . ."

The computer programming class, while accelerated for completion within a three-month period, maintains the usual number of class hours equivalent to standard six-month commercial courses. It is being given by Michael Moss, a professional computer programming instructor who also teaches (and practices) commercially. In this course, he is following all the acceptable standards and procedures prescribed by industry in accordance with the basic outline which he has developed for past courses. He will, however, extend the syllabus slightly, to include lectures on specific equipment and applications relevant to Chase Manhattan's computer activities.

MEDICAL STUDENTS SERVE AS PRACTICING PHYSICIANS TO "PATIENTS" IN MEMORY OF COMPUTER

The University of Illinois Medical Center campus in Chicago has disclosed a new learning technique in which a medical student serves as practicing physician to a "patient" existing only in the memory of an IBM computer. The advanced learning technique enables students to engage in common English dialog with the computer-simulated patients through TV-like devices linked to an IBM 1130 computer.

Students gain realistic experience as independent decision-makers in the critical areas of diagnosis and treatment. Traditional clinical instruction rarely provides a student with the opportunity to observe a case from the initial encounter with a physician to final care — and since they are not fully qualified and licensed physicians, they can never make completely independent, imaginative decisions. The simulation program removes these restrictions and the student becomes the doctor. If his judgment proves to be fatal, the Lazarus-like 'patient' can be brought back to life at the press of a button. The program was developed under a $215,000 grant from the National Institutes of Health.

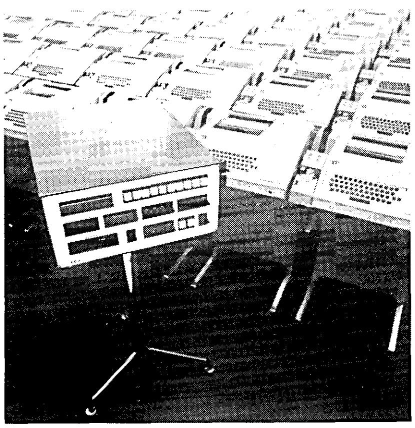
NEW PRODUCTS

Digital

MICRO 812 SYSTEM / MicroSystems Inc.

Basic configuration of the new MICRO 812 System includes a microprogrammed processor with a systems control panel, power supply, 4096 x 9 bit core memory, power-fail/automatic restart, memory parity, a real-time clock, and six communications interface boards. All internal components, power supply and options are enclosed in a cabinet 8-3/4" high, 17-3/5" wide and 23" deep.

Designed specifically for data communications applications, the MICRO 812 System can interface up to 96 low speed lines and up to



32 medium speed lines; special configurations will accommodate up to 6 different simultaneous baud rates. The system also is capable of handling mixed combinations of communication devices at one time, including low speed asynchronous modems, medium speed synchronous modems, teleprinters, and binary devices.

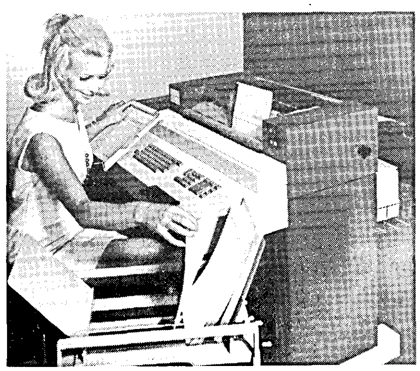
In addition to its data communications capabilities, the 812 is a powerful general-purpose minicomputer in its own right. Third in a series of microprogrammed, low cost digital computers developed by the firm, it has a repertoire of 83 instructions including 17 control instructions, 16 conditional jumps, 12 shifts, 6 input/output instructions, 16 register operate instructions, and 16 memory referencing instructions.
(For more information, circle #41 on the Reader Service Card.)

P-350 OFFICE COMPUTER SERIES / North American Philips Corp.

Philips' family of low cost computerized accounting machines (for invoicing, accounts receivable, payroll, inventory control, general ledger and all related reports) is comprised of three basic systems with pre-programmed software packages and a wide assortment of peripheral equipment. The new office computers — P-351, P-352, P-353 — utilize core memory for data and program storage as in larger, costlier installations. Core storage capacity varies from 300 to 1200 words; cycle time is 3.2 microseconds; and average execution time per 3 address command is 1.5 milliseconds.

The P-350 Series can add up to 16 peripherals on-site, with four operating, simultaneously, at high speed. The Series can handle standard punch cards, paper tape or magnetic cards — or any combination of these. A wide variety of hard copy forms can be used with the system, including continuous forms, standard ledgers, magnetic ledgers, etc.

Operation of the Philips office computers is quite simple and easy to learn. Programming is via a few punch cards with only 14 basic instructions needed for any routine.



Operator skill is not a critical consideration. The computer tells her what to do and checks for correctness.

The new office computers will be delivered as total hardware software packages. Installations of the P-350 are simple and do not require special site preparation, electrical wiring, or air-conditioning. Only 24 square feet of floor space is needed for any unit in the series.
(For more information, circle #42 on the Reader Service Card.)

MODEL A, A SYSTEM-ORIENTED COMPUTER / Multidata

The Model A, a system-oriented computer, includes in its basic configuration 4096 16-bit words of core memory, 32,768 words of disc memory, a memory access controller, a central processor, an input/output bus, and a teletypewriter with paper tape reader and punch.

The core memory and the disc memory work together through the Memory Access Controller to provide large memory capacity. Operating at an 880 nanosecond cycle time, each 16-bit 4096-word memory module is independent and asynchronous. The Model A accommodates up to 16 modules (65,536 words), and field installation is easy; each module requires the insertion of one printed circuit board assembly. The 32,768-word disc is field expandable to 65,536 or 131,072 words; average access time is 17 milliseconds.

Model A programming systems include a FORTRAN IV compiler, a macro-assembler, a utility package, a diagnostic package, and a monitor that optimizes core/disc page transfers while keeping them transparent to the user's program.
(For more information, circle #43 on the Reader Service Card.)

RC 77 SYNERGETIC PROCESSOR / Redcor Corp.

The RC 77 Synergetic Processor incorporates two RC 70 Midi computers as processing elements. The two computers are under control of Redcor's new Synercizer and a software system combining a real time monitor (RTM) and a batch processing monitor (BPM). The two processor concept provides a redundancy factor, assuring 100% uptime.

The RC 77, with a 20 to 65K memory, and a million word disc memory, has been designed to cope with the problem of processing two tasks concurrently. Real-time data acquisition can be accomplished at the same time as background processing, with no loss in computer efficiency. No time is lost in swapping or exchanging data between core and disc, and both programs are resident and operating simultaneously.
(For more information, circle #44 on the Reader Service Card.)

PDS-1 SYSTEM / Imlac Corp.

The PDS-1 System may be purchased (or leased) as either a display or as a mini-processor. The system incorporates a 4K mini-processor with a cathode ray display for input/output ability. The 4K memory may be expanded to 32K in 4K increments, with the associated logic.

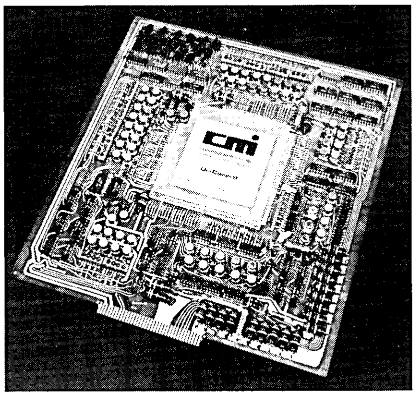
As a communications terminal, PDS-1 can replace any on-line, electro-mechanical device without modifying the central system nor the present communications facilities. The controller is pre-programmed to simulate the exact char-

acteristics of the terminal it replaces. The terminal can function from 1 to 9600 baud using any bit structure or code level.
(For more information, circle #45 on the Reader Service Card.)

Memories

UNICORE-9, A SINGLE-CARD CORE MEMORY / Cambridge Memories, Inc.

A complete memory system on a single plug-in card, called the Unicore-9, is designed for use in calculators, data terminals, digital and numerical controllers, and communications buffers. The random-access memory has 300-nanosecond access time and one-microsecond full-cycle time. It stores up to



1,024 nine-bit words, and is available in eight-bit word length. The entire memory is mounted on an 11 x 11-3/4 inch card that plugs into a 72-pin connector. Component height is less than six-tenths of an inch.
(For more information, circle #46 on the Reader Service Card.)

RAPID ACCESS MASS MEMORY SYSTEM / Electronic Engineering Company of California

The 1640 Disc Tape is a newly patented magnetic tape system whose performance falls between that of tape and disc systems. The new tape drive system employs a direct contact, single drive capstan principle. Threading posts, tension arms, and other tape tension and take-up mechanisms have been eliminated. Both the take-up and supply reels come into direct contact with the capstan, the only motor driven device in the system.

The 1640 is a multi-tape device (2, 4, 6 or 8 reels) capable of storing up to 30 million 8 bit bytes with an access time of 30 seconds or less, and a data transfer rate of over 16 thousand bytes per second. Tape speed is 90 inches per second. Each tape operates independently and is completely interchangeable.
(For more information, circle #47 on the Reader Service Card.)

DISC MEMORY FOR SMALL COMPUTERS / Applied Magnetics

Model M 200C Disc Memory, a fast access, head-per-track type mass memory, has been designed specifically for today's small computers. It is available in four capacities ranging from 426,000 to 3,408,000 bits; average access time is 8.7 milliseconds. The number of data tracks varies from 16 to 128 with 26,624 bits per track. Three timing tracks are included providing a bit clock, sector and origin pulse. With electronics, the Model M 200C Disc Memory weighs 50 pounds and occupies 8-3/4 vertical inches in a standard RETMA rack.
(For more information, circle #48 on the Reader Service Card.)

10-MILLION BIT DISC MEMORY SYSTEM / Magnafile, Inc.

The Model 9330, a new member of Magnafile's low-cost, head-per-track disc memory systems, includes data storage of 10.24 million bits, 128 data tracks, and head-per-track data recovery. An average access time of either 8.3 or 16.6 milliseconds is available.

The 9330, for users who require mass storage but cannot resolve the larger and more expensive systems, offers a very low cost-per-bit — less than one-tenth of one cent.
(For more information, circle #49 on the Reader Service Card.)

UNICON LASER MEMORY / Precision Instrument Co.

A data storage device that stores 26 million digital bits in just one square inch of recording medium was shown for the first time at the recent Fall Joint Computer Conference in Las Vegas, Nevada. By using a laser beam to permanently etch digital bits in its "Unicon" mass memory device, the Precision Instrument Co. can put literally a trillion bits of data on-line. The extreme efficiency in storing data (a single 4" x 31" data strip holds the equivalent of over 25 reels of ordinary computer magnetic tape) reduces the cost per bit of Unicon data storage to under $1 per million bits. Price tag of a typical Unicon system, including software, is about $1 million. The memory shown at FJCC is only 4' by 7' by 5' high.

The laser mass memory concept, nearly eight years in development, will first be put to work in conjunction with an IBM 360/75 system by Pan American Petroleum Corp. They purchased their Unicon system for storage of seismic data used in oil exploration.
(For more information, circle #50 on the Reader Service Card.)

HEAD-PER-TRACK MEMORY SYSTEM / Systematics/Magne-Head Div. of General Instrument Corp.

The head-per-track removable media rotating memory system, called DISKSTOR 505 Memory System, is a combination of the DISKSTOR 500 drive and the DISKPAC 005. Memory capacity for the DISKSTOR 505 System is 5 million bits; average access time is 8.7 ms. The system is designed for small to medium size central processing units. It meets the requirements of both batch processing and real-time applications.

The DISKSTOR 505 Memory System eliminates the need for a separate controller. This Series incorporates the controller electronics in the drive unit. Initial deliveries are scheduled for September 1970.
(For more information, circle #51 on the Reader Service Card.)

Software

ACCOUNTS RECEIVABLE SYSTEM /Executive Computer Systems, Inc., Oak Brook, Ill. / A proprietary computer software designed for both private users and service bureaus, System can process both on an open item and a balance forward basis. The system is written in COBOL and consists of 22 programs and sorts. Originally designed for the IBM 360/30 either in tape

or disk configuration, the system is upward compatible on large 360 configurations and will run on Honeywell 200 series or Burroughs B-3500 systems.
(For more information, circle #52 on the Reader Service Card.)

BANKSERV® CHECK-CREDIT AND OVERDRAFT ACCOUNTING SYSTEM / Arthur S. Kranzley and Co., Cherry Hill, N.J. / System automatically creates and processes new loans triggered by checks or demand deposit overdrafts. Statements produced are keyed to Regulation Z (Truth in Lending); they include full descriptions of each charge incurred and payments applied. Written in COBOL, the new system operates on an IBM 360/30 or an RCA Spectra 70/45. The system is available now to banks which are providing depositors with any form of check credit or overdraft service.
(For more information, circle #53 on the Reader Service Card.)

CLINICAL LABORATORY DATA ACQUISITION SYSTEM / IBM Corp., White Plains, N.Y. / A program enabling hospitals to link dozens of laboratory instruments directly to a computer for automatic monitoring and reporting of test results. The system operates under the IBM 1800 Time Sharing Executive (TSX). The Clinical Laboratory Data Acquisition System will be available in January under a license agreement for a monthly charge of $100.
(For more information, circle #54 on the Reader Service Card.)

LINEAR "A" / Academy Computing Corp., Phoenix, Ariz. / A package of file compression routines designed to compact alphabetic data stored on tape or disc; routines are designed to allow users of time-sharing computers to "shrink" their files. However, they may be used by anyone who has large files of alphabetic data. The LINEAR "A" package can be adapted to any digital computer.
(For more information, circle #55 on the Reader Service Card.)

PICNIC (PERA Instructional Code for Numerical Control) / PERA, the Production Engineering Research Association of Great Britain, Leicestershire, England / A simplified, computer-aided programming system reported to permit time savings of up to 80% over manual programming for typical point-to-point Numerical Control machining and 60% for data preparation. Logically related to Auto Program Tool (APT) systems, PICNIC employs a subset of only 40 major words from the APT vocabulary. The system can be used with any small computer providing USASI FORTRAN IV facility. Semi-skilled operators can be trained to full competence in two weeks.
(For more information, circle #56 on the Reader Service Card.)

SCUP / C&A Computer Associates, Inc., East Orange, N.J. / A third generation utility package for Spectra 70 users; enhances normal tape/card/printer and card/tape/printer options which are required for efficient program debugging and as an operations aid. Options include: selective record extraction; tape positioning capabilities; flexible re-blocking. SCUP is designed to that features can be used either independently or in conjunction with any other option in the same pass.
(For more information, circle #57 on the Reader Service Card.)

Peripheral Equipment

CONTROLLER INTERFACES CALCOMP PLOTTERS AND NCR CENTURY SYSTEMS / California Computer Products, Inc.

CalComp's new controller will interface various CalComp plotters with NCR Century systems. Three types of plotters are being offered: drum, microfilm and flat bed. The plotters produce ink-on-paper or microfilm plots of computer output data.

CalComp will market its equipment directly to NCR Century computer users. The controller which is required for the CalComp-NCR hookup is designated the Model 119 and can be purchased outright.
(For more information, circle #58 on the Reader Service Card.)

DIRECT ACCESS MAGNETIC TAPE TRANSPORT SYSTEM / Sykes Datatronics, Inc.

The COMPU/CORDER® 100 is a high-speed, direct access tape transport system for mini-computers. The cassette-loaded system has high-speed, bi-directional direct access capability. The user can access any file on a tape, containing 3.6 million bits of information, within an average of 15 seconds. Read/write speed is 5 inches/second; bi-directional search/fast rewind speed is 120 inches/second.

The COMPU/CORDER® is provided with comprehensive software and complete interfacing to DEC, Varian and Data General mini-computers. Other interfaces are available as an option.
(For more information, circle #59 on the Reader Service Card.)

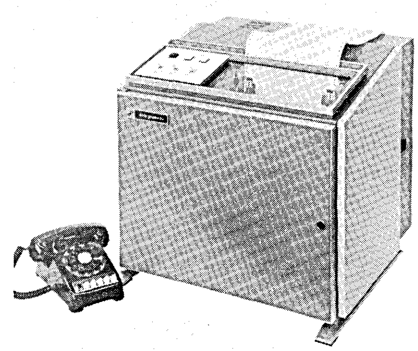
DA-G60 TAPE SYSTEM / System Industries, Inc.

DA-G60 is a low-cost, 4-million-plus word storage addressable magnetic tape unit for minicomputers. The word transfer rate is 16.6KC and its average access time is 7.7 seconds. The unit's self-threading system consists of a controller and up to 8 tape units.

One special feature is its capability for fixed position, block addressable formatting, which, in conjunction with bidirectional search capability, allows selective updating of data via random access.
(For more information, circle #60 on the Reader Service Card.)

MINI-PRINTER / Data Products

Data Products' mini-printer is called the 2310 LINE/PRINTER. It has a drum speed of 1760 rpm and produces listings as fast as 1110 lpm for 20 columns and also prints at a speed of 356 lpm for a full 80 columns.



The 2310 also is being engineered into a fully integrated communications terminal called the Data Terminal 8280 with Binary Synchronous Communications for 8-level USASCII code with 63 printable alphanumeric graphics.
(For more information, circle #61 on the Reader Service Card.

ASCII-CODED I-O TYPEWRITER / Electronic Engineering Company of California

EECO 1651 is an ASCII-coded, I-O typewriter, modeled around a Selectric typewriter. It can operate on-line at 15.3 char/sec with low power requirements. The 1651 can be used in three ways: (1) in on-line operation, the 1651 is a keyboard-printer for transmitting and receiving data; (2) when interfaced with an I-O bus, the EECO 1651 functions as an I-O typewriter; and (3) when interfaced with a data set and phone lines, it functions as a remote computer terminal.
(For more information, circle #62 on the Reader Service Card.)

COMPUTER EXPANDER INTERFACES WITH IBM 1130 / Paragon Systems, Inc.

Comp Ex is a new hardware/software interface system that extends the IBM 1130's capabilities to an on-line, real-time basis. Its functions include: multiplexing from 2-32 devices (i.e. teletypes, data phones, CRT and digital displays etc.); outputting information to operate relays, close contacts, and start or stop experiments and processes. All Comp Ex functions are supported by system programming which is accessible from FORTRAN or Assembly language and interfaces with the 1130 Monitor System.
(For more information, circle #63 on the Reader Service Card.)

KEYLOGIC DATA ENTRY SYSTEM / Penta Computer Assoc., Inc.

KeyLogic is a complete multiple station data entry system designed to operate at nanosecond speed and with sufficient capacity to allow users to utilize the full potential of their computers. The system has five hardware components: (1) a terminal with an IBM 029 keyboard where the CPU identifies and permits correction of errors before data is recorded directly onto a single computer-compatible magnetic tape; (2) a tape unit with full-size synchronous drive tape station; (3) a disc unit which stores 2-million characters, has a fixed read/write head, and a 17 millisecond access time; (4) a CPU with an 860 nanosecond cycle and a 16-bit word unit; (5) an IBM Selectric console.

The KeyLogic system can accommodate up to 64 complete terminals on one tape/disc system, and can be oriented to specific application requirements of users.
(For more information, circle #64 on the Reader Service Card.)

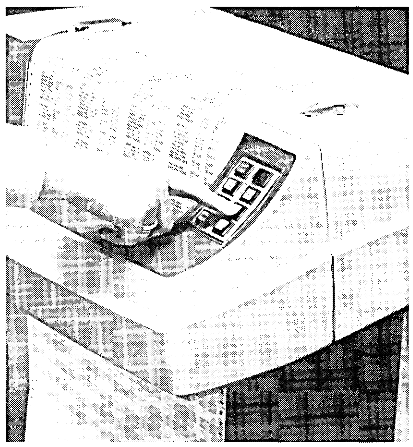
INTERACTIVE DISPLAY SYSTEM FOR PDP-15 / Digital Equipment

The VT15 is a low-cost, interactive graphics display system which includes a VT15 Graphics Display Processor and a VT04 Graphics Display Console for use with the PDP-15. It can be used as a basic graphics processor, a terminal, or to format and display information from a data file.

Software available with the system at no extra cost will include a FORTRAN and MACRO primitive package, and a text editor. The software permits users of the VT15 to store material generated on the display and obtain printed reproductions of the data on an optional copying device or plotter.
(For more information, circle #65 on the Reader Service Card.)

MINI LINE PRINTER FOR MINICOMPUTERS / Nortec Computer Devices, Inc.

Nortec Computer Devices, Inc.'s first "miniperipheral", a low-cost, desk-top line-printer, called Nortec 200, is designed primarily as a printout device for minicomputers. The ASCII-coded Nortec 200 also functions in remote terminal stations.



This mini printer will print data at 200 lines per minute up to 132 columns, and has a 64 alphanumeric character set. Font styles can be easily changed since the characters are on an easily handled low-cost belt.
(For more information, circle #66 on the Reader Service Card.)

DIGITAL CASSETTE RECORDER / Computer Displays, Inc.

The Digital Cassette Recorder connects between Data Sets and the ARDS Computer Terminal. It allows a user to record, at fast rates, the digital signals received from the Data Set and replay them anytime.

The computer connection can be broken and the data played back one frame at a time, or the recorder can be used for testing terminal operation, independent of the computer and communication system.
(For more information, circle #67 on the Reader Service Card.)

MAGNETIC TAPE ENCODER / Data Input Devices

Data Input Devices' new magnetic tape encoder can be used with any computer system. The 8½ pound encoder has an endless number of programming capabilities. By means of its video monitor positioned above the keyboard, the operator can visually verify all material as it is being programmed. An operator can be fully trained in the use of the encoder in less than a day. The encoder, available in both numeric and alpha-numeric models, may be leased or purchased.
(For more information, circle #68 on the Reader Service Card.)

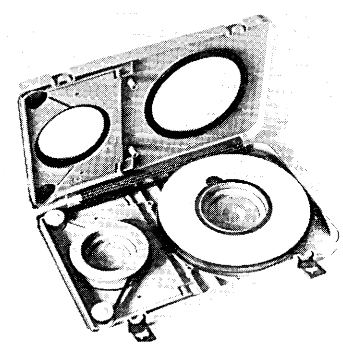
Data Processing Accessories

TEST MESSAGE GENERATOR / Atlantic Research Corp.

A compact new device, the TMG-10, can sent test messages at precise speeds and distortion levels to check capability of data transmission equipment, now widely used in computer and telegraph services. The portable ten-pound test message generator also can exercise I/O devices, check polling functions, verify parity-check circuits, adjust bias in carrier channels and identify the transmitting station to the receiving test center. The TMG-10 contains two factory programmed test messages and a manually programmable two-character message. It measures 9-1/2" wide x 6-5/8" high x 12" deep.
(For more information, circle #69 on the Reader Service Card.)

COMPUTER CARTRIDGE / Data Packaging Corp.

The computer-compatible cartridge replaced key punches for data transcribing. A standard 8½ inch tape reel with up to 1200 feet of ½ inch computer tape is placed in the cartridge along with its own take-up reel. Vacuum operated, spring loaded plates lock the two reels and pre-threaded tape during storage and shipping. When inserted



into a specially designed tape transport, the cartridge's two doors open automatically, thus allowing the tape to be loaded by an automatic threading machine.
(For more information, circle #70 on the Reader Service Card.)

COMPUTING/TIME-SHARING CENTERS

FULL-SCALE COMPUTATION SERVICE TO BE AVAILABLE TO NUCLEAR INDUSTRY

Control Data Corporation and Nuclear Computation, Inc. recently announced that they will offer a full-scale advanced computation service to the nuclear industry. Control Data will augment its Washington, D.C., CYBERNET® Service Center with 150 million characters of on-line storage required to handle Nuclear Computation's library of nuclear programs. The computer programs will be commercially available on a nation-wide basis in conjunction with a Control Data 6600 computer.

Nuclear Computation, Inc., is establishing a Nuclear Data Center at its Pittsburgh headquarters. It has placed an order for a CDC 6000 Series computer which will be installed in the Pittsburgh computation center. Presently Nuclear Computation, Inc. has a multiple access remote computer high speed terminal, linked by broadband communication lines into the Control Data CYBERNET® Service system.
(For more information, circle #71 on the Reader Service Card.)

NATIONAL TIME SHARING NETWORK ESTABLISHED BY VIP SYSTEMS

Completion of a nation-wide computer time sharing network that includes eight major cities has been announced by Miss Joan Van Horn, president of VIP Systems, Washington, D.C. Offices were opened earlier this year in New York and Boston and new offices have been opened recently in Los Angeles, San Francisco, Chicago, Cleveland and Philadelphia. All seven branch offices are served from VIP's computer center in Washington.

APL COMPUTING SERVICES OFFERS TEXT EDITING SYSTEM

Through a series of multiplexers, Marquardt's APL Computing Services offers the ATS/360 text editing system to customers in the San Francisco Bay area, San Diego, Orange County, Chicago, and the Los Angeles area, home base of their IBM 360/50 computer. Competitively priced, it parallels Datatext service and is essentially compatible with it. ATS/360 also provides remote batch processing, allowing customers to utilize their own programs.
(For more information, circle #72 on the Reader Service Card.)

COMPUTER-RELATED SERVICES

BUSINESS EVALUATION SERVICE FOR SMALL CONCERNS USES CASH REGISTER TAPES

Smyth Business Machines, Inc., Canton, Ohio, has developed a system for analyzing the profitability of small businesses through computer analysis of cash register tapes. Store owners mail tapes from their cash registers, either on a daily or weekly basis, to Smyth's computer center. The tapes are run through a paper tape reader and the information is fed into one of six IBM computers in use there. The computers analyze all sales data and produce reports which identify such things as sales by class, by item and by price range within a given product type. Within eight hours after cash register tapes are received, the various performance reports prepared are in the mail to the customer.

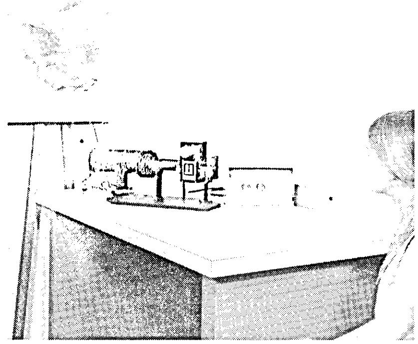
The IBM computers are programmed to produce monthly and yearly sales totals to be used by owners for comparison and planning purposes. Smythe currently provides this and other such services as accounts receivable to some 3,000 stores across the country processing paper tapes from more than 10,000 registers on a continuing basis.
(For more information, circle #73 on the Reader Service Card.)

RESEARCH FRONTIER

ELECTRO-OPTICS DEVICE MAY PROVIDE MACHINE "EYES" TO AID COMPUTER "BRAINS"

An eye-movement-tracing device that may be a step in the direction of giving machines "eyes" to aid computer "brains" in making decisions has been invented by John Merchant at Honeywell's Radiation Center in Lexington, Mass. The device, called a remote oculometer, has been about five years in development by Merchant.

This is the way it works: a fine beam of infrared radiation — invisible and harmless to the eye — is focused on the eye. Separate reflections bouncing off the retina and cornea inform an image dissector (electro-optic sensor) about all eye movements. The device does not need to be attached to the person using it, and thus avoids the problem of vision-research instruments that require the person being tested to be motionless.



The National Aeronautics and Space Administration is interested in the device as a possible means of making working conditions more comfortable for astronauts. Other possible applications are in air traffic control or other places where man scans a machine or radar screen for information. A worker watching a production line could work immediately to correct a flaw by just looking at something: stopping the eye movement on a flaw would signal to a computer or machine that corrections were needed at a particular point.

ALTERABLE MASS MEMORY BEING DEVELOPED

A new beam-addressable computer mass memory system that would permit stored data to be altered is being developed by Energy Conversion Devices, Inc., Troy, Michigan. The new memory will also provide packing densities in the order of 10-million bits/square inch.

The new mass memory is based on a reversible electrical switching phenomenon discovered in various amorphous semiconducting materials. Information would be entered into the system by "writing" on a thin film of semiconducting material with a laser or an electron beam. Energy from such a beam changes the film's transmissivity by as much as 100 times and its reflectivity by 50%. Thus it would be possible to read out stored data by detecting either transmitted or reflected light patterns from the altered film.

Changes in the film's optical properties are reversible, using the same or another energy beam. This means that the mass memory would also provide means for selectively altering or updating stored information as desired.

ECD expects to have its first such mass memory systems available for commercial evaluation sometime next year.

NEW CONTRACTS

TO	FROM	FOR	AMOUNT
Redcor Corp., Canoga Park, Calif.	Penta Computer Associates, New York, N.Y.	Manufacture and delivery of an additional 100 PCA KeyLogic Systems; each KeyLogic System includes Redcor's RC 70 "midi" computer and custom KeyLogic terminals	$10+ million
Computing and Software, Inc., Panorama City, Calif.	National Aeronautics and Space Administration	On-site data processing services (digital, analog, and hybrid systems) at Goddard Space Flight Ctr., Greenbelt, Md.	$4.5 million (approximate)
Philco-Ford Corp., Willow Grove, Pa.	U.S. Post Office Dept. Washington, D.C.	Design, fabricate and field testing of new optical character reader, known as Model II, which will benefit from computer-aided logic	$1,983,160
Honeywell Inc., Framingham, Mass.	Automated Medical Systems, Inc., Minneapolis, Minn.	Computerized patient monitoring equipment which includes eight Model 316 mini-computers and fifteen Model 516 small-scale systems	$1.8 million
IBM Corp., New York, N.Y.	Applied Logic Corp., Princeton, N.J.	Six IBM 2314 Disk Files which will provide an additional 233 million bytes of storage on each of the firm's Dual AL-10 systems	$1.5 million
Sperry Rand Corp., Univac Federal Systems Div., St. Paul, Minn.	Naval Ordnance Systems Command,	Production of Mark 152 (UNIVAC 1219B) computers to modernize the Tartar and Talos missile fire control systems	$1.35 million
Data Products Corp., Woodland Hills, Calif.	Electro-Mechanical Research, Inc., Computer Division, Minneapolis, Minn.	A time-phased delivery of LINE/PRINTERS to be used by EMR in their standard line of computers	$1+ million
KMS Technology Center, Van Nuys, Calif.	National Aeronautics and Space Administration	Data processing and analysis services at National Space Science Data Center, Goddard Space Flight Center, Greenbelt, Md.	$1 million (approximate)
Varian Data Machines, Irvine, Calif.	PRD Electronics, Inc., Syosset, N.Y.	A large quantity of Varian R-622/i computers to serve as process control computers in the Navy's Versatile Avionic Shop Test (VAST) system, which is being supplied to Naval Air Systems Command by PRD Electronics	$1 million (approximate)
Comcet, Inc., Rockville, Md.	Trans World Airlines, Kansas City Data Communications Ctr., Kansas City, Kans.	Two COMCET 60 Computer Communications Systems, software and maintenance -- leasing for five years	$900,000+
Ultronic Systems Corp., Moorestown, N.J.	Compagnie Internationale de Teleinformatique (CITEL) of Paris, France	Telecommunications equipment which will be an integral part of on-line computer network being installed by CITEL in Europe, Southeast Asia, Africa and the Middle East	$548,000
Bryant Computer Products, Walled Lake, Mich.	Scientific Control Corp., Dallas, Texas	Purchase of 25 CPhD's, 50 CLC-1's and two 10512 magnetic storage drums which will be interfaced and sold as part of firm's SCC4700 computer system	$400,000+
Information Systems Corp., Washington, D.C.	U.S. Naval Academy, Annapolis, Md.	Time-sharing services; ISC will install some 30 terminals and will train instructors in their use	$255,000
Applied Dynamics, Inc., Ann Arbor, Mich.	University of Cincinnati	Manufacture and installation of an analog/hybrid system for research simulations in various departments of science and engineering; also as instructional device at both the undergraduate and graduate levels	$184,000
Computer Data Systems, Inc., Silver Spring, Md.	National Institute of Neurology and Stroke	Computer programming and analysis services	$150,000
RCA, New York, N.Y.	North American Air Defense Command (NORAD)	Programming of missile defense computers which instantly process and display data received from missile warning radars and other sensors located around the world	$150,000
Logicon, San Pedro, Calif.	NASA's Electronics Research Center, Cambridge, Mass.	Development of a compiler for CLASP (Computer Language for Aeronautics and Space Programming); will operate on IBM 360/75	$140,000
ITT Aerospace/Optical Div., Fort Wayne, Ind.	Federal Aviation Administration	A modification program permitting computer-generated "tags", identifying aircraft approaching, landing, and taking off at the nation's airports	$117,200
Atlantic Technology Corp., Somers Point, N.J.	Electronics Associates Inc., West Long Branch, N.J.	Delivery of 50 high speed analog data displays over the next two years	$110,000
McDonnell Automation Co., St. Louis, Mo.	U.S. Army	A programming assignment -- one part of a much larger Army effort to upgrade its computer systems on third generation equipment	$108,127
Delta Data Systems, Management Systems Div., College Park, Md.	U.S. Army Mobility Equipment Research and Development Ctr., Fort Belvoir, Va.	Revising and updating the Engineers' Handbook for Configuration and Technical Data Management	$100,000
Hobbs Associates, Inc., Corona Del Mar, Calif.	The Library of Congress, Washington, D.C.	A study of the requirements for terminals in the Library's Central Bibliographic System	---
Ampex Corp., Redwood City, Calif.	Langley Research Center, Hampton, Va.	Development of a monolithic ferrite memory array to be smaller, more reliable, and requiring less drive power than present arrays; successful mass production would eliminate costly hand-stringing of cores	---

NEW INSTALLATIONS

OF	AT	FOR
Burroughs B300 system	Millikin National Bank, Decatur, Ill.	Demand deposit, savings, trust, proof and transit, installment loan, and payroll accounting (system valued at over $400,000)
Burroughs B2500 system	Amelco Semiconductor, Mountain View, Calif.	Monitoring work-in-process, controlling inventory, payroll accounting, general accounting
	St. Petersburg Junior College, Clearwater, Fla.	Data processing technology training, computer assisted instruction and administrative applications (system valued at over $440,000)
Burroughs B6500 system	N. V. Bankgirocentrale, Amsterdam, Holland	Serving member banks; the dual processor system will clear all money transfers among the more than 3-1/2 million accounts serviced
Control Data 1700 system	Hughes Aircraft Co., Space Electronics and Telemetry Laboratory	Use as a testing tool for prototypes of new system configurations and devices; for real-time design, evaluation and checkout of spacecraft digital control and telemetry systems
Control Data 3600 system	Multicomp Inc., Waltham, Mass.	Commercial computing services to the New York-Boston area; time-sharing data processing for businesses, industries and educational institutions
Control Data 6400 system	The French Weather Bureau, Paris France	Weather forecasting services, meteorological research and statistical analyses of meteorological data for the Ministry of Transportation
GE-415 system	City of Buffalo, N.Y.	Personnel/payroll program for City's 7000 employees, tax rolls accounting, utility billing/payments, and assignments in budgets and purchasing
Honeywell Model 120 system	Swift Textiles Inc., Columbus, Ga.	Payroll, finished goods inventory control, sales analysis, invoicing, production reporting, cost accounting and general accounting
Honeywell Model 125 system	Dynanamics Inc., Lansing, Ill.	General ledger, doctor billing and hospital patient billing
Honeywell Model 1250 system	Hillenbrand Industries, Batesville, Ind.	Order entry, processing and billing; inventory planning, reporting and control; production scheduling, reporting and control; and financial and accounting reporting and control
Honeywell Model 2200 system	Blue Cross Assoc., Chicago, Ill. (2 systems)	Business applications, research and development; system will enable expansion of nationwide communications with 75 Blue Cross and 73 affiliated Blue Shield Plans
IBM System/3	Medical Center of Florissant, Mo.	Patient billing, insurance claim processing, payroll and such areas as Workmen's Compensation and supplies inventory
IBM System/360 Model 25	Applied Logic Corp., Princeton, N.J.	Providing high quality off-line printing of customer files; production card reading and punching also will be available to AL/COM users
ICL System 4-40	North of Scotland Hydro Electric Board, Aberdeen	Consumer accounting service for the 450 consumers in the north of Scotland; also, payroll, stock control, financial records and management information
NCR Century 100 system	Hichens, Harrison and Co. London, England	More comprehensive services to customers; variety of accounting and statistical work
	Myodo Kinzoku Co., Ltd., Tsubame, Japan	Accounts receivable and payable, production control, and various financial applications
NCR Century 200 system	Thalhimer Brothers, Inc., Richmond, Va.	Daily sales reports, accounts receivable/payable, fashion control, management information, etc.
RCA Spectra 70/46 system	Prudential Insurance Company of America, Newark, N.J.	A remote computing system to prepare advanced computer programs as well as run batch routines (system valued at $1.5 million)
UNIVAC 1108 computer system	New York University, UHMC Computer Center, Bronx, N.Y.	Data processing needs of several schools of the University as well as the N.Y.U. and Bellevue Medical Centers in Manhattan (system valued at about $2.5 million)
	State University of New York, Albany, N.Y.	Educational applications, teaching, faculty and graduate research projects, and administrative tasks
UNIVAC 9200 system	City of Easton, Pa.	Preparation of about 70,000 water and sewer bills annually; payroll processing, property tax billing and for budgeting
	National Seal Division of Federal-Mogul Corp., Frankfort, Ind.	The center of a management information system designed to provide various reports on plant operation
	University of Puget Sound, Tacoma, Wash.	Student instruction and general business and administrative applications
UNIVAC 9400 system	Communications Workers of America, Washington, D.C.	Replacing a smaller UNIVAC 9300 system being used for membership accounting and general accounting (system valued at about $500,000)
	James E. Crass Coca-Cola Bottling Plants, Inc., Richmond, Va.	Route accounting and control, route statistics, billing and accounts receivable/payable, etc.
XDS Sigma 5	Roosevelt Hospital, New York, N.Y.	Monitoring, diagnosing, and caring for patients with acute cardiovascular and respiratory disorders, system will be connected to operating, coronary care, and surgical recovery rooms as well as surgical labs
XDS Sigma 7	Davis Computer Systems, Inc., New York, N.Y.	Remote interactive batch processing and on-line resource sharing via telephone connections from terminal devices in user offices, plants and laboratories

WHO'S WHO IN COMPUTERS AND DATA PROCESSING

and the "Most Distinguished" Computer People

As many of our readers know, the fifth edition (which is the first annual edition) of "Who's Who in Computers and Data Processing" will be published early in 1970, as a joint publication of The New York Times and Computers and Automation. Over 8000 capsule biographies are already on hand for publication; and we are hoping that over the next month or two another 2000 may be obtained.

It is highly desirable for every user's benefit that the capsule biographies of the "most distinguished" computer people be included. What does "distinguished" mean, and how include them?

Five basic attributes define "distinguished":

1. Accomplishments: A man who has accomplished a great deal is distinguished. Accomplishments are measured in worthwhile things produced; research successfully completed; computing devices designed; computer programs produced; papers written; books published; etc.

2. Positions: A man who has held important positions is distinguished. An officer of a company is distinguished; a director of a computer installation is distinguished; a head of a government bureau is distinguished; a supervisor of a group of computer people is distinguished.

3. Degrees, Awards, and Honors: A man who has received an award or honor, or who has obtained a higher degree from a college or university, or who has received a certificate showing important professional examinations passed, is distinguished.

4. Memberships: A man who is a member of a society with significant requirements for admission is distinguished (but if all he has to do is pay dues to the society, he has not earned any distinction).

5. Seniority: Finally, a person who entered the field of computers and data processing a long time ago is distinguished. His major accomplishments may be in mathematics or management, or in some field other than information processing, but it is desirable to include him, if possible.

The "most distinguished" people in computers and data processing are those who have made the largest or most significant contributions to the advancement of the field. They have been heads of important computer laboratories. They have designed the most important developments in the construction of computers. They have formed or guided the activities of the important associations, groups, schools, conferences, etc., in the computer field, leading to dissemination and fertilization of computer knowledge. They have been invited by the U.S. Congress and other bodies to testify as authorities on the state of the computer field. Or they have done similar outstanding work.

There exists no list of the 500 or 1000 "most distinguished" people in the field of computers and data processing. Almost every effort to find out such people at the present time is based on unsatisfactory, accidental, incomplete, provincial knowledge. We need help!

Here is a beginning of such a list:

- John Bennett, head of Basser Computer Laboratory, Sydney, Australia
- Seymour Cray, designer of very advanced and fast computers, Wisconsin
- Robert M. Fano, head of the computer time-sharing laboratory Project MAC at M.I.T. for many years, Massachusetts
- Edward Fredkin, designer of computer-programmable film readers, and builder of a computer company, Massachusetts
- Grace M. Hopper, designer of advanced programming concepts, Pennsylvania
- Alston W. Householder, investigator of numerical analysis with computers, former president of the Association for Computing Machinery, Tennessee
- Kenneth E. Iverson, designer of the programming language APL, New York
- John W. Mauchly, co-inventor of the first electronic computer (the ENIAC), Pennsylvania
- John McCarthy, one of the creators of the LISP programming language and head of Stanford's computer laboratory, California

We need help in increasing this short list to at least 500 entries. So we appeal to the readers of Computers and Automation: Please send us the name, basis for distinction, and location (including address if possible) of those dozen or more persons whom you think of as the "most distinguished" in the computer field (see the blank below).

We hope we will be able to present a report on those persons whom our readers consider to be the "most distinguished" in the computer field. A free copy of this report will be sent with our warm thanks to every person contributing 5 or more names and addresses of distinguished computer people (and reasons why they are distinguished). This problem cannot today be solved by a computer. Only computer people can solve it.

- - - - - - (may be copied on any piece of paper) - - - -

TO: The Editor, "Who's Who in Computers and Data Processing", 815 Washington St., Newtonville, MA. 02160

( ) Attached are my suggestions for the 5 or more "most distinguished" computer people (Name / Address (or location) / Reasons for distinction (in 6 to 20 words)

( ) Please send me the report on the "most distinguished" computer people, when it is ready

( ) Please send me a blank form for my own entry in the "Who's Who"

Name ____________________ Title ______________

Organization ______________________________________

Address ______________________________________

MONTHLY COMPUTER CENSUS

Neil Macdonald
Survey Editor
COMPUTERS AND AUTOMATION

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

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

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

The following abbreviations apply:

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

SUMMARY AS OF NOVEMBER 15, 1969

NAME OF MANUFACTURER	NAME OF COMPUTER	DATE OF FIRST INSTALLATION	AVERAGE OR RANGE OF MONTHLY RENTAL $(000)	NUMBER OF INSTALLATIONS In U.S.A.	Outside U.S.A.	In World	NUMBER OF UNFILLED ORDERS
Part II. Manufacturers Outside United States							
A/S Norsk Data Elektronikk	NORD 1	8/68	2.0	0	20	20	10
Oslo, Norway	NORD 2	8/69	4.0 (S)	0	2	2	3
(A) (Nov. 1969)							
A/S Regnecentralen	GIER	12/60	2.3-7.5	0	38	38	2
Copenhagen, Denmark	RC 4000	6/67	3.0-20.0	0	4	4	5
(A) (Sept. 1969)							
Elbit Computers Ltd.	Elbit-100	10/67	4.9 (S)	-	-	100	50
Haifa, Israel							
(A) (Nov. 1969)							
GEC-AEI Automation Ltd.	Series 90-2/10/20						
New Parks, Leicester, England	25/30/40/300	1/66	-	-	-	13	X
(R)	S-Two	3/68	-	-	-	1	X
(Jan. 1969)	130	12/64	-	-	-	2	X
	330	3/64	-	-	-	9	X
	959	-/65	-	-	-	1	X
	1010	12/61	-	-	-	8	X
	1040	7/63	-	-	-	1	X
	CON/PAC 4020	-	-	-	-	0	X
	CON/PAC 4040	5/66	-	-	-	9	-
	CON/PAC 4060	12/66	-	-	-	5	-
International Computers, Ltd. (ICL)	Atlas 1 & 2	1/62	65.0	0	6	6	X
London, England	Deuce	4/55	-	0	7	7	X
(A)	KDF 6 - 10	9/61	10-36	0	58	58	X
(Nov. 1969)	KDN 2	4/63	-	0	1	1	X
	Leo 1, 2, 3	-/53	10-24	0	59	59	X
	Mercury	-/57	-	0	13	13	X
	Orion 1 & 2	1/63	20.0	0	17	17	X
	Pegasus	4/55	-	0	30	30	X
	Sirius	-/61	-	0	22	22	X
	503	-/64	-	0	16	16	X
	803 A, B, C	12/60	-	0	83	83	X
	1100/1	-/60	5.0	0	22	22	X
	1200/1/2	-/55	0.9	0	68	68	X
	1300/1/2	-/62	4.0	0	196	196	X
	1500	7/62	6.0	0	110	110	X
	2400	12/61	23.0	0	4	4	X
	1900-1909	12/64	3-54	0	1233	1233	C
	Elliott 4120/4130	10/65	2.4-11.4	0	151	151	C
	System 4-30 to 4-75	10/67	5.2-54	0	105	105	C
							Total: 534
Japanese Mfrs.	Various models	-	-	-	-	4900 E	800 E
(N) (May 1969)							
Marconi Co., Ltd.	Myriad I	3/66	£36.0-£66.0 (S)	0	37	37	9
Chelmsford, Essex, England	Myriad II	10/67	£22.0-£42.5 (S)	0	17	17	12
(A) (Sept. 1969)							
Saab Aktiebolag	D21	12/62	7.6	0	37	37	-
Linkoping, Sweden	D22	5/68	13.4	0	12	12	13
(A) (Sept. 1969)	D220	4/69	9.8	0	1	1	7
Siemens	301	11/68	0.75	-	-	5	C
Munich, Germany	302	9/67	1.3	-	-	18	C
(A)	303	4/65	2.0	-	-	68	C
(Sept. 1969)	304	5/68	2.8	-	-	31	C
	305	11/67	4.5	-	-	33	C
	306	-	6.5	-	-	-	C
	2002	6/59	13.5	-	-	41	C
	3003	12/63	13.0	-	-	37	C
	4004S	-	4.0	-	-	-	C
	4004/15/16	10/65	5.0	-	-	83	C
	4004/25/26	1/66	8.3	-	-	32	C
	4004/35	2/67	11.8	-	-	108	C

NAME OF MANUFACTURER	NAME OF COMPUTER	DATE OF FIRST INSTALLATION	AVERAGE OR RANGE OF MONTHLY RENTAL $(000)	NUMBER OF INSTALLATIONS In U.S.A.	Outside U.S.A.	In World	NUMBER OF UNFILLED ORDERS
Siemens (cont'd)	4004/45	7/66	19.8	-	-	99	C
	4004/46	4/69	34.0	-	-	1	C
	4004/55	12/66	25.8	-	-	11	C
							Total: 234
USSR (N) (May 1969)	BESM 4	-	-	-	-	C	C
	BESM 6	-	-	-	-	C	C
	MINSK 2	-	-	-	-	C	C
	MINSK 22	-	-	-	-	C	C
	MIR	-	-	-	-	C	C
	NAIR 1	-	-	-	-	C	C
	ONEGA 1	-	-	-	-	C	C
	ONEGA 2	-	-	-	-	C	C
	URAL 11/14/16	-	-	-	-	C	C
	and others	-	-	-	-	C	C
						Total: 6000 E	Total: 2000 E

AS WE GO TO PRESS

(Continued from page 16)

plugged into the telephone network. The telephone industry had traditionally excluded equipment that was not its own.

That decision gave a green light to companies to develop devices to transmit data via telephone lines. But the implementation of the decision, according to Conference speakers, has met with such problems as: a crisis in telephone service because of maintenance problems and lack of personnel; the lack of any qualified, objective group to evaluate the claims of the telephone companies about equipment attached to the telephone network by companies outside the system; the lack of a rate-making system that takes into account the capability for sending messages via satellite; etc. Those attending the Conference concluded that while the potential for the data communications market is almost unlimited, these probems will have to be resolved before that potential can be realized.

THE U. S. GOVERNMENT COULD SAVE UP TO 25% OF ITS COMPUTER INSTALLATION COSTS BY UNBUNDLING ITS PROCUREMENTS. This was the opinion of Dan M. Bowers, a computer consultant and president of BCD Computing Corp., in a recommendation he made at the Conference on Selection and Procurement of Computer Systems by the Federal Government sponsored by the Bureau of the Budget in Charlottesville, Va. recently. Mr. Bowers urged the government to give independent consideration to each of what he defined as ten distinct components of a computer system when granting contracts.

If his advice is heeded, it could have a profound effect on the big (as big as $300 million) contract soon to be awarded by the Department of Defense for the World Wide Military Command and Control System.

CLASSIFIED ADVERTISEMENTS

Use economical C&A Classified Ads to buy or sell your computer and data processing equipment, to offer services to the industry, to offer new business opportunities, to seek new positions, or to fill job vacancies.

Rates for Classified Ads: 90¢ per word — minimum, 20 words. First line all capitals — no charge. Ads must be prepaid.

Send copy to: Computers and Automation, 815 Washington St., Newtonville, Mass. 02160

ADVERTISING INDEX

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

The Bug Slayer

No computer stamps out program bugs like RCA's Octoputer. It boosts programming efficiency up to 40%.

Programming is already one-third of computer costs, and going up faster than any other cost in the industry.

A lot of that money is eaten up by bugs—mistakes in programs. With usual methods, programmers don't know of mistakes until long after a program is written. They may have to wait days for a test run.

RCA's Spectra 70/46, the Octoputer, takes a whole new approach based on time sharing.

It substitutes a computer terminal for pencil and paper and talks to the programmer as he writes the program, pointing out mistakes as they are made.

The Octoputer is the only computer available today that has this capability. It's as much as 40% faster. And it works on IBM 360 and other computer programs as well as our own.

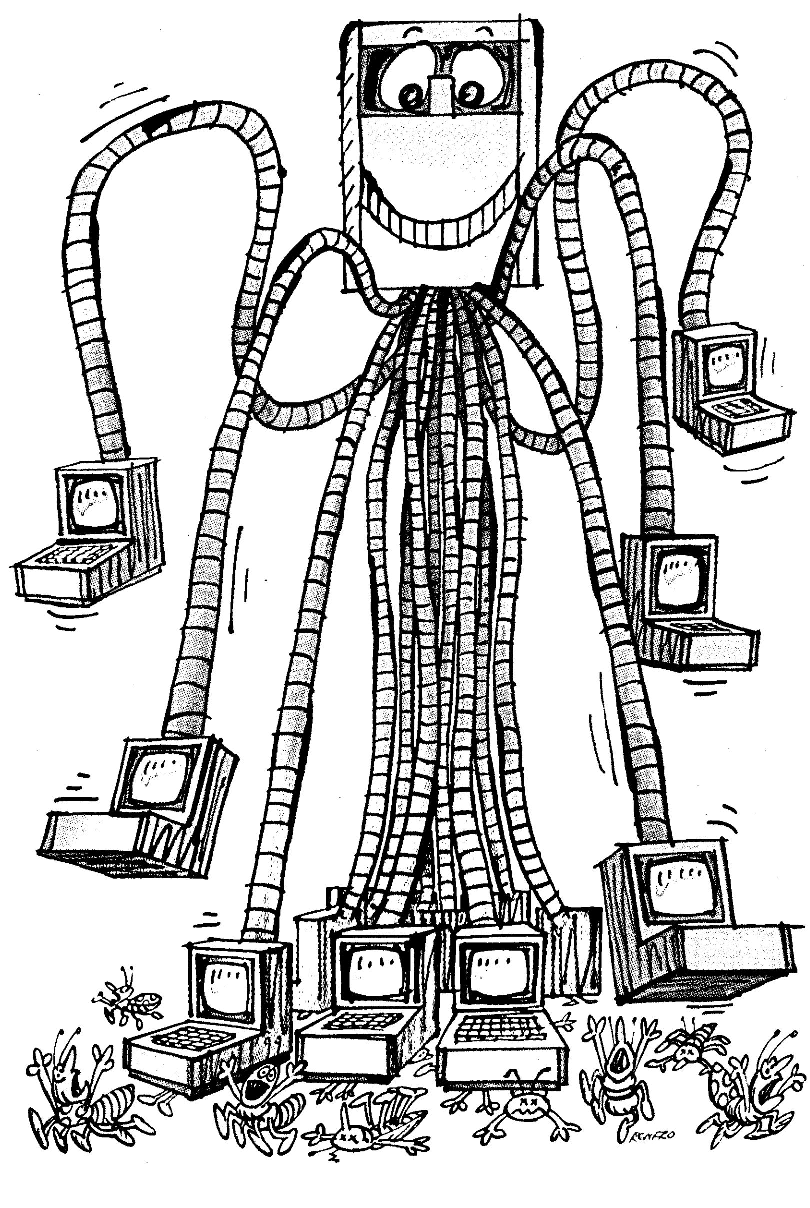
Costs go down. Programs get done faster. And you need fewer programmers—who are scarce and getting scarcer.

Of course, Octoputer does more than just slay bugs.

It's a completely new kind of creature that does time sharing and regular computing together.

The Octoputer concentrates on remote computing because that's where the industry is going. We got there first, because communications is what RCA is famous for. It puts Octoputer a generation ahead of its major competitor. It can put you ahead of yours.

RCA COMPUTERS



Designate No. 17 on Reader Service Card