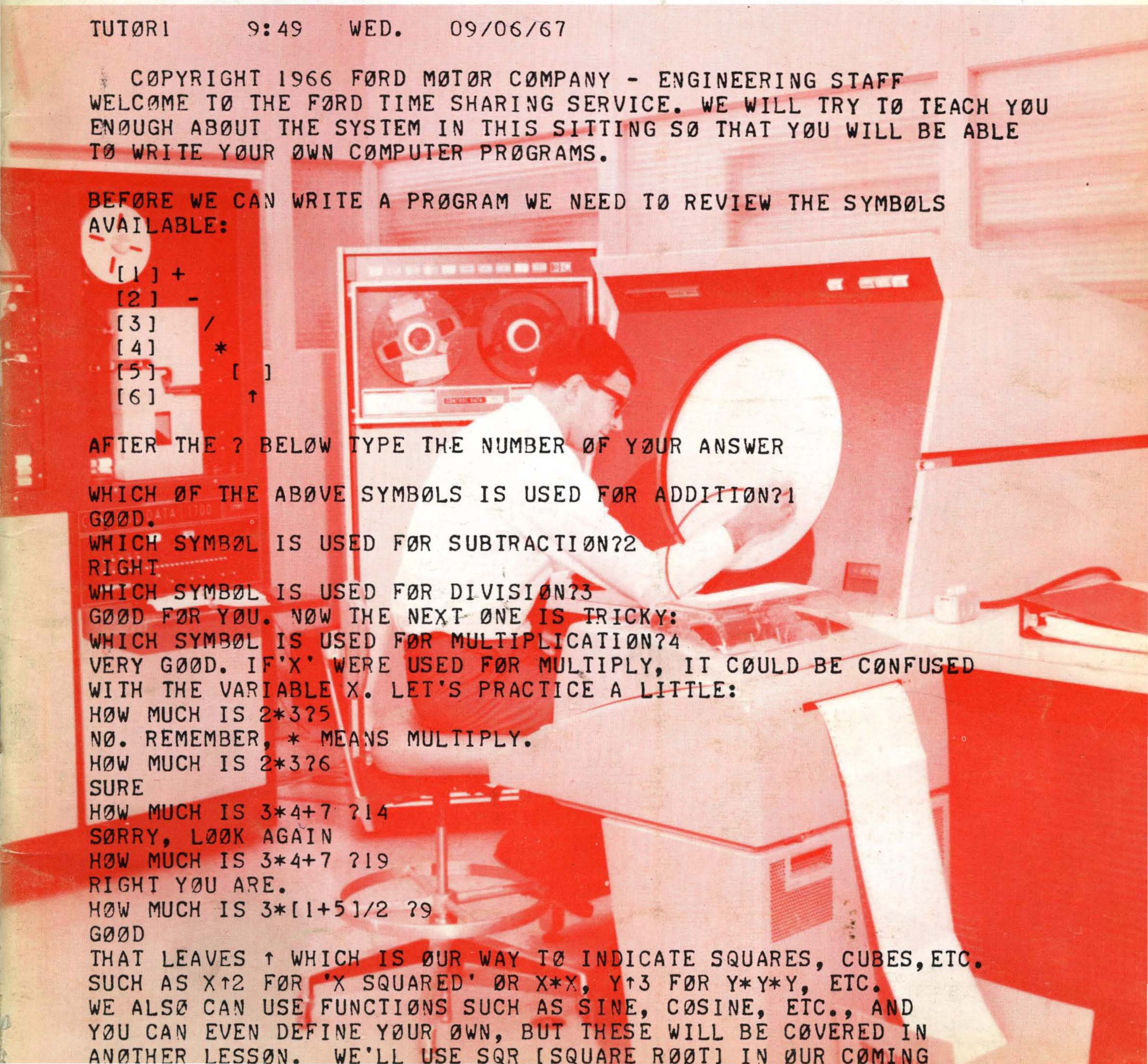
January, 1968

# computers and automation

A Glimpse at The Future in Computer Centers



```
TUTØR1      9:49    WED.    09/06/67

   CØPYRIGHT 1966 FØRD MØTØR CØMPANY - ENGINEERING STAFF
WELCØME TØ THE FØRD TIME SHARING SERVICE. WE WILL TRY TØ TEACH YØU
ENØUGH ABØUT THE SYSTEM IN THIS SITTING SØ THAT YØU WILL BE ABLE
TØ WRITE YØUR ØWN CØMPUTER PRØGRAMS.

BEFØRE WE CAN WRITE A PRØGRAM WE NEED TØ REVIEW THE SYMBØLS
AVAILABLE:

   [1] +
   [2]   -
   [3]     /
   [4]       *
   [5]         [ ]
   [6]           ↑

AFTER THE ? BELØW TYPE THE NUMBER ØF YØUR ANSWER

WHICH ØF THE ABØVE SYMBØLS IS USED FØR ADDITIØN?1
GØØD.
WHICH SYMBØL IS USED FØR SUBTRACTIØN?2
RIGHT
WHICH SYMBØL IS USED FØR DIVISIØN?3
GØØD FØR YØU. NØW THE NEXT ØNE IS TRICKY:
WHICH SYMBØL IS USED FØR MULTIPLICATIØN?4
VERY GØØD. IF'X' WERE USED FØR MULTIPLY, IT CØULD BE CØNFUSED
WITH THE VARIABLE X. LET'S PRACTICE A LITTLE:
HØW MUCH IS 2*3?5
NØ. REMEMBER, * MEANS MULTIPLY.
HØW MUCH IS 2*3?6
SURE
HØW MUCH IS 3*4+7 ?14
SØRRY, LØØK AGAIN
HØW MUCH IS 3*4+7 ?19
RIGHT YØU ARE.
HØW MUCH IS 3*[1+5]/2 ?9
GØØD
THAT LEAVES ↑ WHICH IS ØUR WAY TØ INDICATE SQUARES, CUBES,ETC.
SUCH AS X↑2 FØR 'X SQUARED' ØR X*X, Y↑3 FØR Y*Y*Y, ETC.
WE ALSØ CAN USE FUNCTIØNS SUCH AS SINE, CØSINE, ETC., AND
YØU CAN EVEN DEFINE YØUR ØWN, BUT THESE WILL BE CØVERED IN
ANØTHER LESSØN.  WE'LL USE SQR [SQUARE RØØT] IN ØUR CØMING
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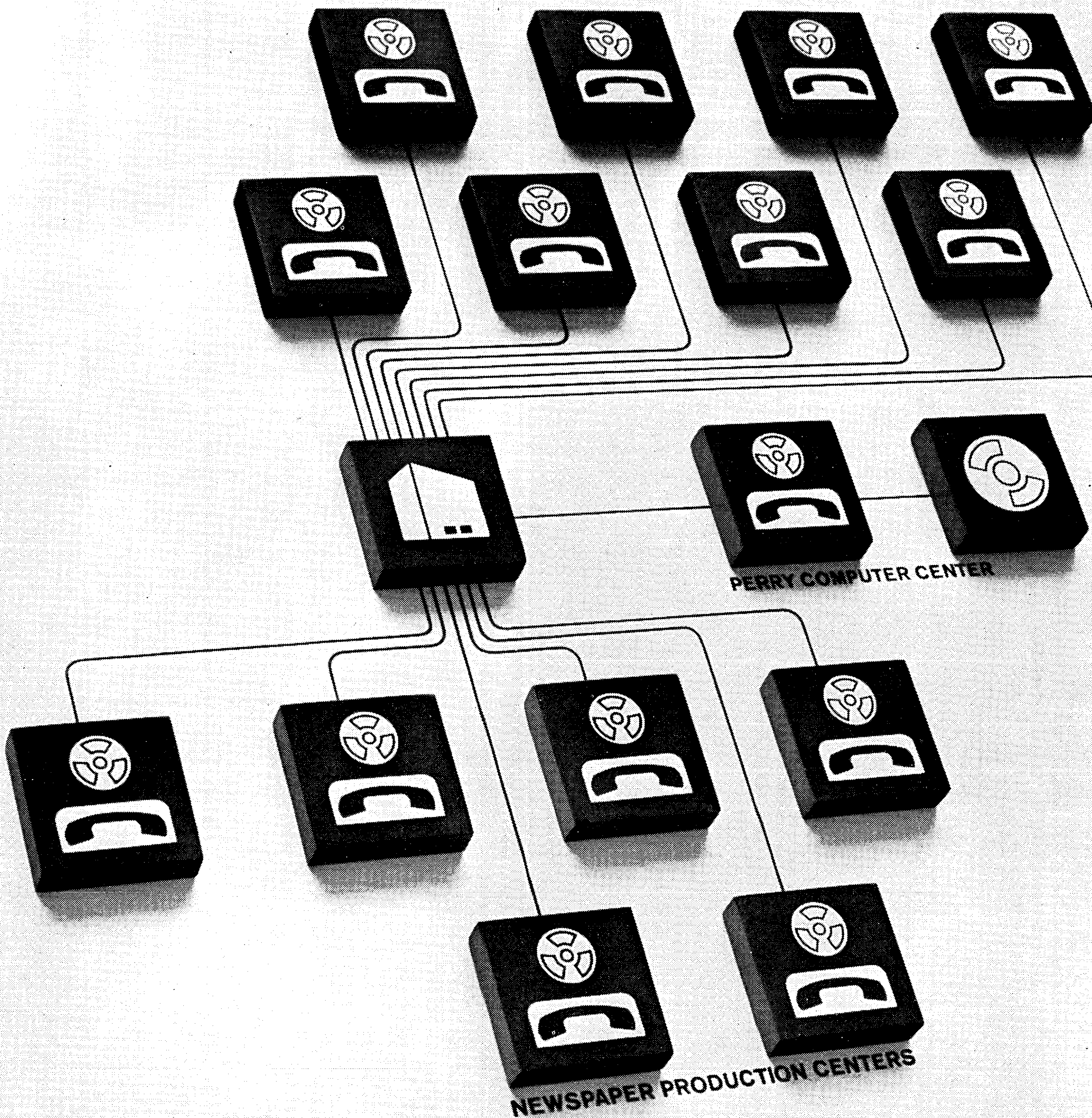


# Perry Publications is making headlines with this system

The system was designed so Perry's 26 daily Florida newpapers could use one computer center in West Palm Beach.

Every day the Perry papers send their display advertising and editorial matter to the center to be prepared for typesetting machines.

Since speed is essential, Perry set up 14 transmitting-receiving centers where newspaper copy is put on paper tape. The tapes are sent via Type 2 Dataspeed* Service (at 1050 words per minute) to West Palm Beach.

At the center, tapes are read into the computers at 1000 characters per second, using photoelectric readers. The computers have a 50,000 word dictionary programmed into them, so that copy can be prepared in newspaper column widths and words hyphenated, where necessary.

The output of the computer is a new tape which is returned by Dataspeed service and fed directly into typesetting machines.

If moving information in a hurry will help you make more efficient use of your computer installation, talk with our Communications Consultant. He'll help you plan a system to beat any deadline.

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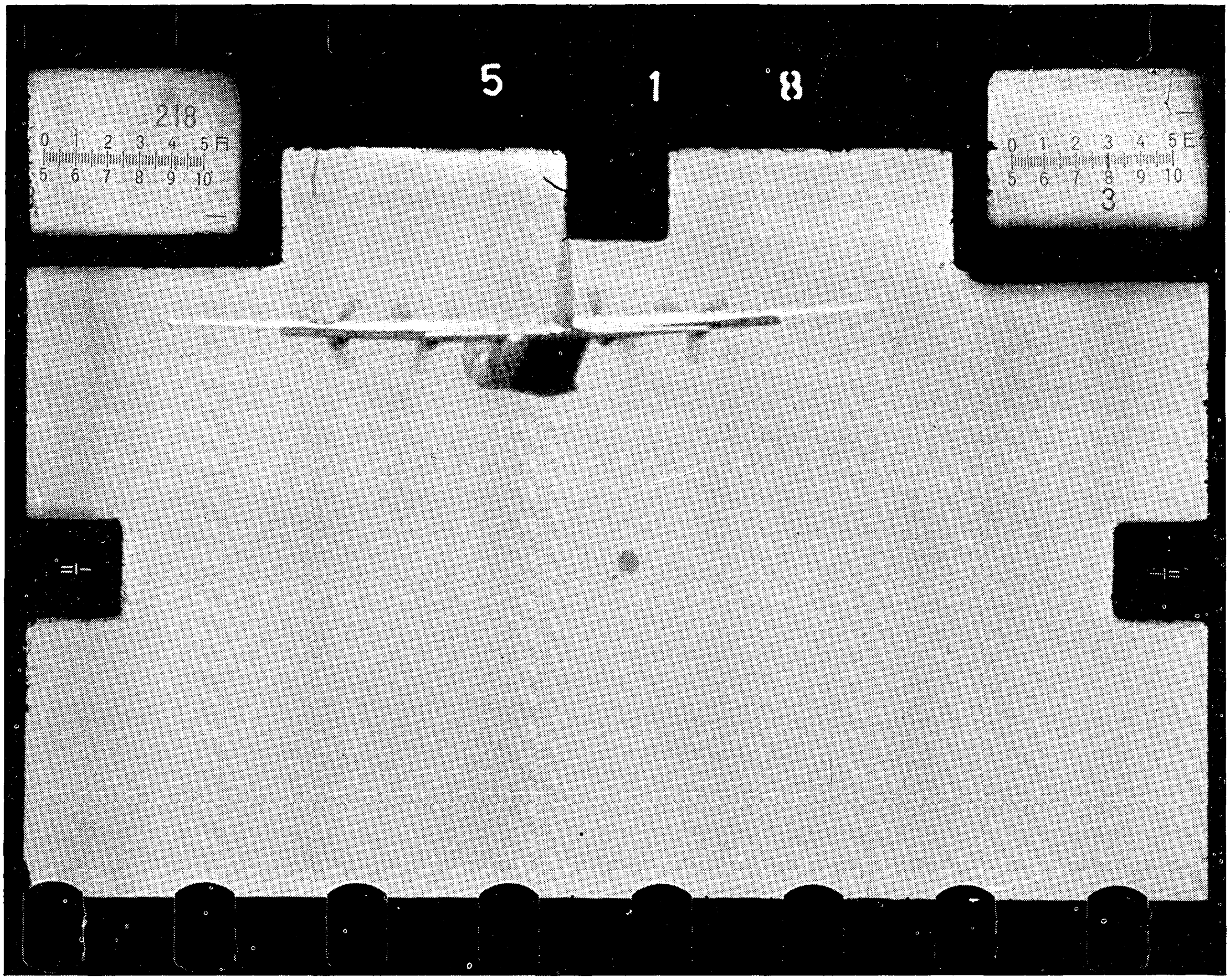


# Hey, you dropped something!

And we know where it is to an accuracy of a thousandth of a degree in azimuth and elevation, on this frame, and the next, and the next — as long as the theodolite follows it.

The positional information is on the film, in those dials at the upper corners. But getting the information off of the film into useable form — automatically — is a task so formidable that only our Programmable Film Reader -3 does it. (Some other pretty big outfits are still trying.)

Think for a moment what is involved. First the computer-controlled scanning system has to locate the dials (they're not always in the same position on the film). Then it has to find and recognize two sets of arabic numbers. Then it has to determine where a tiny marker is on the linear scale and convert this into a number of three place accuracy. The last step is to find the parachute and correct for theodolite aiming error.

Sophistication fit for a human, but our Programmable Film Reader -3 is faster, more accurate and more reliable.

This kind of capability — to find, recognize, analyze, and convert visual information — can be applied to any problem, because the Programmable Film Reader -3 is just that: programmable. And the ultra-precise CRT in the optical system can record on film, too, with the same sophistication.

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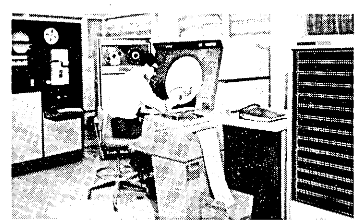
computers and automation

JANUARY, 1968, Vol. 17, No. 1

## *Special Feature:*

## *Trends and Projections in the Computer Field*



*On the front cover appears the beginning of a lesson designed to teach a newcomer the use of the BASIC programming language and fundamental programming techniques at the Ford Motor Company in Dearborn, Michigan. The background picture shows one of the computer rooms at Ford. For more information, see "A Glimpse at the Future in Computer Centers — The Technical Computer Center at Ford Motor Company," beginning on page 20.*

# ACROSS THE EDITOR'S DESK

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C.a

# EDITORIAL

## Access to Information and a Mailing List of All Computer People

In 1946 in the spring — year 2 of the computer revolution — some conversation went on in the Harvard Computation Laboratory, in Cambridge, Mass., then under the direction of Commander Howard Aiken U.S.N.R. (later Professor). Some of the younger computer people there were not very happy about the lack of opportunities they had for access to information about the booming computer field. For example, Dr. John von Neumann visited our laboratory, but Commander Aiken did not introduce him to any of the young people there, who of course would also have liked to talk with him for just a couple of minutes. So there was a restlessness and a desire to have access to more information — to news about computer installations, computer people, computer meetings, etc. I know — I was there.

In 1947 in the spring — year 3 — there was more restlessness and more desire for intercommunication and for a computer society. The logical organization to take action to form a society seemed to be the National Research Council Committee on Large Scale Calculation, which had five members, Dr. Howard Aiken, Professor R. C. Archibald, Dr. Derrick Lehmer, Dr. John von Neumann, and Dr. George Stibitz.

I went to the Prince George Hotel in New York one evening in April 1947, the day before the scheduled annual meeting. There I talked with Dr. Lehmer and Dr. Archibald, urging that the time was ripe for forming a society in the computer field; I begged them to bring up the subject the next day at the meeting, and seek a favorable decision. They agreed. I found out a few days later that when the subject was brought up, Aiken and von Neumann declared they saw no need for "still another society — there were too many already," and Stibitz did not say much, and so the proposal was tabled, to be brought up again at their next meeting a year away.

This outcome made me angry; so, after talking with some friends of mine, together we sent out by mail a notice proposing to form the Eastern Association for Computing Machinery. The names of the senders of the notice were:

| | |
|---|---|
| E. C. Berkeley | Prudential Insurance Co. of America, Newark, N.J. |
| R. V. D. Campbell | Raytheon Mfg. Co., Waltham, Mass. |
| J. H. Curtiss | Bureau of Standards, Washington, D.C. |
| H. E. Goheen | Office of Naval Research, Boston, Mass. |
| J. W. Mauchly | Electronic Control Co., Philadelphia, Pa. |
| T. K. Sharpless | Moore School of Electrical Engrg., Philadelphia, Pa. |
| C. B. Tompkins | Engineering Research Associates, Washington, D.C. |

This new group held its first meeting in September 1947 at Columbia University; 75 people were present. I know — I was there. Shortly afterwards the name was changed, and the newly formed organization became the Association for Computing Machinery.

---

In 1947 it was decided that the dues of the Association would be $2 a year. It was believed then that this annual amount would be enough to maintain up to date a mailing list of computer people which would send out 3 or 4 times a year a brief mimeographed bulletin of notices of information and lists of interested persons. In this way, even a newcomer with almost no financial resources would have as much access to crucial information in the computer field as the old timers would have.

The dues of the ACM have now become $25 a year. Many of us feel that this is far too much. We feel it is not right to tax every member to provide those things that only some members want. Many of us object to such decisions made by those few members who gravitate into the ruling bodies of a professional association. Many of us feel that the time has come to go back to the simple concept of a mailing list for all computer people costing not more than $2 a year, less if possible.

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*Computers and Automation* has decided to start a mailing list of all persons interested in the field of computers and data processing.

C&A invites everybody who is interested in the field to send us their name and address, for inclusion in this list, *Computers and Automation's* Universal Mailing List, C A U M L.

We plan that the rules covering this universal mailing list will be as follows:

1. Anybody who wishes to mail information that bears some reasonable relation to the interests of people in the computer field will automatically have permission to mail to this list.
2. The mailing list rental fee will be $20 per thousand pieces addressed.
3. After deducting from income the reasonable and necessary expenses for updating and maintaining the list on some suitable automatic medium like metal plates, the net income will be contributed to worthy causes for improving education in the computer field.
4. An audited accounting will be published in *Computers and Automation* once a year.

(Please turn to page 18 )

# Letters To The Editor

## Simulation Story

Sir:

Would you please give us a quotation on 200 reprints of the Computed Display (cover story, November issue)?

We are delighted with the way you handled this story.

HUBERT M. SNIDER
*GE Electronics Park*
*Syracuse, N.Y.*

## Printing Error

Sir:

Page 13 of your November, 1967 issue contains an admission that the September, 1967 cover photo was reversed in error. You excuse this error with the comment:

> "This was a printer's error, and we had no way of stopping it. But the procedure is being improved and it *should* not happen again."

I'm glad you said *should* rather than *will* not happen again. The right-most miniature in the second row of your November cover is indeed reversed.

R. F. MICHAELS
*Toledo, Ohio*

## Problems

Sir:

Problem 6710 which appeared in the "Problem Corner" of your October, 1967 issue ends with the question: "What does the program compute?" My solution is that it computes how many readers will detect that the FORTRAN coding was omitted from the problem statement!

W. PRESTON HAUPT
*Chincoteague, Va.*

(Ed. Note — *We regret our error. The problem was reprinted in the November issue so as to include the FORTRAN program.*)

## Better Insight

Sir:

I recently saw a copy of your magazine in the public library, and I enjoyed it very much. I am presently a student at Mercer County Community College in the Business/Data Processing Curriculum, and I appreciate your giving me a better insight into the computer world through your magazine.

SALVATORE M. ZULLA
*Trenton, N.J.*

## Reapportionment Cases

Sir:

In the September issue of C&A (page 12) you mentioned a New York Court of Appeals decision re reapportionment. Could you supply me with a citation to that decision, or the names of the parties involved?

MICHAEL A. DUGGAN
*Durham, New Hampshire*

(Ed. Note — *The cases are No. 254, Jerry Iannucci vs. The Board of Supervisors of the County of Washington and the State of New York; and No. 255, The Saratogian, Inc. vs. Board of Supervisors of the County of Saratoga and The State of New York and Harry D. Snyder, Jr., Supervisor of the City of Saratoga Springs, Intervenor-Defendant-Respondent. Both cases were tried in the Court of Appeals of the State of New York.*)

## Social Implications Group

Sir:

I have been informed that you have formed a Special Interest Group on the Social Implications of Computers. I would like very much to become a part of this group.

I would also appreciate having the names of others in the field who are doing work in this area, as I plan to write to them and organize a list of ongoing projects.

WILLIAM BAURIEDEL
*Chicago, Ill.*

(Ed. Note — *The organization that has the special interest group on social implications of computers is the Association for Computing Machinery, 211 East 43rd St., New York, N.Y. We discuss the subject often, but do not have an organization.*)

## Truthful Facts into Computers

Sir:

I just want to express my agreement with the point made in your letter on page 13 of the October, 1967 issue of C&A: computer people do have a responsibility to see that truthful facts are put into computers.

LEON DAVIDSON
*White Plains, N.Y.*

## Art Reproduction

Sir:

I am writing for permission to reprint three pictures from the "Annual Computer Art Contest" which appeared on pages 8, 10 and 11 of your August, 1967 issue. The photos will be used in INBUSMAG, the IBM employee magazine published in India. The pictures we want to use are: "Sine Curve Man, 1967", "Boxes", and "Seeing Stars." We will, of course, include your standard credit line.

H. A. MENDELSOHN
*IBM World Trade Corp.*
*New York, N.Y.*

(Ed. Note — *Permission granted.*)

# Move With Advanced Computer Technology At NCR Electronics Division

SYSTEMS FORMULATION
Analysis and development of advanced systems specifications; consultation on systems design, hardware configuration, software trade-offs; analysis of competitive systems. Applicant should have familiarity with very high speed memories, large-scale integration, disc files, drum files, communications and time sharing plus related BS degree and 3 to 5 years' experience in one or more areas mentioned.

SOFTWARE SYSTEMS
Programmers to develop executive and operating systems for third-generation computer systems. Desire experience with medium- and large-scale general-purpose systems employing high speed peripheral units, tapes, random-access files, disc files, drum files, on-line, time sharing and multiprogramming. Requires related BS degree and 3 to 5 years' directly related experience. Positions also open for hardware-oriented programmers to do systems diagnostic work.

EDP ANALYST/PROGRAMMERS
Analyst position entails systems analysis in financial and administrative areas. One year of EDP experience required, degree desirable. Programming positions involve accounting and manufacturing systems. Degree and recent experience on medium- to large-scale systems desired.

OPTICAL SYSTEMS
To do computer-aided design of specific elements in complex optical systems, such as field and condenser, as well as image-forming elements. Activity includes optical-electronic lab work, systems layout and design, technical liaison. Involves geometrical and physical optics. Requires BS in physics or optics plus 2-5 years' directly related experience.

MEMORIES RESEARCH
To design high-speed magnetic memory circuits. Requires knowledge of nanosecond pulse techniques and magnetic memory organization. Familiarity with plated-wire and mass-storage memory concepts desirable. Requires BSEE plus five years' experience.

SYSTEMS ENGINEER
For systems design on advanced computers. Requires extensive knowledge of memory technology, systems logic and large-scale integration as applied to medium- to large-scale general-purpose computing systems. Minimum of BSEE and five years' direct experience required.

LOGIC DESIGN
Several positions available for EE's with 2-5 years' experience in logic design on either special- or general-purpose equipment. Positions require thorough knowledge of logic as related to real-time hardware development or automatic test equipment.

CIRCUIT DESIGN
Positions for both systems- and device-oriented circuits men to work either in developmental projects or standard circuits group. BSEE required plus 3-5 years' design experience and thorough understanding of IC technology. Knowledge of large-scale integration concepts and ramifications desirable. Projects include thin-film memories, IC utilization and development, project/vendor liaison, systems applications.

FACILITIES/LAYOUT
Work entails projecting needs of expanding division, development of proposals, program implementation. Requires three years of facilities and layout experience, preferably in electronics industry; BSIE or equivalent; ability to deal effectively with all levels of personnel. Knowledge of safety codes desirable.

MACHINE DESIGN
Creative mechanical engineer capable of designing sophisticated manufacturing hardware and of developing machines to do jobs which heretofore have not been encountered. Requires BSME and minimum of two years' experience.

CHEMICAL PROCESSES
Positions in both engineering and manufacturing for man with BSChe and 2-5 years' experience in electroplating and electrodeposition in thin and thick films. Thorough knowledge of related materials, pre-plating surfaces, plating equipment required. Work entails development of advanced processes and techniques for computer development and production.

QUALITY ASSURANCE ENGINEERS
Q.C. assignments include process capability studies, failure analysis, design reviews, establishment of inspection standards. Position requires 2-3 years' experience with EDP equipment, knowledge of magnetic materials, BSME degree. Reliability positions involve planning, conducting and reporting reliability tests of electronic components, assemblies and units. BSEE required plus experience with reliability mathematics, computer circuitry. Positions also available in systems test.

NCR Electronics Division is the largest commercial computer manufacturing facility in Southern California and one of the most advanced in the world. The Los Angeles plant and laboratories have recently been doubled, and an additional manufacturing facility is now under construction in San Diego. At NCR you will enjoy stable, non-defense activity in a thoroughly professional environment. Your job and your future: the creation of advanced business automation for NCR markets in 121 countries.

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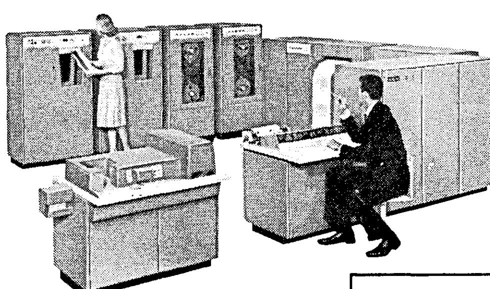

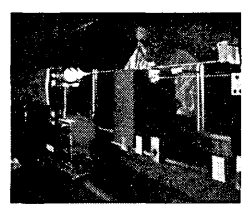

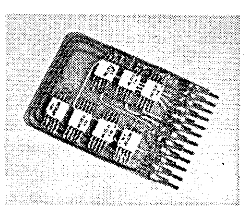

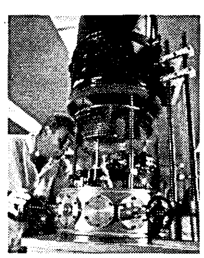

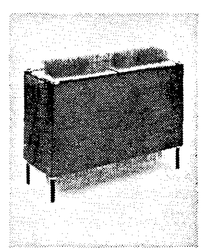

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c.a

# MULTI-ACCESS FORUM

## ANY PROTESTS AND OBJECTIONS TO COMPUTERS SHOULD BE DIRECTED AT THE MEN WHO USE THEM, NOT AT THE COMPUTERS

**James E. Harrison**
**Arlington, Va.**

Mr. Warburton's study of the philosophical sources of man's sometime objection to computers is interesting [See *Computers and Automation,* Oct., 1967, page 12.] First, he goes off into the classical refuge of learned discussion about Darwin, Freud, Copernicus, etc., and then he proceeds to analyze why men have objected to the *uses* to which some computers are put.

I believe that there is a basic flaw in his discussion, that he ignores some important facts which surround man's view of the electronic beasts he has created. It is all very well to investigate the nature of man and his "soul," man and his relation to "nature," and to write learnedly about their philosophical bases. What Mr. Warburton seems to be doing is to analyze the analysts, both historical and present, and come up with many words about criticisms of critics, distrust versus trust of computers, and whether or not computers can "think."

The facts which I believe he has ignored are these:

1. Computers are made and controlled by men. They cannot operate for long without human intervention.
2. Few intelligent men are really worried about *computers.* They *are* worried about what other supposedly intelligent *men* are doing and may do in the future with these sophisticated machines.
3. Historical research seems to have largely failed to enlighten modern man. Our current social condition, except for material wealth, bears out the fact that we are in approximately the same condition as early barbaric tribes warring against each other.
4. Computers are being used by *men* to destroy human beings on a mass scale. Those same computers are being used also to improve man's lot. Both uses are planned, directed, controlled, and can be stopped or started by *men.*

It is pleasant to spend one's time reflecting on why man views his computers or other creations in one way or the other. Philosophical vagaries have occupied man in his spare time for centuries. But if such pastimes have led us to our present world condition, then I propose to abandon such pleasantries. I need to think instead about curbing and controlling the *men* who use computers to try and destroy the world into which I and my son were born.

I have never seen a computer that made me afraid. If my "soul," or any other part of my being, felt fears, it was because I looked long and hard at the *people* surrounding that machine. I sensed, from other informational inputs, that they were out to use that machine to irradiate, napalm, bomb, or otherwise destroy me: just as they are doing to the less fortunate citizens of another country, and with help from scores of computers. I could be close to top on their list (stored in a machine memory) of those they will destroy — when convenient. All I have to do in order to raise my priority is to write a little more against those *men,* talk a little more, resist the ugly and historically-based plans for destroying human beings made by the military-industrial complex, and it could be not very long before my name is tagged with the fatal binary mark. I can't tell where, philosophically, my self-protective feelings originated; I really don't care. If Robert Ardry in "The Territorial Imperative" is correct, and I am simply a rather advanced species of animal, still I am not barred from sensing danger, seeing beauty, or wanting to save my life. I am perfectly willing to be called an animal. Who cares about the semantics of whether I am human or animal? Perhaps my "dignity" or "meaning" is simply to want to live peacefully until my body will no longer function because of cellular breakdown.

On the other hand, I have seen dedicated *men* who use computers to help people reach old age with minimal pain and problems. I am not afraid of those men. They are trying to save my life, not take it, by using computers. But again, the computer is simply a tool. *People* make it work toward a positive or negative effect on my life.

In sum, I have absolutely no objection to computers, philosophical or otherwise: only to the destructive uses to which man is putting them. Minds as fertile as Mr. Warburton's could better be directed to the question, "Is there a real basis for human objections to certain computer *uses?* and should we do something about these adverse uses?" The traditional Christianity he refers to has failed miserably. Christian philosophy has bred the "moral war" supported by some Catholic Cardinals; theology and Christian philosophy defends it on a seemingly logical basis. A friend of mine receives a statement of his contributions toward the work of God each month, and it is prepared on a computer by those same Christians.

My concern, unlike Mr. Warburton's, is not whether my nature is two-part or one-part, but whether we can control the computer-users who have produced what seems a near-Fascist government in the United States: whether we can direct the use of computers toward helping mankind instead of destroying it. But the tension in my "conceptual framework" is not caused by computers. It is caused by animal or human fear (whichever you choose) generated by observing the direct action, direct result, and immediate death of some of those opposing some powerful American computer users.

Light the burner on your kitchen stove; put your finger directly into the flame. Long before you have time to philosophize on the nature of fingers, the rate of flesh carbonization, or *why* you feel fear for your entire being, you will have felt fear and jerked your finger and probably your whole body away from the flame. Only then can you afford the luxury of activity analysis: after you have *done* something about the immediate danger.

Each time I go near the Pentagon, I think about the computers whirring away inside. I have inside myself a fear generated by the organization, and the men inside at their consoles, and it makes hackles rise up on the back of my neck. Dogs and other animals show the same reaction when threatened. Animal or human, the basic instinct of self-preservation operates.

If we can find a way to control certain classes of computer *users* (people), then I think computers as machines will cease to worry anybody.

I would like to invite Mr. Warburton to discuss the relative merits or objections of using computers for war or for mankind's benefit.

## SOVIET LAGS IN USE OF BUSINESS COMPUTERS, BUT PLANS NETWORK THAT WILL RUN ENTIRE ECONOMY

**(Based on an interview with Richard Judy, Professor of Economics and Computer Sciences, University of Toronto, reported by the Toronto** Globe and Mail, **October 28, 1967.)**

The Soviet Union is at least a decade behind North America in computer applications for general business. The Soviets have developed sufficient computer capability to make Sputnik possible, build a strong anti-missile defense system, and carry out advanced work in nuclear physics. Yet Soviet offices still rely on the abacus and desk calculator to carry out normal accounting operations, such as payroll preparation.

The Soviet is now trying to develop a mathematical model of the entire economy that would allow optimal planning and control of the economy. Soviet managers have been debating for some time the role the computer should play in the economy. The complexities of managing a vast, centralized state pose basic problems in paperwork and communications.

Two years ago a Soviet economist warned that by 1980 the country would require at least 100 million people simply to do the state's paperwork, unless widespread use was made of computer systems.

And beyond this, the Soviet looks upon cybernetics — basically the science of control and communications between man and machine — as part of the basic philosophy of the state.

Most Soviet computer work to date has been directed toward the needs of mathematicians and scientists. Soviet programming, input-output units, and supporting equipment is weak and unreliable. While North Americans are blasé about print-out units that produce mountains of paper at the rate of several hundred lines a minute, the Soviet has only recently developed units capable of printing in alphabetical or numerical characters. These are not yet reliable.

There are serious reliability and quality problems with tapes and tape drives, too. One Soviet scientist has said it is impossible to store anything on a Soviet tape and expect it to last longer than a month.

The Soviet has serious programming difficulties, but is trying to develop software libraries. Until recently, it was still programming in machine language, and had no equivalent of computer languages such as FORTRAN or COBOL. It has now been agreed that ALGOL will be the standard computer language in the Soviet Union, but it is only starting to be used.

One reason for Soviet computer difficulties has been poor organization. Whereas in North America the computer manufacturer is responsible for installing the computer, developing supporting programming, and putting the system in operation, this has not been the case in the Soviet Union. There the manufacturer until recently was responsible for making the computer only, and in large measure the assembled components were supplied by other industries. Now the Soviet Government has put design production and programming all under one roof, in the Ministry of Radio Industry.

National planning right now is being done on a rough and ready basis, with many errors. But once the Soviets decide to give high priority to something, they have the power to mobilize remarkable resources. That is exactly what is happening in the Soviet computer world today.

## IMMEDIATE NATIONWIDE INFORMATION ABOUT JOB VACANCIES IN ENGLAND

**Based on a report by**
**Richard Wagner**
**in** The Times
**London, England, Nov. 6, 1967**

The Ministry of Labour is to spend £500,000 on computer facilities for handling Selective Employment Tax calculations and which will be the first stage of what could become a £1m complex linked to every employment exchange in Britain, to provide immediate information about job vacancies.

If the scheme comes to fruition, it will be by far the largest multi-access installation in Europe. It is seen by the Ministry of Labour as a further development in shaking off the "dole queue" picture of employment exchanges. With the computer, the Ministry hopes to match man and job systematically, and provide better labour market information for both employers and workers.

The 970 exchanges in England, Scotland, and Wales place 1,500,000 able-bodied adults each year, and provide other aids to mobility and replacement at an annual cost of about £8m.

Using the computer will not replace individual judgment by Ministry officers, but it should make it easier and quicker to match vacancies and applicants, especially where applicants are mobile.

Similar schemes have already been tried in several European countries, but have so far failed to achieve their full potential because of technical difficulties.

## AUTOMATED TEACHING IN BIOLOGY SAVES MONEY AT FRASER UNIVERSITY

**(Based on a report in the** Winnipeg Free Press, **Winnipeg, Manitoba, Canada, October 11, 1967.)**

Officials at Simon Fraser University in Burnaby, British Columbia (a suburb of Vancouver) have discovered that modern, automated teaching methods are not only effective, but also save money.

The University contains a laboratory where first-year biology students receive their instructions from a combination of tape recorders, slide projectors, film loop projectors, models, and specimens, rather than teachers. Students sit in booths and listen to taped lectures on aspects of biology which are keyed to a slide or film presentation. Assignments and lab exercises also are given by tape.

Students can go for lab instruction when they please, and take as long as they want going over it. They meet once a week in groups with a professor for discussion.

The approach is based on recognition that different kinds of learning occur through different sensory organs. For example, persons don't learn how to operate sophisticated scientific equipment just through a visual description, because this is too fast. They need to hear instructions. When a variety of signals are "sent" to the student — and the student has control over his own rate of learning — he learns faster and better.

There's not much saving on personnel costs, for while fewer professors are required, more technical support people are needed. But less money is spent on equipment at Simon Fraser than at a regular university, because equipment is utilized to a greater degree. It is estimated that under conventional methods, it would have cost the University $500,000 for microscopes for first-year biology, but with the automated lab it cost only $100,000.

## DPMA 1968 RESEARCH GRANTS AVAILABLE

**Data Processing Management Association**
**505 Busse Highway**
**Park Ridge, Ill. 60068**

The Data Processing Management Association (DPMA) will again sponsor a Research Grant program for doctoral candidates. A number of individual awards of up to $2000 will be made to candidates who perform the necessary research and prepare doctoral dissertations in the field of data processing systems and management. The research should be directed toward methods of management planning, control, organization, and decision-making with regard to automatic data processing technology.

Applicants must be doctoral candidates at accredited graduate schools. The doctoral committee must have already been appointed by the university, and the proposed research, including content and methodology, must have been approved. A copy of the accepted manuscript is to be submitted to the Association, which will have first option to publish.

Applications for 1968-69 grants must be received at DPMA International Headquarters no later than March 1, 1968. Additional information and application forms can be obtained by writing to the address above.

## FIFTH ANNUAL COMPUTER PROGRAMMING CONTEST FOR GRADES 7 TO 12

**Association for Educational Data Systems**
**Programming Contests**
**Computer Instruction Network**
**607 Chemeketa N.E.**
**Salem, Oregon 97301**

A contest designed to stimulate inventive interest among young students in the computer programming field is being sponsored for the fifth year by the Association for Educational Data Systems (AEDS). April 8, 1968 is the deadline for entries. Students in grades 7 through 12 are eligible to enter.

The grand prize winner will receive a $150 U.S. Savings Bond, plus an all-expense-paid trip to the 1968 AEDS Convention in Fort Worth next spring. The winning pupil's teacher also will receive an all-expense-paid trip to the convention.

Second prize awards of $50 U.S. Savings Bonds will be given, and students who submit projects are also eligible to receive a one-year subscription to a professional publication.

A project may be submitted by an individual or by a team of two or more students. In the event that the project winning the grand prize is submitted by a team, the team must select one of its members to make the trip to Fort Worth.

Students wishing more details and an application blank should write to the AEDS Programming Contest at the above address.

The 1967 winner was Richard Baum, a 12th grade student at Abraham Lincoln High School, Brooklyn, N.Y. His project, "Simulation of an Orbital Rendezvous and Docking Maneuver on a Small Digital Computer" was written to operate on a Monrobot XI computer.

# ACM SIGPLAN TO SET UP REGISTRY FOR SOFTWARE NAMES

**Arnold D. Sobol**
**SIGPLAN Registry Subcommittee**
**Lockheed-California Co.**
**D/83-13, Bldg. 66, Plant A-1**
**P. O. Box 551**
**Burbank, Calif. 91503**

With the explosive growth of computing, and especially computer programming, the problem of duplication among software names and acronyms is growing ever more acute. To tackle this problem, the Special Interest Group on Programming Languages (SIGPLAN) of the Association for Computing Machinery (ACM) has established a Registry Subcommittee to maintain a registry for the names of computer programming languages, and for major, publicly-reported software packages, where inadvertent duplication of names could cause confusion in the computing literature.

The services to be provided by the SIGPLAN Software Registry will include the following:

1. Register submitted names and acronyms. Duplicates would be registered, but submitters would be informed of previous registrations and their legal status, and advised to cancel their entry and make some other choice.
2. Answer queries regarding registered names and acronyms.
3. Annually solicit and regularly accept revisions to existing entries.
4. Annually publish the complete register.

It is expected that the creation and maintenance of the SIGPLAN Software Register will be a considerable undertaking. A retrospective literature search is under way to compile an initial version of the register, and a continuing literature search will be conducted for reports of new programming languages and software packages. These would be entered in the register, and the authors would be sent a copy of the entry, and also a form letter inviting them to complete, revise, or validate it. Should a name or acronym thus uncovered be already registered, the author would be informed of this and advised to consider a change.

# AMERICAN SOCIETY FOR INFORMATION SCIENCE IS CREATED

**Dr. Bernard M. Fry, President**
**American Society for Information Science**
**2000 P St. NW**
**Washington, D.C. 20036**

A new professional society was created in October, 1967 at the National Convention of the American Documentation Institute, when that group voted to reconstitute itself as the American Society for Information Science.

This change reflects great development in information science, and the next 30 years are certain to witness further tremendous developments in information science. The American Society for Information Science aims to provide leadership in this field.

Information science deals with the diverse fields that comprise communication: recording, microfilming, indexing, abstracting, translating, filing, storing, retrieving, publishing, and disseminating the ever-growing output of research data in all fields of knowledge.

# INTERNATIONAL GROUP FOR ADMINISTRATIVE DATA PROCESSING IS FORMED

**American Federation of Information Processing Societies**
**345 East 47th St.**
**New York, N.Y. 10017**

A special-interest group on administrative data processing (ADP) has been organized under the auspices of the International Federation for Information Processing (IFIP). Called the "IFIP ADP Group" (IAG), the new organization has as its basic aim the international interchange of information in the field of data processing as applied to public and business administration. Up to this time, there has been no international organization specifically concerned with the administrative field.

The IAG has begun publication of a bi-monthly bulletin (in English) containing news of international activities, including reports on special projects undertaken by the group itself. It also publishes a monthly journal of documentation abstracts (in English, French and German) of important papers in the field of ADP. Several special technical reports have been produced in English, including a survey on Network Analysis and another on Automatic Literature Processing. A quarterly technical journal, which will make available in English original papers and papers that have previously had limited distribution in other languages, is planned for the near future. The Group will also sponsor occasional international symposia on subjects of broad interest in the ADP field.

Subscription to the publications and other services of the IAG are provided automatically to "partners" of the Group. Any company, computer center, interested organization, or individual may become a "partner" by application to the Group and payment of a $100 annual fee.

Further information and partnership applications forms may be obtained from AFIPS Headquarters at the above address. Organizations outside the United States may write directly to IAG Headquarters, 6, Stadhourderskade, Amsterdam W. 1, Netherlands.

## ACM NATIONAL CONFERENCE IN AUGUST 1968 — CALL FOR PAPERS

**Marvin W. Ehlers, Program Comm. Chrmn.**
**Ehlers, Maremont & Co., Inc.**
**57 West Grand Ave.**
**Chicago, Ill. 60610**

The 1968 National Conference and Exposition of the Association for Computing Machinery will be held in Las Vegas, Nevada, August 27-29, 1968. Papers are invited for presentation at sessions. Areas of interest are suggested below as a guide for submission of papers:

On-line Automatic Indexing and Classification
Simulation of Continuous, Discrete and Combined Systems
New Applications of Simulation Techniques
Selection and Training of Computer Personnel
Administrative Applications in the University
Computational Techniques in Civil Engineering
Data Management for Urban Planning
Techniques for Symbolic and Algebraic Manipulation
Computer Graphics
Computer Assisted Instruction
Design Automation
Language Implementation Tables and Techniques
Artificial Intelligence
Data Transmission for On-Line Terminals
Certification of Numerical Routines
Interactive Numerical Analysis
General Purpose Mathematical Programming Systems
On-line Programming Languages: Alternative Approaches
General Purpose Languages
Development and Operation of Remote Access Utilities
Pricing Strategies for Computing Centers
Real-time Systems — Operations and Applications
Testing and Conversion of Real-Time Systems
Systems Acceptance Criteria
Evaluation of Computer Installations

Only papers which have not been presented or published previously should be submitted. Each paper must include an abstract of 100–150 words, and a text not to exceed 7,500 words.

Five copies of the abstract and of the entire paper must be submitted to me at the above-address by March 1, 1968.

## DECEMBER EDITORIAL — CORRECTION

The hypothesis that the word "hypotenuse" is spelled "hypothenuse" is incorrect — we regret the uncorrected error in our editorial last month, *Computers and Automation*, December, 1967, page 6, eighth paragraph.

# Prospects in Municipal Information Systems: THE EXAMPLE OF LOS ANGELES

*Takuji Tamaru*
*General Manager*
*Data Service Bureau*
*Los Angeles, Calif.*

*"Los Angeles' move to centralized data processing is proving its worth. The Data Service Bureau budget is a little higher today than the cost of the separate data processing facilities existing four years ago — but for the modest cost increase, the Bureau is handling a workload that has more than doubled."*

The City of Los Angeles, which currently includes 2.7 million residents served by 47 separate departments and bureaus with a staff of 32,000 employees, is considered one of the pioneers in the application of automatic data processing techniques to municipal government. As early as 1922, the Los Angeles Police Department mechanized tabulation and analysis of crime statistics and developed novel search techniques. This was followed in 1925 by the first automatic operation for utility billing in the world, inaugurated by the L.A. Department of Water and Power.

In the 1940's the city's Civil Service Department began scoring examinations and preparing eligible lists by machine, and the City Controller and City Clerk started using ADP systems for processing payrolls, sales taxes, business licenses, and the like. When first and second generation electronic computers and tape systems became available in the 1950's, Los Angeles was one of the first municipalities to install them.

Thus it is hardly surprising that in late 1963, when it was decided to halt proliferation and dispersion of data processing facilities, the City had 12 installations in various departments, ranging in size from an EAM system with a machine rental of $9,000 per year to a complex EDP facility comprising three computers and extensive associated equipment.

An earlier study and an Administrative Services Review Committee had established that centralization of all data processing was required to eliminate wasteful overlapping and duplication of data processing applications in various City departments, and to achieve maximum economy, efficiency, coordination, and control. Moreover, only a centralized DP facility would make possible the later implementation of a unified municipal information system designed to assist all City levels in their operational and planning functions.

In December 1963, the City Council passed an ordinance that established a Data Service Bureau (DSB) for centralizing all data processing functions of the City except those of the Department of Water and Power. These were considered too large and specialized to be advantageously consolidated. Interim control and management of the Data Service Bureau was to reside in the City Controller. Final control of the DSB was to pass to a seven-man Board of Administration, in which various City elective and appointive officers were to be represented under the chairmanship of the City Administrative Officer.

Takuji Tamaru was appointed General Manager of the City of Los Angeles Data Service Bureau in the spring of 1966, after a nationwide, competitive examination. He is assisted by a staff of 200 analysts, programmers, systems specialists, operators, and clerical personnel, who are divided into three major divisions: Systems, Operations, and Data Control.

### Three Phases to LAMIS

The ultimate objective of centralization — the development of a Los Angeles Municipal Information System (LAMIS, for short) — is to be achieved through an eight-year Master

Plan, which is divided into three major phases. Phase I consisted of overall plans and implementation schedules; specifications, selection of, and training for new-generation computing equipment, and physical consolidation of existing ADP facilities. Phase II comprised installation and implementation of IBM System/360 Models 30 and 40, the necessary system redesign and conversion of existing punched card applications and computer programs, and also the conceptualization of new applications. Phase III covers reconceptualization and redesign of the various applications and subsystems into a coordinated municipal information system. The entire plan is to be completed by 1972.

The planning phase (Phase I), resulting in physical consolidation of the City's ADP facilities under the roof of City Hall, was completed in late 1964. By that time the Data Service Bureau was running 450 applications for 44 separate departments or offices, with the jobs ranging from payrolls to engineering computations.

The decision to install the medium-scale System/360 Models 30 and 40, each with a full Operating System, was arrived at through extensive study and analysis by a special task force. The decision not only provided Los Angeles with a new generation data processing potential equal to or ahead of that of any governmental organization of similar size, but also yielded a number of significant additional advantages:

- The system was compatible with existing computers and programs such as the IBM 1401. Planned expansion would not require a change in program logic or new input/output devices.
- The 1401 Emulator (delivered with Model 30) would permit a smooth transition of existing EDP applications to the new computer, with reprogramming to follow.
- System/360's capacity to perform binary and decimal arithmetic operations concurrently would permit processing of scientific, engineering, and accounting applications on the same system with good efficiency.

The use of the full Operating System — though one of the smaller operating systems could have been used initially — was anticipated to yield an immediate increase in system throughput and continuous processing of a vast number of jobs written in a variety of source languages. It was also expected to provide the DSB staff with the necessary experience for phasing in multi-programming and a number of on-line and real-time applications. Further it was hoped that OS/360 would materially lighten the programming effort for future applications through program segmentation and better diagnostics, and would provide a consistent job priority scheduling and job accounting system.

The System/360 Model 30 was delivered and installed in December 1965, and the basic programming became available in January 1966. The equipment consists of the 2030 central processing unit with 65K bytes storage, two selector and one multiplexor channels, four 2402 nine-track dual-drive magnetic tape units, one 2404 tape unit and control with a seven-track drive, a 2311 disk drive and control unit, the 1403 printer and 2540 card read/punch with their control unit, and 1052 printer-keyboard and 1051 control unit. The latter are part of a 1050 data communications system with eight remote terminals which are presently used off-line. The computer also was equipped with the 1401 Emulator.

The Model 40 was delivered and installed in November 1966. Its configuration is similar to that of the Model 30, but the 2040 central processing unit has more than 131K bytes storage capacity and there are an additional five 2400 series magnetic tape units and three 2311 disk drives. The 1401 Emulator was not needed, since the Model 40 is used primarily for implementing new applications.

### Redesign, Reprogramming and Emulation

At the time of System/360 installation, the Los Angeles Department of Public Works had 197 separate punched card (407-EAM) applications requiring over 7000 hours per year of 407 running time. The redesign and conversion of these applications into a unified information system, capable of running efficiently on the new computers, is a major undertaking still in process. Also requiring conversion were the more than 560 1401 programs and 240 SPS programs. Three techniques are being utilized for this purpose:

1. Use of the Emulator as a transitional aid;
2. Redesign and reprogramming in System/360 COBOL or FORTRAN IV for engineering and scientific programs;
3. Reprogramming in System/360 Assembler Language.

Emulation has proved successful. Actual running time of most programs on the Model 30, using the compatibility feature, was on the average two times faster than on the existing 1401 computers. Successful Emulation permitted the return of one of the 1401's as early as December 1965.

Reprogramming of 1401 programs written in AUTOCODER language (as well as new applications) into System/360 COBOL language ran into some difficulties. Most were due to the use of the relatively small E-level compiler — the only one available at the time — in conjunction with the highly sophisticated full OS/360 Operating System. The fact that our then understaffed Data Service Bureau had to learn to cope quickly with this complex operating system did not help matters any.

However, by the middle of 1966, the operating system and the COBOL compiler were operating in a satisfactory manner and the huge task of program conversion has now been more than half completed. A number of 1620 scientific programs have also been successfully converted to the OS/360 FORTRAN IV Compiler. In a few cases, where running efficiency was highly important, conversion to the Assembler language was carried through.

To run the vast and highly diversified applications of a city the size of Los Angeles on computers without an effective operating system is virtually unthinkable, if not impossible. This is true not so much because of the advanced features — multiprogramming, real-time on-line processing, time-sharing, etc. — which some operating systems can provide, but primarily because of such fundamental capabilities as smooth, programmed job flow, priority job scheduling, data management, file maintenance, and flexible, automatic allocation of system resources. Operating System/360 maintains the flow of DSB services around the clock, virtually without operator intervention, and provides extensive job accounting, along with a complete log of Data Service Bureau activities. This, in turn, yields the information we require to evaluate the effectiveness of the installation.

The general operation of OS/360 may be understood by reference to the simplified block diagram (Fig. 1). The Operating System, located in disk storage, consists essentially of a complex control program and a number of processing programs. The control program, acting on control card specifications, directs the operation of the entire system, supervises the job flow through the system (job management) provides job and input/output device scheduling, and controls the location, storage, and retrieval of data (data management). The processing programs include RPG, Assembler and Compilers, sort merge programs and utilities, and of course, our own application programs. Control functions fall into three major categories: data management, job mangement, and task management.

## Data Management

*Data management* enables the systematic classification, identification, storage, cataloging, and retrieval of all types of data and programs processed by the operating system. The system controls physical location of data and allocation of storage space. The programmer need not know the actual location, but can retrieve the data or program by its symbolic name. Data management also includes the function of an expanded Input-Output Control System (IOCS) through pre-written sets of instructions. The input/output specifications need not be supplied until a job is ready for execution; this permits programs to be designed, debugged, and inter-changed *independently* of the I/O devices required at execution time. Data management, finally, provides protection of security files — on reading or writing — through the use of "passwords" supplied by the console operator. Each city department has access only to its own files. The assurance of privacy of departmental security information was a major factor in overcoming resistance to centralization of data processing facilities. As a further safeguard, all DSB operating and programming personnel have been bonded.

## Job Management

Through *job management,* the operating system assures a continuous and orderly flow of jobs. Routine job activities are performed automatically. For example, if the operating system cannot complete a job because of programmer error, it automatically skips to the next job. The functions of the console operator are performed in advance through a job control language, which defines an orderly, sequential stream of jobs.

Job management is performed primarily by two program modules known as master scheduler and job scheduler, along with several supporting routines. The master scheduler serves as a two-way communications link between the operator and the system. For example, by issuing commands to the master scheduler, the operator can alert the system to a change in status of an input/output device, or direct it to process messages from remote terminals concurrently with job processing.

The incoming job stream is read and analyzed by the job scheduler. It first collects and organizes all program and file requirements for each step of the job and allocates the necessary input/output devices. The job scheduler next requests the supervisor program to initiate the job step, which thereby becomes a "task" to be handled by the CPU.

While most of the Data Service Bureau jobs are in sequential order for batch processing, there are also available the optional multiprogramming features that enable several jobs to be processed concurrently and to be rescheduled in the order of their priority. Three job priorities are presently

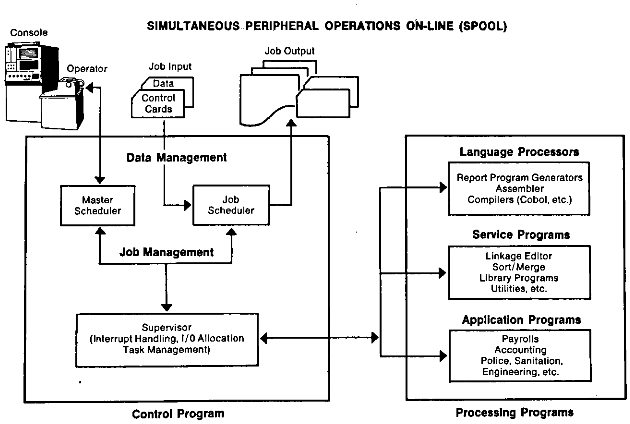


Fig. 1 Organization of Operating System / 360

assigned. The job scheduler also permits concurrent peripheral operations, allowing the operator to mount disk packs or tape reels for one job while other jobs are being processed. Additional routines enable the system to spool such peripheral tasks as card-to-tape data conversions without delay.

## Task Management

*Task management* allows several tasks to be processed concurrently and automatically, thereby increasing throughput. A task is any unit of work (job step) to be done by the CPU under the direction of the supervisor. The supervisor consists of a series of programs and subroutines that perform such varied control functions as interrupting the main program to gain access to the CPU; "attaching" and "detaching" tasks and dispatching them to a task queue; allocating main storage space and, when feasible, sharing areas of main storage among routines (overlay); scheduling input/output operations; recognizing exceptional conditions and errors; and supervising the concurrent execution of programs and routines.

1. Uniform Payroll System.
2. Modern Accounts Payable System (MAPS).
3. Coordinated Inventory Control System (COINS).
4. Sanitation Management Information System (SANMIS).
5. Automated Library Technical Services (ALTS).

A major benefit of multiprogramming is more efficient allocation and sharing of the computer's basic resources. The basis for it is a continual switching of control, or interleaving, of tasks, which may take place on two levels: (1) between tasks of the same job or job step (called multitasking); or (2) between tasks that are part of different jobs (called multijobbing). While we have hardly begun to experiment with multiprogramming some of our major applications, we have found that it results in a noticeable stepup of Data Service Bureau activity.

## New Applications for LAMIS

During 1966 and early 1967 the Data Service Bureau implemented five new major System/360 applications:

The first three (Payroll, MAPS, and COINS) interphase with each other at many points and are used for performance budgeting, a biweekly checkoff of departmental performance versus budget allocations. They provide the initial data base for Phase III of the plan — the achievement of a coordinated municipal information system.

The uniform payroll system, written in COBOL, consists of more than 50 separate programs and is a horizontal subsystem which embraces all City departments and bureaus. This system must run with top priority on a biweekly basis on both the Models 30 and 40.

Modern Accounts Payable (MAPS), which runs on the Model 40, is an advanced system for paying vendors and others doing business with the City. A uniform, punched purchase order serves as master document for all transactions (verification, receipt, etc.), thus bypassing the vendors' invoices usually required for payment. MAPS reduces clerical work, speeds payments to vendors, and as a built-in bonus, permits the realization of enough in cash discounts to justify the initial cost of the system.

The Coordinated Inventory Control System (COINS), now nearly complete as a Model 40 production program, provides purchasing agents for the first time with information on type and quantity of supplies held in the inventory of various departments.

SANMIS is a sophisticated information system that supplies sanitation management and first level supervisors with the data they must have to effectively control the City's $16 million per year refuse collection program. Data on tonnage by load, man-hours worked, and miles driven by each of the City's 400 refuse trucks is collected through six remote 1050 data communication terminals, which feed into the central printer-keyboard at the Data Service Bureau. The information is processed and redistributed to district collection foremen. Exception reporting informs higher level management of conditions that may require decisions; for example, breakdowns or abnormal overtime and tonnage trends. Long-range planning is facilitated through computer-aided statistical analysis and forecasting techniques based on the information collected. Payroll data and information for performance budgeting is also extracted from the basic data, making the operating system compatible with the city-wide information system. SANMIS is presently being run off-line, but will be connected shortly to the multiplexor channel of the Model 40 computer as an on-line application.

The Automated Library Technical Services are conceived as a five-part program for developing a fully automated information system for the Los Angeles Public Library. Presently implemented are two parts — patron registration and book ordering. The registration system automatically maintains the records of more than 800,000 library users and keeps track of loans, overdues, and fines. The City purchases more than 267,000 books (62,000 titles) annually, which used to require over $130,000 just to place the orders. Now, a 1050 has been installed at the chief source of the City's books in Reno, Nev., eliminating clerical work and substantially speeding book ordering. The system also handles book status reports and various accounting and budget control functions not heretofore performed. Though presently off-line, the library terminal will soon be on-line to the Model 40; the job will then operate as a once-a-day background program.

Finally, daily operations and transactions of the Los Angeles Harbor Department are presently being reported off-line via a 1050 located at the port. This will also operate on-line. Some daily operations will also be transmitted to a master file on an exception basis. A daily report will be returned to the Harbor Dept.

### Looking to the Future

Realization of the Los Angeles Municipal Information System, through development of new applications and subsystems, is progressing at a rapid pace. At this writing, a Civil Service Examination File and Retrieval System, processed and stored on the Model 40, is nearing completion. Within the next year or so, library services will be expanded to include remote information retrieval of the entire catalog of shelf titles through ten on-line terminals. This will be followed by an automated circulation system using remote transactors. The Police Department's Wants & Warrants tape file will be converted to mass random access storage and placed on-line for real-time processing. Later, this operation will be transferred to Los Angeles County for eventual consolidation into a national police information network.

A little further in the future, when we have built a comprehensive data base serving all City departments, we intend to bring this information repository to the entire community through a city-wide network of Branch Administrative Centers. These little City Halls will be linked by an information network operating via on-line time-sharing and message switching. Los Angeles' move to centralized data processing is proving its worth, and paying off financially. The Data Service Bureau budget is a little higher today than the cost of the separate DP facilities existing four years ago, but for that modest cost increase the Bureau is handling a workload that has more than doubled. Finally, the stage has been set for continued expansion to better serve the needs of a community which is still growing rapidly.

## EDITORIAL

(Continued from page 6 )

### What about "junk mail"?

What is one man's junk mail is another man's valuable information.

In the office of *Computers and Automation* we receive over 600 pieces of mail each week. Of this a goodly portion consists of publicity releases — unsolicited — about new products, new installations, new contracts, new equipment, new software, coming events. From this unsolicited mail we fill several wastebaskets a day — but also we find out much news, many ideas, and every now and then something of great interest and importance to us.

We hope to develop C A U M L eventually into a more selective list. In the days to come when computers can work well with a list of 200,000 names, we hope to attach signals to the entries of names and addresses, so that the request "please do not send me mail on subjects ........................ because I am not interested" will automatically be fulfilled.

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If you wish to have your name and address included in the C A U M L, please circle no. 1 on the readers service card. Or write us a request on any convenient piece of paper.

For example, some of the kinds of material that may be mailed to part or all of this list will be:

- — an announcement of a new small-scale general-purpose computer;
- — announcements of courses, seminars, conferences, and meetings;
- — calendars of coming events;
- — tables of contents of issues of magazines in the computer field, etc.

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By now there are more than 200,000 people in the computer field. The largest existing commercial (non-manufacturer) mailing list is apparently about 60,000; its use is restricted to the publishers of one magazine. Of commercially available mailing lists, probably the largest single list is about 35,000 names. Societies are limited to persons who will pay dues. Paid circulation magazines are limited to those persons who will pay the subscription cost. Controlled circulation magazines are limited to the number of persons that advertisers are willing to subsidize the magazine to try to reach, i.e. the number that advertisers think "exert a possible buying influence." Most controlled circulation magazines therefore cannot currently go over about 60,000 circulation. So it is silly to try to cover the computer field of over 200,000 persons with the existing pattern of rentable mailing lists. A universal mailing list is needed in the computer field.

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Edmund C. Berkeley

# Quiz for Big-Computer experts. Part 1:

1. Open ended time-sharing PDP-10's are being delivered. Other companies delivering time-sharers are__________.

2. Complete time-sharing software is now being delivered with the PDP-10 hardware. Others delivering completely integrated hardware/software time-sharing systems are__________.

3. Digital's PDP-10 can directly address up to 262,144 36 bit words. It has a 1 usec memory cycle time, a logically complete order code, 7 fully nested programmable interrupt levels, 16 accumulators (15 of which can be used as instantaneous index registers), a high speed, full word multiplexer, and floating point hardware. An equivalent computer might be__________.

4. Basic PDP-10's go for as low as $113,000 but most customers usually buy everything they need to solve big problems. The typical PDP-10 time-sharing system actually sells for between $300,000 and $400,000. An equivalent problem solver from another company probably costs__________

5. General purpose, multi-user PDP-10 systems can handle multiple jobs simultaneously — conversational time-sharing, real-time simulation and control, batch processing. What other computing system can do this?__________.

6. How much does it cost?__________.

7. **PRIZES:** Part one of this quiz will be followed by part 2 and part 3. What, beside a PDP-10 brochure, do you consider an appropriate prize for answering all questions in the three parts correctly?__________And what would you consider an appropriate prize for the man who suggests the most appropriate prize?

Send Entries to Dept. A, Digital Equipment Corp., Maynard, Mass.

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# A Glimpse at the Future in Computer Centers –

# THE TECHNICAL COMPUTER CENTER AT

*Technical Computer Services Department*
*Ford Motor Company*
*Dearborn, Mich. 48121*

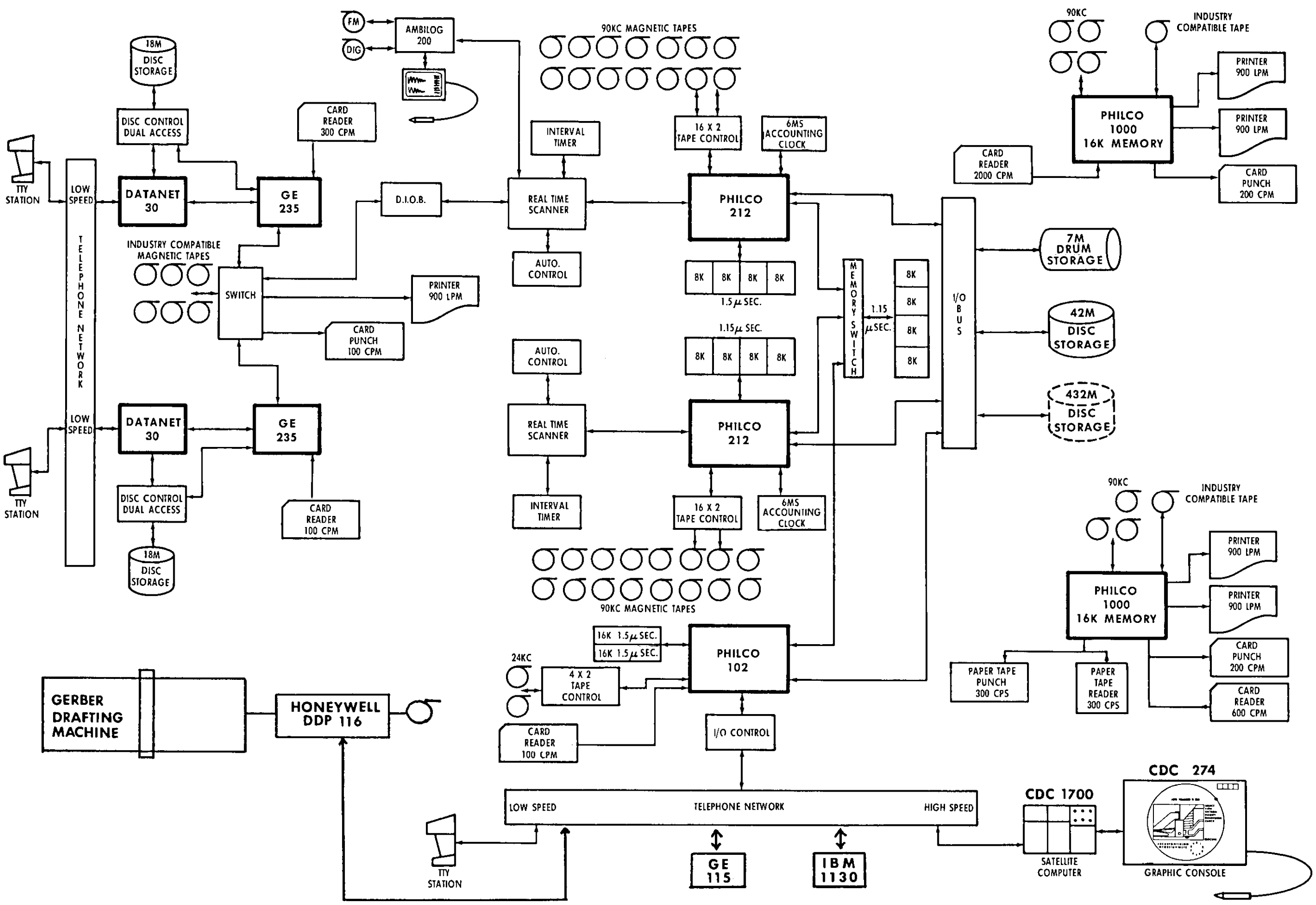


Figure 1. Configuration Diagram of the Ford Technical Computer Center

# FORD MOTOR COMPANY

*"The Technical Computer Center now includes 22 major computer systems built by 10 different manufacturers. Over 150 remote terminals or computer sub-stations can access the system through standard phone lines — and more than 100 people per month are being trained in the use of the time-sharing system, the use of the BASIC programming language, and the use of fundamental programming techniques."*

The Engineering Staff of the Ford Motor Company operates one of the largest technical computer complexes in the world. "Automotive Industries" in a comprehensive survey rated the Ford installation as "the most ambitious and advanced complex to be found at the present time." The computer facility serves Ford operations throughout the United States and overseas via a transatlantic link. A number of vendors and universities also have access to the center in cases where their efforts are of mutual interest to the company.

The heart of the computing complex is a network of large-scale Philco scientific processors which are supported by Philco input/output processors, General Electric time-sharing computers, an Ambilog 200 hybrid computer, a Gerber automatic drafting system, magnetic tape controlled digital plotter, large-scale random access devices and a staff of technical personnel.

### Machine Independence

With the recent installation of the Control Data Graphic Display equipment, the Technical Computer Center now includes 22 major computer systems built by 10 different manufacturers. (See Figure 1.) Most of this complex is directly linked through specially designed interface equipment. Over 150 remote terminals or computer sub-stations can access the system through standard phone lines.

The software available includes 11 major compiler languages and 10 problem-oriented languages which operate under 7 different executive systems. (See Figure 2.) Also available are nine assembly languages and several translation aids for the system programmer.

### Philco

The Philco 212 is the latest model of the Philco computer

| | |
|---|---|
| <u>Compilers</u> | <u>Self-Instruction Packages</u> |
| FORTRAN II | BASIC |
| FORTRAN IV | ALGOL |
| BASIC | FORTRAN |
| ALGOL | |
| MAD | <u>Operating Systems</u> |
| SLIP | FORDEX (212) |
| BEEF | 32KSYS (212) |
| TOPS | 8KSYS (212) |
| JOVIAL | RINGMASTER (1000) |
| COBOL | DARTMOUTH TSS (GE-265) |
| PL/2 (Advanced Time-Sharing Language) | AMOS (Ambilog) |
| | MSOS (CDC-1700) |
| <u>Problem-Oriented Languages</u> | <u>Assemblers</u> |
| SIMSCRIPT | P-212 (TAC) |
| SAMIS | P-1000 (OPAL) |
| KAM | P-102 (SHAL) |
| APT (Version 8) | GE-235 (GAP) |
| MIDAS | GE D-30 (GAP) |
| MIMIC | GE-115 (APS) |
| PERT | A-200 (ADEPT) |
| XMAS | CDC-1700 (Macro) |
| STAT-2000 | DDP-116 (DAP) |
| LP-2000 | |
| <u>Special Aids</u> | |
| BASIC-to-FORTRAN Translator | |
| SIFT (FORTRAN II to IV) | |

**Figure 2. Available Software at the Ford Technical Computer Center**

line which introduced solid state technology to the industry, and currently two are installed in the Technical Computer Center. Designed for military command and control systems, the main processors are unique in the computing industry because of their complete asynchronous internal operation. Each processor has its own high speed core memory of 32,768 — 48 bit words in addition to a common memory of 32,768 — 48 bit words which may be used by either processor or both simultaneously. High speed input/output to the two processors is available in a tape or disc media. Sixteen 90,000 char./sec. tape drives are connected to each system, and a 42 million character disc file with a 1,000,000 character per second transfer rate is available from either of the processors.

## Time-Sharing

With the remarkable new development of time sharing, the Center provides direct on-line computer services to operations in the United States and overseas. This system permits engineers and scientists to converse with the Dearborn, Michigan complex in a natural language from their desk-side using remote terminals and regular telephone lines. Each user has his own programs stored in the computer's disc file, and also has access to a comprehensive library of analytical programs and special computer languages.

A completely unique hardware/software interface between the GE 235 and the Philco 212 permits users to run a Philco 212 job from any one of the remotely located teletype terminals. This facility provides a remote user with access to the large Philco disc file and also permits programs to be written and edited "on line."

## Programmed Instruction

For more than a year, the Technical Computer Center has been using interactive teaching techniques for the instruction of new users. (See Figure 3.) The initial effort consisted of a series of 30 programs (chapters) designed to teach a non-computer oriented individual the use of the Ford time-sharing system, the use of the BASIC programming language, and fundamental programming techniques. (See Figure 4.) This approach permits interested users to investigate the use of time sharing and learn the BASIC language by simply dialing a phone number. They can use any chapter at any time of their choosing and progress at their own pace in the privacy of their office. The tutorial approach has proven to be particularly well-suited to training new users who are geographically removed from the central computer facility. This on-line teaching sequence no longer requires an on-site instructor or formal classroom sessions.

Current figures indicate that more than 100 people per month are being trained using the current tutorial sequence. Users include not only scientists and engineers, but accountants, clerks, technicians and salesmen as well. (See Figure 5.)

The Technical Computer Services Department has recently released on-line tutorial packages for Time-Sharing Algol and Time-Sharing Fortran. Other areas under development include Fortran IV, COBOL, APT and SIMSCRIPT.

## Additional Services

The analog data reduction facility features the Ambilog 200, which is a hybrid computer with high speed core memory

---

BE YOUR OWN "COMPUTER EXPERT"

Let the computer itself teach you how to write your own programs! At your own convenience, "sign on" with the procedure listed below at any of the remote terminals located around the Center; and the computer will take it from there.

1. Push "ORIG" button.
2. Dial 28442 or 78500.
3. Wait for the computer to answer, which it will do by typing out an identification code for your particular console.
4. Push "K" button located on far left. (Disregard this step on machines without paper tape capability.)
5. Type "HELLO" and push "Return" key (2nd row, right end). The computer may type a general announcement and then ask for your user number.
6. Type your user number ___________ (this is available from whomever is in charge of the local console). Push "Return" key.
7. The computer will ask for a charge number. Type in the charge number you are to use and push "Return".
8. After computer types "SYSTEM", you type "BASIC" and push "Return" key.
9. It will type "NEW OR OLD"; you type "OLD" (if you want to call out a program already stored in the library). Push "Return" key.
10. It will ask "OLD PROBLEM NAME"; you type in "TUTOR1***" and push "Return" key.

    This is the first of many self-teaching programs available on the Ford time-sharing system.
11. When it says "READY" you type "RUN" and push "Return".

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

12. When finished, type "BYE" and push "Return" and the console will shut itself off.

**Figure 3. Sample Instruction Sheet**

and magnetic tape capability. Many programs for data analysis have already been written; functions such as auto and cross correlation, power spectral density (PSD), and correlated transfer functions may now be obtained from analog recordings. Results can be displayed on a cathode ray tube, and the operator may select options or effect changes by simply pointing with a light pen to key control words on the screen.

```
TUTØR1      9:49   WED.   09/06/67

   CØPYRIGHT 1966 FØRD MØTØR CØMPANY - ENGINEERING STAFF
WELCØME TØ THE FØRD TIME SHARING SERVICE. WE WILL TRY TØ TEACH YØU
ENØUGH ABØUT THE SYSTEM IN THIS SITTING SØ THAT YØU WILL BE ABLE
TØ WRITE YØUR ØWN CØMPUTER PRØGRAMS.

BEFØRE WE CAN WRITE A PRØGRAM WE NEED TØ REVIEW THE SYMBØLS
AVAILABLE:

  [1] +
  [2]  -
  [3]   /
  [4]    *
  [5]     [ ]
  [6]      ↑

AFTER THE ? BELØW TYPE THE NUMBER ØF YØUR ANSWER

WHICH ØF THE ABØVE SYMBØLS IS USED FØR ADDITIØN?1
GØØD.
WHICH SYMBØL IS USED FØR SUBTRACTIØN?2
RIGHT
WHICH SYMBØL IS USED FØR DIVISIØN?3
GØØD FØR YØU. NØW THE NEXT ØNE IS TRICKY:
WHICH SYMBØL IS USED FØR MULTIPLICATIØN?4
VERY GØØD. IF'X' WERE USED FØR MULTIPLY, IT CØULD BE CØNFUSED
WITH THE VARIABLE X. LET'S PRACTICE A LITTLE:
HØW MUCH IS 2*3?5
NØ. REMEMBER, * MEANS MULTIPLY.
HØW MUCH IS 2*3?6
SURE
HØW MUCH IS 3*4+7 ?14
SØRRY, LØØK AGAIN
HØW MUCH IS 3*4+7 ?19
RIGHT YØU ARE.
HØW MUCH IS 3*[1+5]/2 ?9
GØØD
THAT LEAVES ↑ WHICH IS ØUR WAY TØ INDICATE SQUARES, CUBES,ETC.
SUCH AS X↑2 FØR 'X SQUARED' ØR X*X, Y↑3 FØR Y*Y*Y, ETC.
WE ALSØ CAN USE FUNCTIØNS SUCH AS SINE, CØSINE, ETC., AND
YØU CAN EVEN DEFINE YØUR ØWN, BUT THESE WILL BE CØVERED IN
ANØTHER LESSØN.  WE'LL USE SQR [SQUARE RØØT] IN ØUR CØMING
EXAMPLE TØ GIVE YØU THE IDEA. LET'S ASSUME YØU WANT TØ CØMPØSE
A PRØGRAM TØ CØMPUTE RADIUS VECTØRS [THE SQUARE RØØT ØF THE
SUM ØF THE SQUARES ØF THREE CØMPØNENTS.]  THIS PRØGRAM WILL
BE A SEQUENCE ØF STATEMENTS TØ TELL THE CØMPUTER WHAT TØ DØ.
DØ YØU THINK THESE STATEMENTS SHØULD BE NUMBERED:
 [1] CØNSECUTIVELY [1, 2, 3, ETC. ]
 [2] INCREMENTALLY [10, 20, 30, ETC.]
 [3] ANY SEQUENCE FØR IT DØESN'T MATTER
[TYPE NØ. ØF ANSWER]
?3
WELL, THE CØMPUTER DØESN'T CARE SINCE IT SIMPLY WILL DØ THEM
IN SEQUENTIAL ØRDER WHEN IT RUNS YØUR PRØGRAM, HØWEVER
LEAVING SPACE BETWEEN NUMBERS PERMITS EASIER INSERTIØNS LATER.
FØR ØUR SAMPLE PRØGRAM, LET'S FIRST CALL FØR ØUR KNØWN
VARIABLES.  WE SIMPLY TYPE:

10 INPUT X, Y, Z

10 IS SIMPLY THE FIRST STATEMENT NUMBER. X,Y, AND Z ARE
ØUR 'DATA'. NEXT WE WRITE ØUR EQUATIØN BY TYPING:

20 LET R = SQR [X↑2 + Y↑2 + Z↑2]

WHERE 20 IS THE NEXT STATEMENT NUMBER, 'LET' TELLS THE CØMPUTER
THAT AN EQUATIØN IS CØMING, AND 'R' IS ØUR UNKNØWN VARIABLE.
NØTE: UNKNØWNS MUST BE ØN THE LEFT ØF THE '=' AND KNØWNS ARE
ØN THE RIGHT. SQR IS THE SQUARE RØØT FUNCTIØN MENTIØNED
EARLIER. THE REST IS TELETYPE ALGEBRA. FRØM THIS PØINT ØN
'R' CAN BE TREATED AS A 'KNØWN' IN ØTHER EQUATIØNS. IN THIS
EXAMPLE WE'LL TELL THE CØMPUTER TØ PRINT THE VALUE ØF R
BY TYPING THE STATEMENT:

30 PRINT R

WHICH WILL CAUSE THE CØMPUTER TØ DØ JUST THAT. WE NØW ADD
AN 'END' STATEMENT AND THIS IS ØUR CØMPLETE PRØGRAM:

10 INPUT X, Y, Z
20 LET R = SQR [X↑2 + Y↑2 + Z↑2]
30 PRINT R
40 END

WHEN 'RUN' IS TYPED, THE PRØGRAM WILL CALL FØR VALUES ØF
X, Y, AND Z WITH A QUESTIØN MARK.
      [TRY IT: TYPE ANY 3 NUMBERS SEPARATED BY CØMMAS.]
?2,4,8
 9.16515   [THIS IS YØUR 'R' ØR RADIUS VECTØR.]
WELL, THE HARD PART IS ØVER AND NØW THE FUN BEGINS. BY THE
WAY YØU HAVE ANSWERED 7    CØRRECTLY ØUT ØF 10   QUESTIØNS.
IN ØRDER TØ CØNTINUE WHAT WE HAVE BEGUN, IT WILL BE NECESSARY
TØ REQUEST ANØTHER PRØGRAM FRØM ME. TØ DØ THIS,
TYPE 'ØLD' AND USE 'FØLLØW***' FØR THE PRØBLEM NAME. WHEN
THE CØMPUTER IS 'READY' TYPE 'RUN' AND I'LL MEET YØU THERE.
LAST ØNE THERE IS A HUMAN. GØØD LUCK.


TIME:  18 SECS.
```

**Figure 4. A Run of Tutor 1**

An interface connection between the Ambilog and the Philco 212 systems permits the Ambilog to act as a hybrid terminal to the large scientific processors.

Other services include a Gerber 2000 Series Drafting System capable of producing engineering drawings 5′ x 16′ at the rate of 750 inches per minute to an accuracy of ±.003 inches. Additional plotting capability is provided by CALCOMP batch and time-sharing plotters.

## Advanced Projects

An advanced time-sharing system is presently being implemented using the two Philco 212 scientific processors and a Philco 102 communications processor. The advanced time-sharing system will allow users to run larger programs, access private and public data files, save object programs, and initiate background jobs from foreground. In addition to these qualitative improvements, significant increases in performance will occur due to the speed of the 212 processors, the swapping drug storage, and the very sophisticated 102 communications processor.

A second advanced project involves graphic displays. A Control Data 1700 computer has been installed and is linked to a CDC-274 Display Console. The CDC-274 has a flat screen 22 inches in diameter and can display 11,000 inches of vector under control of a light pen. Common access to core memory permits the CDC-1700 computer to handle display manipulation and local processing using a disc for auxiliary storage. An automatic communication link with the central time-sharing facilities will provide large scale support for the more complex operations.

The facilities will be used for computer-aided design, on-line data editing, and Numerical Control applications. Development teams from the Design Center, Body Engineering, Metal Stamping Division, Automotive Assembly Division, and Engine and Foundry engineering activities are participating in the project.

- Coordinate Transformations
- Weibull Analysis
- Equilibrium Constants for Chemical Reactions
- Curve Fitting (Least Squares, etc.)
- Engine Horsepower Calculations
- Solution of Simultaneous Ordinary Differential Equations
- Statistical Analyses of Test Data
- Mathematical Modeling
- Inventory Analysis
- Parts Simplification
- Labor Summaries
- Project Documentation and Summaries
- Manpower Scheduling
- Progress Report Updating and Formatting

**Figure 5. Some Typical Problems Solved by New Users**

# MARKET REPORT

## GOVERNMENT SEEKS NEW DATA ON COMPETITION IN THE COMPUTER INDUSTRY

*Stanley Penn, Staff Reporter*
*The Wall Street Journal*
*New York, N.Y.*

Is International Business Machines Corp. too tough to compete against?

Seeking to answer that question in its current investigation of the computer industry, the Justice Department's antitrust division quietly sent a letter and a five-page questionnaire to each of the major computer makers earlier this month.

The questionnaire, says an official of one company, digs far deeper into specifics about the industry than previous Government queries. It asks for information, by Jan. 15, on the kinds of computers produced, the size of order backlogs, computer revenues from 1961 through 1966 and other matters.

This investigation, first disclosed last January, marks the second time the Government has looked into whether IBM is throttling competition in violation of antitrust laws.

### Second Time Around

The first Federal probe resulted in a 1952 antitrust suit that in 1956 forced IBM to start selling its punched-card tabulating machines, instead of only leasing them. But the suit didn't slow IBM's growth so competitors in the business machines field could catch up, which was clearly the Government's aim. The electronic computer was just beginning to come into its own then, and IBM successfully directed its corporate resources toward leadership of the fledgling industry.

The result: In the 10 years through 1966, IBM's revenues rose 253%, to $4.2 billion, net income soared 376%, to $526.1 million, and IBM got what competitors describe as a "stranglehold" on the computer business. The company has built an estimated 71% of the $10 billion worth of computers in use in the U.S. — more than 10 times as many computers as its nearest competitor, Sperry Rand Corp.'s Univac division, has delivered.

Sperry Rand has an estimated 6.6% of the computer market in terms of dollar volume. Honeywell Inc. has 5.4%, Control Data Corp. has 4.3%, General Electric Co. and Radio Corp. of America each have 3.2%, Burroughs Corp. has 2.7%, and National Cash Register Co. has 1.7%. Several smaller companies share the remaining 1.6% of the computer market.

They are competing for huge stakes. A Merrill Lynch, Pierce, Fenner & Smith Inc. study says the computer industry's "growth in the future promises to be even more dramatic than its impressive development to date." The brokerage firm estimates that more than $6.5 billion worth of computers and ancillary equipment was shipped to customers last year, up from less than $400 million in 1955. The study says that "shipments could reach an annual rate of $15 billion by 1975," and remarks that "even that forecast could prove to be conservative."

(Reprinted with permission from *The Wall Street Journal,* November 22, 1967.)

### Rivals in the Red

Yet some of IBM's rivals already have sunk $200 million to $300 million in computers without having any significant profit to show for it. At least three, and possibly four, of IBM's seven chief competitors are in the red on their computer operations. GE and Burroughs, two early entrants in the field, haven't made a nickel from computers so far. RCA's computer business showed a small profit for a time but has been losing money since the third quarter of 1966. It isn't known whether National Cash Register is making money on its computers.

IBM's competitors don't want to comment publicly on the current Government investigation (neither does IBM, nor the Justice Department), but executives of three IBM rivals privately confess that they consider Government intervention to stimulate competition in the industry long overdue. Some competitors make no secret of what they would like to see result from the current probe: Some sort of Federal limitation on IBM's growth — perhaps by restricting IBM's future share of such new computer markets as education, medicine and time-sharing services. At the very least, one rival would like to see the Government require IBM to charge customers for services it now provides free.

Some of the woes of IBM's chief competitors are their own fault. It's generally agreed in the industry that Univac, which introduced the first commercial computer in 1951, has failed to build a strong sales and service force — a key reason Univac's early industry lead dissipated before the onslaught of IBM's army of smooth, aggressive salesmen and highly trained repairmen. And Ralph J. Cordiner, former GE president, candidly admitted in a recent Forbes magazine interview that GE blundered by not putting its very best men in charge of the computer group it set up in 1956. In recent years, GE has been putting some of its brightest executives in charge of various computer operations and has been pumping huge sums into development of computer operations in Europe. Even so, GE and its French computer partner, Compagnie des Machines Bull, have shared a loss of $73.9 million over a two and one-half year period through 1966.

### A Running Start

But it's also true that IBM's dominant role in the punched card tabulating machine business gave it a running start in the computer field. It was natural for satisfied users of IBM tabulating machines to use IBM computers. And IBM's income from leased tabulating machines provided the company with the large cash flow it needed to plunge into computers.

The new field's swiftly advancing technology made customers understandably reluctant to spend hundreds of thousands of dollars to buy computers that they knew would be obsolete within five years, but customers were eager to lease the machines. IBM leased its computers for a year at a time; its competitors followed suit.

IBM's revenues from tabulating machines kept the company out of the financial bind that many of its competitors faced as a result of the huge spending needed to develop computers, coupled with the painfully slow recovery of their investment through leasing. A manufacturer often doesn't show a profit on a leased computer until the customer has had it for at least four and a half years. (In the past year, IBM's rivals have had some success in getting customers to agree to longer-term leases of three to five years.)

Some IBM competitors say that Government buying practices over the years also helped IBM gain dominance. The head of one rival computer maker claims that Federal "procurement specifications are written around IBM machines," a charge that Government purchasing men deny.

This computer executive also maintains that Air Force purchasing officers "want aerospace firms to stick to IBM machines" and, in some cases, have refused to allow aerospace companies to buy from other manufacturers on the ground that costly new computer programs would have to be prepared for non-IBM machines.

IBM's competitors have squawked publicly about some of the Government's procurement practices. This summer the Air Force was forced to cancel a $114 million contract it had awarded IBM. Several losing bidders, including Honeywell, charged the IBM contract would cost the Government many millions of dollars more than any of the losing bids. The Air Force, which at first insisted that only IBM's machines met the required specifications, agreed to seek bids again as a result of pressure from the General Accounting Office and Sen. John L. McClellan's Senate Investigations subcommittee.

But IBM's share of the rich Government computer market has shrunk in the past few years. A Washington source says IBM computers currently account for 35% to 40% of the Government's inventory, down from 65% in 1963. "I think you'd have to say the Government is leaning over backwards to be fair," he says.

In fact, IBM's share of the overall computer market has been declining recently. One industry source says that even though IBM accounts for 71% of the computers in use, the company's share of today's computer market is probably between 55% and 65%. He estimates that IBM currently has over 65% of the market for medium-priced computers but less than 55% of the market at the high and low ends of the price scale.

### Fighting for a Share

This situation, however, doesn't console IBM's rivals. "Two-thirds of the business isn't competitive because customers just reorder IBM machines," grumbles one competitor.

Another competitor asks: "When IBM has two-thirds or so of the market, and at least 10 times more machines out than anybody else, can the marketplace regulate competition? Or does IBM have such tremendous economic power that competition can't work?"

Nevertheless, IBM's rivals hope for better days. "If we didn't believe we could begin making a profit at some point, we wouldn't stay in," says one company. With the industry growing 15% to 20% a year, big, profitable companies like GE, RCA and Burroughs figure they can well afford to pour cash into computer operations that are losing money now but have tremendous growth potential. Burroughs recently said it expects to be making a profit on computers by 1969. Honeywell moved into the black on its computers just last year.

One aspect of the long-term industry outlook may work to the advantage of IBM's competitors. Peripheral equipment for computer systems is expected to account for a bigger and bigger chunk of the total market. The computers themselves already operate at lightning speeds, so much of the industry's future emphasis will be on efforts to make such equipment as display screens and printers more efficient and versatile. IBM's rivals won't labor under such heavy disadvantages in this area.

### "Room to Grow"

"If this were a static market, I would be discouraged," says an official of an IBM rival. "But with this potential, there's room for a little fellow to grow."

Some industry officials contend that the entire computer market already is fiercely competitive and that the competition between IBM and other manufacturers is bringing customers improved products at lower costs. By way of example, a source friendly to IBM says that it cost a user $1.38 to perform 100,000 multiplications on one of the most efficient computers available in the late 1950s; the same calculations today would cost the user of one modern computer 3.5 cents.

At least one IBM rival company, however, believes the computer business would become far more competitive if Federal trustbusters ordered IBM to quit providing free services to its customers — including preparation of computer programs and visits from IBM systems analysts who show customers how to adapt a computer system to their own needs. Competitors complain that they can't match the services that IBM provides for no charge beyond the lease or purchase price of its machines. If IBM had to charge extra for such services, one of its strongest selling points would be eliminated, some industry sources believe.

IBM makes a point of instructing its salesmen never to belittle competitors or try to induce a customer to cancel an order for a rival's computer. But some rivals accuse IBM of using a more effective ploy to undercut competitors' marketing efforts — premature announcements of new IBM computers.

### An Early Announcement?

IBM insists it does not publicize new computers unusually far in advance of availability, but some industry sources contend IBM used a premature announcement ploy against Control Data a few years back. Control Data's Model 6600, a new $6 million computer system, was announced in October 1963, for delivery beginning in 1965. In August 1964, IBM announced a rival computer, IBM Model 90, with no delivery date specified. William C. Norris, Control Data president, has said that after IBM's announcement some customers deferred orders for the 6600 until they could learn more about the IBM 90.

The cool reception Model 6600 received, together with technical problems in producing it, contributed to a net loss of $1.9 million for Control Data in the fiscal year ended June 30, 1966. The company had a dramatice recovery in fiscal 1967, as it began delivering more Model 6600s, and reported net income of $8.4 million for the year.

Technical problems also caused delays in production of IBM's Model 90. Instead of shipping six of the huge computers this year, as it had forecast, IBM will ship only one, but it plans to deliver them at a rate of one a month during 1968. Earlier this year, the company quit taking orders for Model 90s, saying the computer system was a "limited program" aimed at producing technological advances that will benefit future IBM products.

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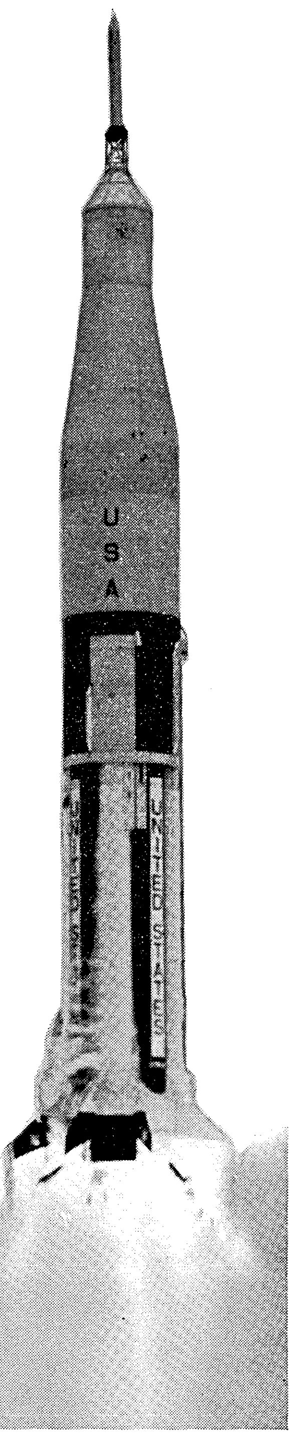
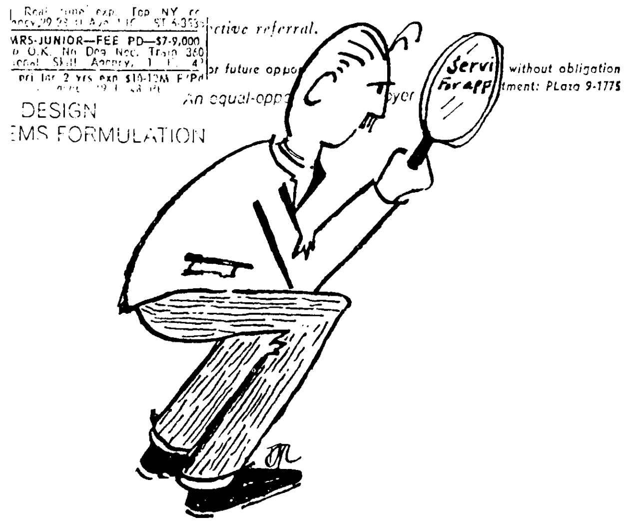


# JOBS AND CAREERS IN DATA PROCESSING




## THE CHANGING NATURE OF PROGRAMMING

*Dr. Paul S. Herwitz*
*Director of Programming Resources*
*IBM Corporation*
*Armonk, New York*

A glance at the "help wanted" columns of most newspapers today offers ample evidence of the current programmer shortage. What isn't quite so evident in these listings, however, is the changing nature of the job. Programming is no longer just a matter of defining a problem and then translating its various steps into binary code. It has become a highly sophisticated profession encompassing a variety of specialties and demanding people with varying academic backgrounds.

This change has been evolutionary rather than revolutionary in nature. From a software standpoint, the early computers were relatively simple devices. To get them to run, the programmer went through the tedious process of translating program steps into binary code and then having this code punched into cards. The card deck, in effect, served as the one and only set of instructions needed by the machine to process a job.

But the early computers were comparatively slow, cumbersome machines. When the second and, more particularly, third generation of computers arrived, the machine's capabilities increased dramatically. Instead of being limited to a single job at a time, computers could now handle many assignments together, cater to a variety of remote terminals, and generally handle data at a rate that left the older models in the dust.

But faster, more versatile computers required a more complex variety of systems programs designed to take advantage of their increased capabilities. Because of their tremendous speeds, it was impractical for operators to feed in jobs on a manual basis. Therefore, operating systems had to be designed and written which would allow the computer — in effect — to schedule and control its own jobs. By the same token, systems programs had to be written for the handling of Tele-processing functions, for control of input/output units such as tape drives and printers, and for high speed sorting and merging of data. Thus, while the present acute shortage of programmers is due in part to the proliferation of computers, a significant share of it is the result of this need for systems programs.

The reason for this is the extremely complex nature of systems programming. The systems programmer works much closer to the hardware than does the applications programmer. With the aid of such languages as COBOL, FORTRAN and PL/1, the applications programmer who possesses only minimal knowledge of hardware functions can put together an extremely efficient program. The systems programmer, however, must know: how the machine functions; its memory capacity, retrieval and processing speeds; its input and output capabilities; and its electronic limitations. An academic background in the scientific disciplines is consequently valuable here.

Systems programming is one of the most challenging and rewarding careers in the entire data processing field. More than most computer-oriented jobs, it is an intellectual exercise limited only by an individual's imagination. There are no tools or devices involved in systems programming — other than the use of computers to debug new programs. The men and women who bear the title "systems programmer" rely solely on their knowledge, skill and ingenuity. In every sense of the phrase, they are an elite group of problem solvers.

Despite the intellectual challenges of the job, systems programmers are in extremely short supply. Although some 60 colleges and an increasing number of high schools now offer data processing courses, few graduates qualify for systems programming. Graduates rarely have more than a good idea of what programming is all about and some basic knowledge of applications programming techniques. To become a systems programmer, however, requires more background and more effort.

While there are no hard-and-fast rules concerning qualifications, increasingly today the systems programmer is a college graduate — very often ranking near the top of his class. Although there is ample opportunity in this field for liberal arts graduates, a mathematics, engineering, or "hard science" background is desirable for systems programming.

In most cases, the systems programmer really begins to learn his craft when he leaves college. As one veteran systems programmer put it (and a veteran in this field may be still in his twenties): "I've been out of college six years but I've never really left the campus." At IBM, initial training programs may last anywhere from six to 26 weeks; on-the-job systems programmer training may take another six months; and continuing education at a university or graduate school level may go on throughout the programmer's entire career. Programming — and systems programming in particular — is a dynamic profession subject to almost continual technological change. The man or woman who wants to advance in this job will find that education — encouraged and assisted by his employer — is vital to progress.

Perhaps the most significant job aspect of systems programming is its "open-endedness". The ranks of systems programming today encompass many different specialties — most of them virtually unknown as job categories just five years ago.

Within the field of systems programming itself, the skilled professional has the option of many paths. He may start, for example, in a programming systems group, preparing and writing the various systems that enable computers to process data. Usually he will be part of a small team working on a small segment of an overall system. Such an assignment may last months or even years. The eventual product — whether it's an operating system, a new programming language, or simply a housekeeping routine — will have a key effect on the basic efficiency of computing systems and become an integral part of his company's software line.

The product test, or quality control group, is another vital systems programming area. The emphasis here is measurement of the quality and efficiency of new programs and new programs ideas — rather than writing the program itself. Product test is an increasingly important function with a tremendous amount of impact on the efficient use of both present and future computers.

The advanced technical area is still another systems programming category which wields great influence on the utilization of computers. These are the people who take a long look down the road and anticipate technological changes. They are almost exclusively an "idea" group — super-skilled programmers who dream up the software that will be in use a year, or ten years from now.

Another programmer function is documentation: the writing and editing of manuals which describe the function and use of the programs they accompany. Raw information provided by programmers is polished and organized so that it is meaningful to computer users. People who do this possess not only writing skills, but enough knowledge of systems programming to understand technical jargon and spot errors. Their efforts, too, are essential to the efficient and economic use of computer systems.

While systems programmers are in great demand, personnel requirements in the applications programming area today are just as great. The days when programming represented only the tedious job of coding have long since vanished. The man or woman today who wants challenge, opportunity, advancement, and interest should certainly consider a programming career.

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# IDEAS: SPOTLIGHT

The purpose of "Spotlight on Ideas" is to focus attention on significant, important, and interesting ideas — even though some of them will not be novel to some people. Readers are invited to submit contributions to be considered for this department. (See the announcement of this department in "New Ideas that Organize Information" in *Computers and Automation* for December, 1967, page 6.)

## THERE IS A CRYING NEED FOR IMPROVEMENT IN THE TECHNIQUE OF EDUCATION

**Dick H. Brandon**
**Brandon Applied Systems**
**New York, N.Y.**

In the last fifty years or so, our needs for education have doubled. Industrial production has doubled. The standard of living has doubled. The amount of information that we have to teach has doubled. The new technology has enormously increased the amount that people have to learn.

But we are trying to educate with the methods of fifty years ago. We are teaching in the same old way. The relative income of teachers has gone down. The investment of taxpayers is already strained. By a kind of Gresham's Law, a great many people of very poor abilities go into teaching, and do harm to the minds of young people. And my kids are learning in the same old way.

It is vitally necessary that this problem be faced, and that we discover new social and technical inventions and devices to solve it.

## COMPUTER - ASSISTED INSTRUCTION IS EXPANDING

**American Management Association**
**New York, N.Y.**

Corporations are becoming major users of educational equipment and materials, according to a survey recently completed for the American Management Association.

The AMA sponsors an Education and Training Conference and Equipment Exposition in August each year. The survey was made of the August 1967 exposition attendance of more than 5,000, which was divided between commercial organizations, with 53%, and academic institutions, with 47%.

The highest interest among both groups, according to the survey, was computers and television as new methods for instruction.

22% of the academic organizations said they planned to start using computer-assisted instruction in 1967-68, while 10% of the commercial organizations said they would start CAI in this period.

# CALENDAR OF COMING EVENTS

Jan. 15-17, 1968: New York Academy of Sciences conference, "The Use of Data Mechanization and Computers in Clinical Medicine," Waldorf Astoria, Park Ave., New York, N.Y.; contact Dr. E. R. Gabrieli, Director, Clinical Information Ctre., State University of N.Y. at Buffalo, Buffalo, N.Y. 14215

Jan. 18-19, 1968: First Annual Simulation Symposium, Sheraton-Tampa Motor Inn, Tampa, Fla.; contact Ira M. Kay, P.O. Box 1155, Tampa, Fla. 33601

Jan. 22-23, 1968: The "IV League," Sportsmen's Lodge, N. Hollywood, Calif.; contact Robert Steel, Informatics Inc., 5430 Van Nuys Blvd., Sherman Oaks, Calif.

Jan. 25-26, 1968: Second Annual Symposium on the Interface: "Computer Science and Statistics," International Hotel, Los Angeles, Calif.; contact Business Administration Extension Seminars, Room 2381, GBA, University of California, Los Angeles, Calif. 90024

Feb. 22-23, 1968: Management Conference, the Association of Data Processing Service Organizations (ADAPSO), Jung Hotel, New Orleans, La.; contact W. H. Evans, 947 Old York Rd., Abington, Pa. 19001

March 14-16, 1968: Sixth Annual Symposium on Biomathematics and Computer Science in the Life Sciences, Shamrock Hilton Hotel, Houston, Texas; contact Office of the Dean, The University of Texas Graduate School of Biomedical Sciences at Houston, Div. of Continuing Education, P. O. Box 20367, Houston, Texas 77025

March 18-21, 1968: IEEE International Convention & Exhibition, Coliseum & New York Hilton Hotel, New York, N.Y.; contact J. M. Kinn, IEEE, 345 E. 47th St., New York, N.Y. 10017

Apr. 3-5, 1968: The Numerical Control Society Annual Meeting and Technical Conference, Marriott Motor Hotel, Philadelphia, Pa.; contact Mary Ann Devries, Numerical Control Society, 44 Nassau St., Princeton, N.J. 08540

Apr. 23-26, 1968: Cybernetics Conference, Munich, F.R., Germany; contact H. H. Burghoff, 6 Frankfurt/Main 70, F.R. Germany, Stresemann Allee 2, VDE-Haus

Apr. 30-May 2, 1968: Spring Joint Computer Conference, Atlantic City Convention Hall, Atlantic City, N.J.; contact American Federation for Information Processing, 345 East 47th St., New York, N.Y. 10017

Apr. 30-May 3, 1968: The Association for Educational Data Systems Convention, Hotel Texas, Fort Worth, Tex.; contact Convention Coordinator, Assoc. for Educational Data Systems, 1201 16th St., N.W., Washington, D.C. 20036

May 1-3, 1968: Joint National ORSA/American TIMS Meeting, St. Francis Hotel, San Francisco, Calif.; contact Miss Joan T. Sullivan, Computer Usage Co., Inc., 3181 Porter Drive, Palo Alto, Calif.

May 3-4, 1968: Fifth Annual National Colloquium on Information Retrieval, University of Pennsylvania, Philadelphia, Pa.; contact Dr. David Lefkowitz, Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, Pa. 19104

May 8-10, 1968: Electronic Components Technical Conference, Marriott Twin Bridges Motor Hotel, Washington, D.C.; contact F. M. Collins, Speer Res. Lab., Packard Rd. & 47th St., Niagara Falls, N.Y. 14302

June, 1968: Sixth Annual Conference of The Special Interest Group on Computer Personnel Research of the Association for Computing Machinery; contact A. J. Biamonte, Program Chairman, West Virginia Pulp and Paper Company, 299 Park Ave., New York, N.Y. 10017

June 12-14, 1968: Annual Meeting, The Association of Data Processing Service Organizations (ADAPSO), Waldorf-Astoria, New York, N.Y.; contact W. H. Evans, 947 Old York Rd., Abington, Pa. 19001

June 25-28, 1968: DPMA International Data Processing Conference and Business Exposition, Statler Hilton Hotel, Washington, D.C.; contact Mrs. Margaret Rafferty, DPMA, 505 Busse Hgwy., Park Ridge, Ill. 60068

June 25-27, 1968: Second Annual IEEE Computer Conference, International Hotel, Los Angeles, Calif.; contact John L. Kirkley, 9660 Casaba Ave., Chatsworth, Calif. 91311

July 8-11, 1968: SHARE-ACM-IEEE Fifth Annual Design Automation Workshop; Washington, D.C.; contact H. Freitag, Program Chairman, IBM Thomas J. Watson Research Center, P.O. Box 218, Yorktown Heights, New York, 10598

Aug. 5-10, 1968: IFIP (International Federation for Information Processing) Congress 68, Edinburgh, Scotland; contact John Fowlers & Partners, Ltd., Grand Buildings, Trafalgar Square, London, W.C.2, England

Aug. 27-29, 1968: Association for Computing Machinery National Conference and Exposition, Las Vegas, Nev.; contact Marvin W. Ehlers, Program Committee Chairman, Ehlers, Maremont & Co., Inc., 57 West Grand Ave., Chicago, Ill. 60610

Oct. 28-Nov. 1, 1968: Business Equipment Manufacturers Assoc. (BEMA) Annual Business Equipment Exposition and Management Conference, International Amphitheater, Chicago, Ill.; contact Laurance C. Messick, Business Equipment Manufacturers Assoc., 235 East 42nd St., New York, N.Y. 10017

Oct. 29-31, 1968: Fall Joint Computer Conference, San Francisco, Calif.; contact AFIPS Headquarters, 345 E. 47th St., New York, N.Y. 10017

# Cheap mass storage for small computers and how to get the most out of it

For some people the only limitation of the small computer is the price of the extra memory. What's needed is low-cost mass storage, and lots of it. For filing data. For quick and convenient program manipulation.

DIGITAL, the leader in small computers, has a low-cost disc and unique magnetic tape unit tailored for the small computer. Now, new software is available to take even better advantage of this low-cost memory.

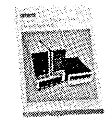
DECdisc adds 32,768 words of memory for $6,000. Additional expander discs (up to 3) can be added at $3,000 each. That means a total of 131,072 words of disc memory for $15,000.

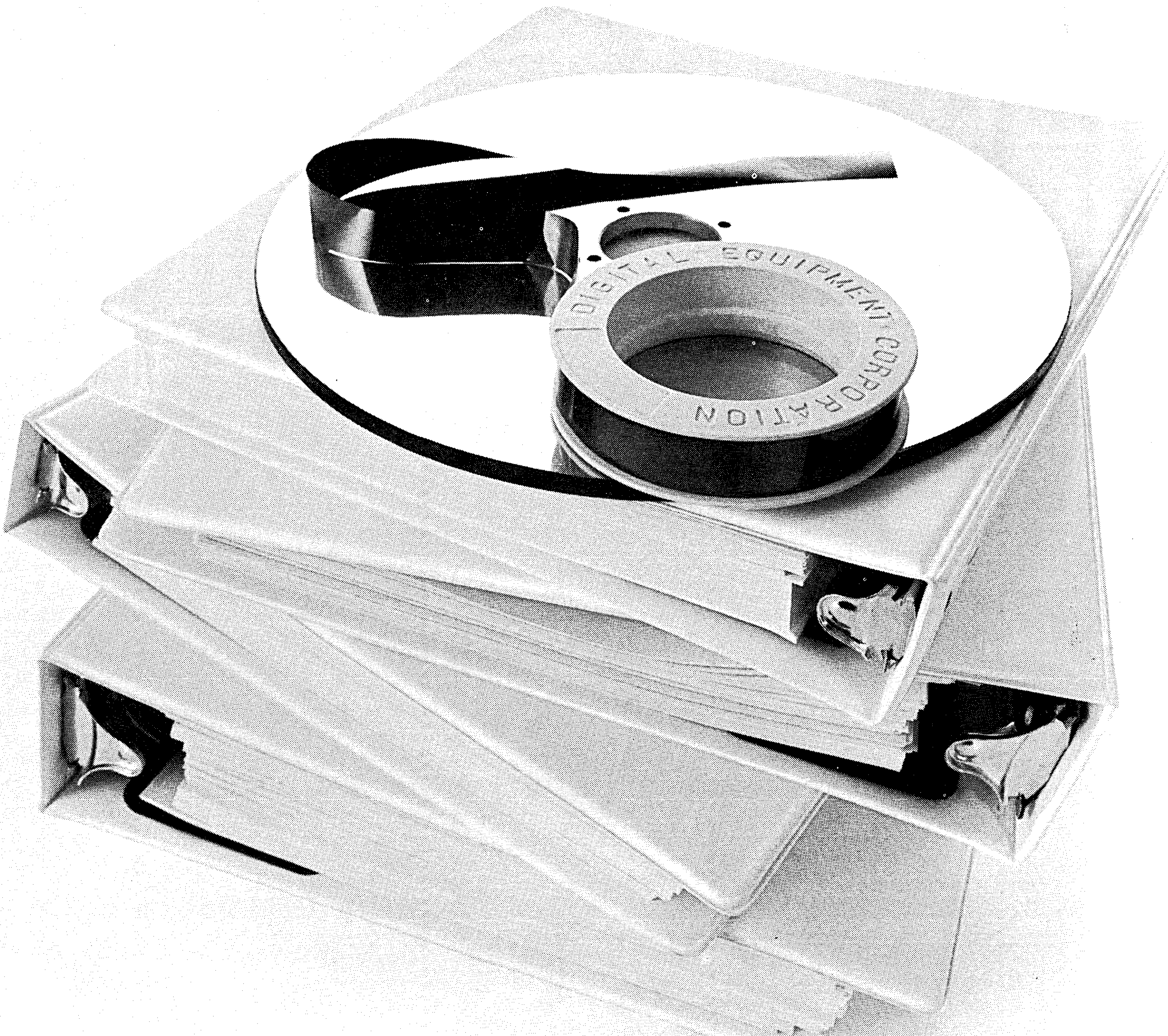
A full scale PDP-8/S computer with 36,864 twelve bit words of memory, for example (4k core plus disc), costs $18,500.

DECtape, Digital's unique fixed address magnetic tape system, provides over 200,000 words of storage on a 3½-inch reel. It's the lowest cost mass storage available anywhere. You can edit and debug programs on line. Then you can put your programs in your pocket and take them away until you want them again.

New keyboard monitor software all but eliminates the laborious use of paper tape and cards. You edit from the keyboard, compile from the keyboard, assemble, load, store, debug all from the keyboard. What might have been hours or days in getting the computer ready for use, is now just minutes.

Available now. PDP-8/S off-the-shelf. PDP-8 in one month. PDP-8/I in the spring. DECdisc and DECtape immediately available. Send for our new Small Computer Handbook. It's free.



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c.a

# WORLD REPORT — GREAT BRITAIN

## Ministry of Technology Wants to Limit Number of Manufacturers of Small Computers

It looks as if the ubiquitous Ministry of Technology is going to have the final say on the small computer front, at least as far as Plessey goes. Plessey has given an indication that it has not yet made up its mind about the small, compact and powerful XL12 message switching and process control computer developed under the aegis of the Ministry and its predecessor, the Department of Scientific and Industrial Research.

The company says it does not have to decide whether to go ahead or not till early next year. But it is an open secret that Ministry master-minds do not want more than two manufacturers of small units. This, of course, disregards the fact that all the other companies involved in telecommunications — STC, AEI, GEC — are making their particular version of message-switcher. But then there are many unpalatable facts that the Ministry tends to ignore in the hope, no doubt, that they will go away.

## Computer Technology Will Manufacture Small Machine

One such fact is the decision by the Computer Technology company — whose merger with AEI was blocked by Mintech — to go ahead and manufacture its own small machine, which it claims will be faster and cheaper than the equivalent Digital Equipment Corporation unit. Computer Technology, supported by a Labour millionaire, has recently received an injection of money from Europe.

Basil de Ferranti, ebullient managing director of International Computers and Tabulators, has had a short, sharp barnstorming session in Europe, where he must have made for himself a legion of friends. For instance, he said that the giant Siemens group would have done better to develop its own technology (rather than rely on that of Spectra 70), and he also commented that Telefunken's big machines were unlikely to bring that company much profit.

Nevertheless, "Boz" (as he is known in the British D.P. fraternity) had some sound commonsensical ideas on co-operation between European companies in which those firms which were particularly good at a given job should concentrate on that area, drawing from other countries those products — peripherals, programme suites, etc. — in which they, in their turn, excelled. As a way of co-operation without domination or too much inter-European merging (particularly difficult where large and highly diversified companies are involved), this plan takes a lot of beating.

## Anglo-French Co-operation

A first concrete move has been made towards Anglo-French co-operation — after something like 2½ years of ministerial chit-chat on the desirability of such a thing. Elliott-Automation and CITEC (main company in France's Plan Calcul framework) have agreed to collaborate in process control, and the like. Primarily aimed at software and instrument expertise, the two partners at some stage might well use each other's central processors and other hardware, according to Monsieur R. Remillon of CITEC. The agreement does not yet cover the English Electric automation effort, though this must only be a matter of time, since Elliott and English are now being merged very quickly.

A second Anglo-French move, which established bureaux must view with some apprehension, comes from the French Metra organisation, which is joining with Freeman, Fox Wilbur Smith in exploiting a vast CDC6600 to be set up in London next year. Metra already has been running its own 6600 successfully in Paris for about six months, and it is an aggressive organisation which will scour the U.K. market for the big linear jobs which have had to go outside Britain until now, for want of adequate capacity at home. Pipped at the post was the INTINCO organisation, part of the giant International Publishing Corporation group, which would have liked a share of the 6600, but will now make do with twin 1108's. INTINCO runs SCAN, a stock broker's real-time, time-shared system with 50 consoles running from twin Univac 418's in a portfolio handling and updating service.

SCAN had to work overtime during the tense 24 hours after the devaluation of sterling. Both increases of corporation tax and the rise in the Bank Rate had made everyone's ready reckoner for stocks useless. In a few hours the SCAN staff had made the necessary adjustments to programmes and launched a market campaign for fresh terminals. Takers included Westminster Bank. Refusals came from the Treasury ("Write to the Permanent Secretary, old boy"!), the Tory Party and the Liberals. The SCAN staff did not think the Labourites would be interested.

## English Electric Still Faces Problems

English Electric's troubles, though a little alleviated, are not yet over. Production of the central processor for the most popular machine of the series, the 4-50, is to be taken up at an Elliott plant in Scotland. At the same time, 12 of the equivalent machine from RCA — the 70-45 — are to be imported at a cost of around $5m for use by the company, but also for customers of the 4-50 who are not prepared to accept the delay in English Electric production. Two customers have given indications that they may cancel. This English has denied, but an order for a Honeywell 1200 and one for an equivalent ICT machine placed by companies which previously had English machines on order indicates that something is wrong.

Ted Schoeters

ADDENDUM

On protest from the editor, our columnist provided an explanation for the following abbreviations:

STC - Standard Telephones and Cables - UK subsidiary of ITT
AEI - Associated Electrical Industries
GEC - General Electric Company of the UK, not to be confused with G-E of the US.
CITEC - Compagnie pour l'Informatique et des Techniques Electroniques de Controle
INTINCO - International Investment Computers
SCAN - (a sub-group of the above) - Stockmarket computer answering

# THE TREND IN SIMULATION

*John E. Cremeans*
*Technical Staff*
*Research Analysis Corp.*
*McLean, Va. 22101*

*"Simulation is an extremely valuable tool when used properly to attack problems amenable to simulation; but a most wasteful and inappropriate tool when other techniques are available."*

Only a short time ago it was quite difficult to obtain funds for a simulation project outside certain areas of very specialized research. "Practical" managers who really expected useful answers to questions about operating problems were rarely interested in investing money in simulation. In the past two years this reluctance seems to have been reduced considerably. Simulation is now looked upon in many areas as a practicable means to obtain answers to the questions raised by managers running a business, operating a government agency or conducting a military operation. Simulation has joined the growing number of "OK words" used in our profession. Simulation is "in" along with management information systems, real-time and time sharing.

In many respects we should be delighted with this turn of events. Simulation is generally a great deal of fun. It is very much like being given a giant erector set with which you can build the most elegant and esoteric toys ever. Most desirable of all — simulation is considered to be a form of research and therefore the practitioner is seldom faced with embarrassing questions about the real value of his expensive project. With any luck at all the simulation project manager can so dazzle the customer with tales of the elegance of the simulation language and complexity of the model that he may never be asked if any useful product has been obtained.

Of course, there have been many useful and productive simulation projects. Fortunately, these successes have occurred with a high enough frequency to maintain our faith in the value of the technique. My concern is that there seem to be altogether too many simulation models being built which are unlikely to produce any useful results at all. More dangerous still, there seems to be many simulation models which produce apparently useful answers which are not verifiable. We can accept them on faith or ignore them.

From a professional point of view, I am concerned that we are overselling simulation as a technique. From a practical point of view, I am concerned that the pendulum may well swing back in the next two years to the point that simulation is regarded as an untrustworthy and expensive form of boondoggle. Simulation is an extremely valuable tool when used properly to attack problems amenable to simulation; but a most wasteful and inappropriate tool when other techniques are available.

Now that our customers have lost their skepticism, we as professionals must develop our own restraints if we are to avoid wasteful and misleading simulation projects.

## Development of Simulation

If we are to discuss the limitations of simulation, we must define what simulation is. The literature in the field is of limited usefulness in tying down exactly what the term describes. The more recent the document, the more likely it is that the author will quote several alternate definitions, reject them all and proceed to develop his own definition which is more general and less restricting than any of those given.[1] The use of the term "simulation" seems to outgrow even the broadest definition. I will not attempt a precise definition, but as an alternate will suggest that the history of the development of simulation as we know it today may be a less rigorous, but more satisfying way to describe simulation.

The origins of simulation are generally traced to the work of Von Neuman and Ulman in the late 1940's. They coined the term "Monte Carlo Analysis" to describe a technique whereby essentially deterministic problems, too expensive or

[1]See, for example, Naylor, et al, *Computer Simulation Techniques*, (New York, 1966), pp. 1-4.

too complex to solve analytically, could be solved by treating them as stochastic problems. The genius of their method was that it was an inversion of the usual approach to stochastic problems; that of treating stochastic problems as if they were deterministic in order to solve them analytically. The Monte Carlo Approach was then the process of finding a stochastic analogue to the deterministic problem in order to estimate the solution through simulation.

Figure 1 is a greatly simplified example of Monte Carlo analysis. The area within the glass could be calculated through integration of the function which represents the sides of the glass, but such integration might be difficult and costly. The Monte Carlo approach would be to enscribe the glass with a rectangle of known area. An appropriate sample of randomly generated points are then entered in the rectangle in such a way that all points within the rectangle have an equal chance of being selected. The area within the glass is then estimated by multiplying the fraction of all points which fall within the glass by the area of the rectangle. This example is a two-dimensional case which is relatively simple; however, this basic technique can be applied to problems of significantly greater complexity which might not be solvable using analytical means.

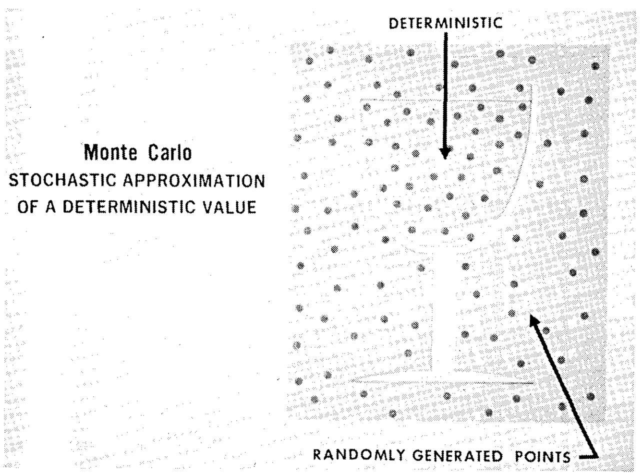



Figure 1

## Computer Modeling of Real World Processes

The development of Monte Carlo analysis occurred concurrently with the development of the high-speed computer, and as a result most applications were soon being conducted with the use of a computer. The techniques so developed were then applied to problems which were basically stochastic. There followed a rapid application of the technique to many of the classic stochastic problems not amenable to analytic solution. For example, processes involving multiple channel queues. We now know a great deal about scheduling and related problems as a result of the availability of these techniques and the digital computer. In the process, a body of knowledge of the computer modeling of real world processes was developed which has become the real basis of computer simulation as we know it today.

Figure 2 indicates a simple example of the stochastic simulation of a stochastic process. Here the problem is the interaction of the arrival of orders and the service time of each of the processes which lead to queues forming ahead of some processes and a particular distribution of total order processing time. Here the rate of arrival of new orders is known, as is the distribution of service times for each of the processes. The basic simulation approach is to generate arrivals and service times by selecting from the known distributions of these times through the use of random numbers. Thus the whole procedure can be described as the development of a distribution for the total process based on detailed knowledge of the behavior of each of the components.

A key point, not always recognized, is that the simulation of large queueing systems began after a well-developed theory of the behavior of the single channel queue was available. Large simulation models of queueing systems were then constructed using components which were understood. The success of this general type of model has led some of us to attempt the modeling of large systems in which little is known of the behavior of the individual components.

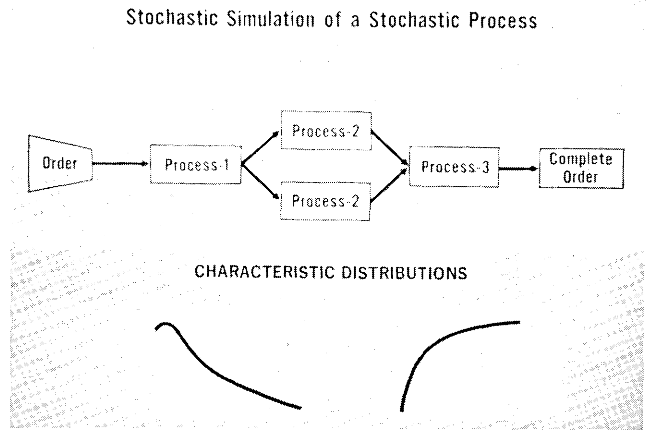



Figure 2

A somewhat later development was the use of computer modeling techniques to study business, economic, and organizational problems. Clearly, these processes are probabilistic in nature and not deterministic. Yet, some of the foremost practitioners chose to develop deterministic models of these systems. For example, Jay Forrester's Industrial Dynamics[2] approach is essentially deterministic. He chose to study the dynamic character of industrial systems first without the noise created by random events and only later introducing stochastic elements to observe their effect. This approach is prompted by the belief that the probability functions of such processes are not yet known in sufficient detail to support a useful stochastic model and further that there is much to be learned about the dynamic properties of these processes aside from their probabilistic elements. Thus, an essentially deterministic approach is used to study a probabilistic process.

Figure 3 is a simple example of the deterministic approach such as might be used in an Industrial Dynamics simulation. Here the focus is upon the feedback problem of control. Here the controlling manager observed the level of inventories and based upon this information regulates the flow of resources into the manufacturing process. The emphasis here is upon the oscillations of the system which may be created by the information and control mechanism.

## What Simulations Is Not — and Is Like

While this review has certainly not defined simulation in any rigorous way, I think that we can now characterize simulation models in two ways. First, by describing *what it is not.* Simulation models do not purport to find the best solution to any problem. Simulation models are not optimizing in any sense. The best that one can say about any simulation

[2]Jay Forrester, *Industrial Dynamics,* MIT Press.

Deterministic Simulation of a Stochastic Process

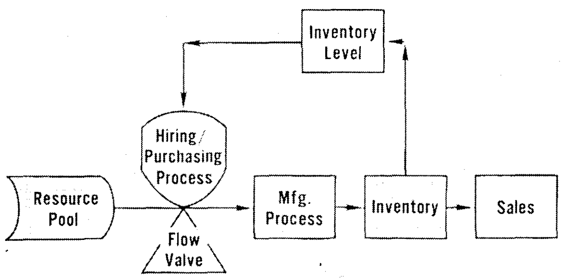



Figure 3

model is that it describes the object process using those characteristics which are important to the results that the model builder wishes to study. A simulation model thus serves its function by demonstrating the consequences of a particular set of inputs and decision rules applied to the process. The model builder is free to change any of these in the hope of improving the result, but improvement is by no means guaranteed. Thus, if optimization (or improvement) is the model builder's goal, he must obtain that improvement through inference from the model's behavior.

Secondly, we can say *what simulation is like*. Simulation has many of the characteristics of a laboratory experiment. Simulation can certainly be controlled. We can replicate any run of any simulation precisely or we can change any element in exactly the degree we wish. Since the digital computer is a deterministic mechanism, we can actually control the conditions of the simulation run more accurately than we can the conditions of the laboratory model.[3]

Simulation, like laboratory experiment, is also an abstraction from the real world. Laboratory experiment seems at first to have an advantage in that we usually separate some material, some actual part of the real world, and place it in the controlled conditions of the laboratory. We are tempted, therefore, to think that the laboratory experimenter has no problems in proving the validity of the abstraction. But clearly this is not the case. The laboratory experimenter must be concerned that in his abstraction he has not altered the basic condition he wishes to study. He must be concerned that he is faithfully reproducing in the laboratory those conditions which are important to the process he wishes to explore. This, of course, is precisely the problem that the simulation model builder must consider.

## Simulation and Laboratory Experiment—A Comparison

If simulation is in effect an experimental process, there are a number of things which we can infer from the experience of laboratory experiment. One is that laboratory procedure is carefully followed and reported in such experiments. The simulation analogue of this may be the strict control and reporting of the random number of generators used, the collection and tabulation techniques used in gathering the basic data, the sample sizes used, and other related techniques.

An important point here is that in simulation there is not yet a formalized set of control techniques which ensure the accuracy of simulation experiments. The skill, experience, and thoroughness of the individual experimenter is all important. There is no cookbook formula which permits the non-participant to assure himself that the results of a simulation experiment are valid.

Another similarity between simulation and laboratory experiment is the results that one can reasonably hope for. The simulation model builder hopes that he will be surprised by the results of his model. He hopes that the model will behave in a manner that he would not have predicted, yet that does not violate any of the known characteristics or relationships of the object system. For, if surprising results occur, the model builder may have discovered some new and interesting property of the object system not apparent before.

Of course, many surprises turn out to be the result of a failure in the model rather than a legitimate key to new understanding. The separation of surprises into two categories is one of the most difficult problems of simulation.

A second thing that one can hope for from simulation and experimentation is that the relative merit of two or more courses of action can be tested. Acknowledging the imperfections of our models, we may still hope that they will be capable of distinguishing a better set of decision rules or a more favorable set of inputs. This implies the measurement of the result against the changes to the model or its inputs. Consequently, the measurement of results is vital in simulation as it is in physical experimentation.

## The Advantages of Simulation

The limitations as well as the advantages of simulation are perhaps most succinctly stated by Teichroew and Lubin:[4]

> "Simulation problems are characterized by being mathematically intractable and having resisted solution by analytic methods. The problems usually involve many variables, many parameters, functions which are not well behaved mathematically and random variables. Thus, simulation is a technique of last resort. Yet, much effort is now devoted to 'computer simulation' because it is a technique that gives answers in spite of its difficulties, costs and time required."

The advantage of simulation, then, is that it permits us to attack problems not otherwise feasibly solved. I would submit that this is the only true advantage. In all other respects, in terms of cost, elapsed time required for solution, skill required of the analyst, and the accuracy of the results, simulation is second best if a reasonably realistic analytic solution is available.

There are, of course, cases where analytic or experimental solution is theoretically possible, but practically difficult or infeasible. In the vast majority of cases, however, if an analytic solution is available, we should by all means use it. The point here is that simulation's single overwhelming advantage is that it is often the only feasible approach to important problems.

Now this idea is not always popular with people in the simulation field. Other additional advantages are often cited. One of those proposed advantages is that simulation permits more complex, more elegant and hence more realistic models. This is certainly true. The number of variables and parameters may in some cases be larger by an order of magnitude than currently available optimizing models. Types of functions not feasible in analytic models can be used relatively easily in simulation models. The richness and variety of the modeling language available to simulation is certainly greater by far than in available optimizing models.

The real question is, "Does the complexity pay off?" Elegance for its own sake is not very valuable. Complexity pays off only if it truly adds to the realism of the model

[3]R. W. Conway, "Some Tactical Problems in Simulation Method," Rand Corporation, October, 1962, page 13.

[4]Daniel Teichroew and John F. Lubin, "Computer Simulation — Discussion of the Technique and Comparison of Languages," Communications of the ACM, Vol. 9/Number 10/October, 1966, page 724.

and further, when that realism is necessary to useful solution. Complexity is thus not an advantage per se, but only if it is the only recognizable path to solution.

Another advantage, sometimes cited, is that simulation can be used even in those cases where the process is not fully understood and/or the data are not complete. This too is quite true. If one is willing to make the necessary assumptions, a simulation model can be developed for virtually anything that we can conceive. In some cases the construction of a simulation model may be excellent preparation for the gathering of additional data. The process of building and exercising a simulation model has a remarkable way of focusing one's attention on the need for specific data and the necessity for better understanding of particular aspects of the object process. But then, isn't this a claim that can be made for all model building?

There is much to be said for an approach to problem solving which uses simulation to test the consequences of data and hypotheses already at hand and to focus on those areas in which additional work needs to be done. Two things must be said of this approach. First, other modeling methods can make the same claim. Hence, if we chose to use simulation then it should be because no simpler or cheaper approach may be used. Secondly, there is a great danger in this approach in that the first answers are all too often taken as *the* answers. Thus, simulation in the face of poor data and weak theoretical foundation is only an advantage if we recognize the weakness of the outputs as well as the inputs. Simulation is not a machine which converts weak inputs and assumptions to strong results and conclusions.

Finally, it is sometimes stated that one of the advantages of simulation is that the manager himself can understand simulation models without the intensive training or technical background generally thought necessary for the use of optimizing models. This conclusion is subject to considerable argument. First, let us recognize that those citing this as an advantage are generally talking about operating problems and non-technical managers. It is true that one can generally explain the basic approach to simulation to non-technical managers more readily than one can explain, for example, linear programming. Further, the outputs of simulation are frequently easier to understand because they are themselves simulations of object system reports. If we restate this advantage to read, "The results of simulation models are easier to sell because they can produce results similar to those produced by object system," then I think we must admit that this is true.

Simulation can be described as the computerization of experience. That is, in the study of operating processes we build our model based on our practical knowledge of the object process and then, by running it, repeatedly gain "years" of experience in a relatively short time. Thus, while the manager may not understand the intricacies of stochastic processes, he can appreciate the basic trial and error approach.

It seems to me that this advantage is also a danger. Simulation models, no matter how thin the data or how limited the understanding of the object processes, can almost always come up with answers. If these answers are superficially understood we may create a source of misinformation. I would therefore suggest to you that this advantage is also a trap. We might actually be better off if the results of simulation could not be understood without extensive training and in-depth understanding.

### Modeling Problems and Simulation

It is not always popular to refer to the problems which are encountered in any endeavor. We prefer to discuss interesting situations, or challenges. In simulation there are a number of these interesting situations which one should recognize before plunging into the world of simulation modeling.

One of the first to be recognized is the fact that good simulation requires skilled and experienced analysts. The analyst's first, and perhaps most important, job is to select those properties of the object system which are important to the process being studied. This implies deep understanding of the process itself and considerable skill in modeling. The model builder thus needs thorough familiarity with the object process, skill in working with the modeling language, and skill in exercising the model.

Few simulation models are constructed in this fashion. These functions are more commonly separated. One individual or group examines the object process and determines the properties that are important, and a second individual or group then maps these properties using the simulation language. In many cases a third individual or group then conducts experiments with the model and interprets the results. There would seem to be no necessity for having a single person perform these tasks; however, there is certainly a clear need for superior communication to ensure that the modeling process or the experiments do not go beyond the capability of the conceptual model.

A second requirement is thorough technical knowledge of the statistical processes involved. Experiments with simulation models should be as carefully controlled as any physical experiment. The achievement of the steady state by the model, the measurement of the behavior of the model, and the selection of the sample size to be used, are all tasks which require considerable technical capacity beyond that which is normally considered necessary for programming.

Finally there is a need for considerable skill in planning experiments and interpreting their results. In its present state of development, simulation is an art, not a science. Experience and intuitive skill play a very important part in differentiating genuine new information of the object process and the anomalies of the model itself.

### Determining Validity

A fundamental problem affecting all models, but particularly simulation models, is the difficulty of determining the model's validity. This is a problem which has not been solved in any rigorous sense, and one which may never be solved rigorously. One of the aspects of the problem is illustrated by the following two statements:

1. Simulation models are valuable because they permit us to observe processes difficult or impossible to observe in the real world.
2. Simulation models are valid if they behave as the object system behaves.

These statements are, of course, simplified and perhaps imprecise, but they do summarize valid points. A model, by definition, will not behave in all respects as the object system behaves. One of the important characteristics of a model is that it permits us to concentrate upon those parts of the object process which we believe to be important. Yet ultimately those findings which are most important to us are not directly observable in the object system. One can always deflate a simulation model builder by classifying all his results in two categories: one containing those results which he could have obtained by observing the system directly, and one containing those results which are unsupported.

The validity problem is summarized in Figure 4. A is the object system and B is that portion of the object system which is directly observable, such that B is a subset of A.[5] C

[5]B will not be a subset of A unless our observations of the system are completely accurate. A'B is, in fact, the region of inaccurate observations.

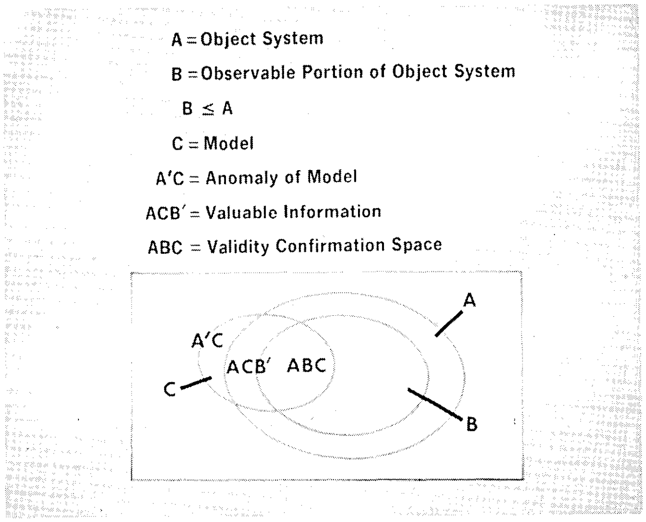



Figure 4

is then the model. Now the model, by definition, does not contain all the characteristics of the real system. Thus AC′ and ABC′ are not empty. In addition, A′C will not be empty. That is, the model will contain anomalies which are characteristic of the model and not of the object system. ACB′ is valuable information. These are those characteristics of the model and of the object system which are not observable. ABC is the validity confirmation space. That is, it is in this region which we may test the validity of the model by comparing its performance with the observed performance of the object system.

Now the discussion above is a conceptual one, but it illustrates the fundamental problem of simulation. That is, as each experiment is conducted on the model, we may classify the results in two categories. One category consists of the region ABC which consists of those points in which the observable portion of the object system and the model coincide. This is the region upon which we base our claims for the validity of the model.

The second classification consists of the union of CA′ and ACB′. (CA′ U ACB′.) That is, these results may consist of invalid results of the model and/or valid results of the model. Herein lies the crux of the validity problem. We cannot distinguish the valid and invalid results without resorting to information outside the simulation process.

The usual defense against attacks on the validity of one's model is to point to the great detail and precision of the model itself. That is, we imply that greater detail and greater complexity ensures greater realism and hopefully greater validity. In short, simulation model builders frequently find themselves driven to larger and larger models of unfathomable complexity. One gets the impression that the prize goes to the most complex model rather than to the most useful results.

This leads to some curious situations. It is not uncommon to discover that a simulation model of a sequential process is made up of components which vary widely in their levels of detail. One component may be built in the greatest detail with all the elegance and complexity that its builder can devise. Its outputs, however, may be digested by the next component in such a manner as to lose the detail generated in the previous step.

## Model Complexity

Model complexity is in itself a problem. It is the unexpected result that we are looking for in model building and experimentation. When we find that unexpected result, however, we normally search for a reasonable explanation. That is, we attempt to explain the outcome as the result of known properties of the object system. The complexity of models works against us in this situation. We may find that our model is so complex that we are unable to trace the outcome to the originating causes within the object system.

When this situation occurs, the model builder has a difficult choice. He must redesign the model, search elsewhere for confirmation, or plunge into conclusions knowing they may be based upon characteristics in the model, but not in the object system.

In our earlier definition of simulation, we characterized simulation as non-optimizing. It hardly seems fair to now state this as a limitation. I would submit, however, that this characteristic of simulation is an operational limitation as well as a theoretical limitation.

In actual practice we don't really expect to optimize real-world processes as a result of "optimizing" models. Such models tend to oversimplify the real world and can rarely be put into practice directly. Optimization is an elusive goal. It is extremely difficult, if not impossible, to formulate our true objectives in precise form, let alone solve for them.

Optimizing models do, however, have one great operational advantage. This advantage is simply that we know when we have accomplished the stated objective. This is not to say that the model cannot be reformulated or the objective function altered. But, given the model and its objective function, experimentation does end.

Simulation models have no such built-in assurances. We may be able to identify improvements, but we can never be assured that some small change will not result in a major improvement. Progress is being made in the development of techniques for the systematic exploration of simulation models (for example, Sim Optimization[6]). But at this point in time we are still groping for systematic means to locate improvements.

## Conclusions

Simulation is a powerful technique that has been used in the past and will be used in the future to solve important problems. Simulation is, however, not a cure-all or a panacea. It is a technique of last resort. A perfectly valid goal of simulation may be to organize our thinking and knowledge of a problem to the point where other techniques may be applied.

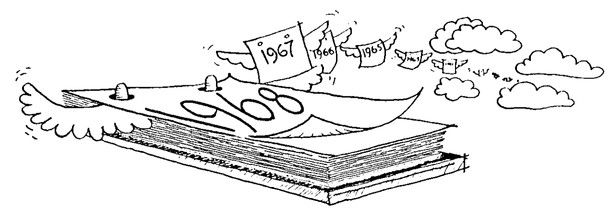
It is not uncommon for simulation model builders to discover that they can predict the results of runs using their models with relatively simple analytical procedures.

If this is true, then simulation analysts should study optimizing techniques thoroughly; both to avoid attempting simulation of analytically solvable problems and to direct their thinking toward the kinds of solutions which may be most useful and productive.

We must also conclude, I believe, that simulation models should not attempt too much in one leap. If we attempt massive breakthroughs in one step, we are likely to find that we have results which are unverifiable. We may be unable to distinguish those results which are truly new information about the object process from those which are aberations of the model.

Finally, we as computer professionals and those to whom simulation problems ultimately come, should be most careful in explaining to the customer what he may reasonably expect from simulation.

[6]H. W. Karr, Ernel L. Luther, Harry M. Markowitz, and Edward C. Russell, "SimOptimization, Research Phase I," California Analysis Center, Inc., Santa Monica, California, November 1, 1965, page 1.




# 15 YEARS AGO IN computers and automation

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## GYPSY, MODEL VI, CLAUDE SHANNON, NIMWIT AND THE MOUSE

*George A. W. Boehm*
*Science Editor,* Newsweek

Two of the hardest working computers in the country are stationed at the Bell Telephone Laboratories in Murray Hill, N.J. One is a differential analyzer, known familiarly to the Bell Labs staff as Gypsy, a corruption of GPC (general purpose computer). At the heart of its calculating system, amplifiers and condensers simulate and enact physical problems. The other machine, the Model VI, takes the digital approach, with 4,600 electric relays performing such numerical tasks as adding, subtracting, multiplying, and dividing.

A particularly interesting job recently assigned to the analyzer was to calculate the path of a coin inserted in a pay telephone. This question bears directly on one of the telephone company's most persistent and annoying problems: how to foil the petty crook who feeds slugs into the slot. Partway down the coin bounces. Thus, mathematically, its motion is discontinuous and is best represented by two distinctly different equations. One describes the initial plummet. The second applies to the flip and tumble which the coin takes after it bounces.

As digital computers go, Model VI is not exceptionally fast; yet it takes only 0.8 seconds to multiply two five-digit numbers. It is quite rapid enough to handle the work which Bell Labs engineers assign it. Most important, its reliable relays make it one of the steadiest workers in the computing machinery world. Since it began fulltime operation three years ago, Model VI's steady habits have improved gradually, until by last November, its time sheets reveal, it averaged more than 24 hours of work per day. This implausible record is, in part, a statistical figment. For purposes of this calculation, "day" was defined as "regular working day." And the computer inflated its average by laboring unattended on many weekends and holidays. It has recently done its part in designing electronic filters to disentangle the messages that will be sent over the Bell System's new L-3 coaxial cable. This cable is now being installed between New York and Philadelphia and will be able to transmit simultaneously more than 1,800 telephone messages. Alternatively, one television program, in either direction, can be substituted for 600 telephone conversations.

While these two companies drudge tirelessly, a growing flock of smaller machines play parlor games at Bell Labs. Boss and chief designer of this seemingly frivolous group is Dr. Claude E. Shannon, a 37-year-old mathematician notable for his work on thinking machines of various types.

Shannon's interest in machines that play games started as a hobby. One of his earliest successes was a homemade cart which dashed to and fro to balance a stick on end. The stick was pivoted at its base so that it could topple backwards and forwards but not to either side. In a more personal approach to the problem of balancing, Shannon has mastered the knack of bouncing along on a pogo stick and is now learning to ride a unicycle.

Bell Labs has been glad for Shannon to convert his pasttime into a long-range development project in working hours at Murray Hill. The switching system in a telephone office is in a sense an elaborate game-playing machine. Its electric relays must connect or disconnect telephone users as rapidly and as efficiently as possible. And any slight improvement in the speed or accuracy of this switching system is reflected in better service at lower cost. Shannon's machines, most of which rely on relay mechanisms identical in principle with those of a telephone switching system, are proving grounds for new ideas in telephony.

The simplest of his game-playing machines solves the ancient puzzle known as the Tower of Hanoi. This game starts with three posts. On one are stacked several disks of graduated size — the largest at the bottom, the smallest at the top. The problem is to transfer the stack to another post, without moving more than one disk at a time and without ever putting a larger disk on top of a smaller one. Shannon's machine has 14 relays which follow a set line of play and, using six disks, solve the puzzle in 63 moves. This is the minimum number of moves for six disks. An Indian legend relates that beneath the great temple at Benares, which marks the center of the world, rests a brass plate skewered by three diamond needles, each a cubit tall and as thick as the body of a bee. On one of these needles, God placed 64 disks of pure gold. Day and night, priests transfer the disks according to the laws of Brahma, which in this case are identical with the rules of the Tower of Hanoi puzzle. When the priests have finished their job, the world will come to a cataclysmic end. Whereas Shannon's machine solves the six-disk puzzle in less than two minutes, the Brahman priests will have to hurry to finish their task in less than 60 billion years! . . .

The Tower of Hanoi is, in the modern sense, a rudimentary thinking machine. It follows a logical and predetermined pattern of play without referring to the moves which it has already made. Shannon's other machines represent higher levels of sophistication.

One is the Nimwit, which plays expertly at Nim. This game has several versions. Perhaps the most common starts with a pile of matches. The first player may remove one, two, or three matches. Then the second player may remove one, two, or three matches. The two contestants take turns until the pile is exhausted, each trying to force his opponent to remove the last match.

Shannon's version, played by his machine against a human opponent, consists of three rows of lights, with a maximum of seven in each row. The moves are made by turning off any number of lights in one row. The machine can be preset to play any of three sub-versions. It can attempt to leave the last light for its opponent. Or it can attempt to extinguish the last light. Or it can play under the restriction that not more than three lights may be turned off in any row in one move. No matter which set of rules, the Nimwit always wins if given the first turn and a favorable starting position. By moving first, an opponent can win in most cases, but when losing, the Nimwit plays to prolong the game as far as possible. Its brain is built around a thinking network of 45 relays. . . .

The latest of Shannon's machines is a mouse which solves a maze, as countless mice do in psychology laboratories throughout the world. The difference is that Shannon's mouse is a realistic, lifesize lump of gray rubber, molded around a magnet, adorned with copper whiskers, and mobilized on three wheels. As a maze-solver it is definitely in the super-mouse class.

The maze is about half the size of a desk top and has aluminum fences which can be slipped into 40 different slots in order to create problems for the mouse. When Shannon places the mouse at any spot in the maze, it starts scurrying for a piece of cheese (a brass contact which rings a bell) in one corner. Every time the animal runs head on into a fence, it backs away, makes a quarter turn, and scuttles off in a new direction. By this trial and error process it finally stumbles upon the cheese. Then comes the truly extraordinary performance. Shannon replaces the mouse in some part of the maze. This time it proceeds surely and swiftly toward the cheese, never so much as brushing against a fence. It has learned the maze. If Shannon then alters the maze, the mouse resorts to further trial and error until it has mastered the fresh arrangement of fences.

Naturally, this ability to learn a complicated pattern and to relearn its lesson when the pattern changes cannot yet be crammed into so tiny a machine as the mouse's body. The brain, indeed, is in a separate case.

Stripped of its fetching animism, this is the way the mouse works: When it is set on the metal floor of the maze, its magnet trips a switch under the floor. A motor-driven electromagnet hurries to a spot directly beneath the mouse and seizes it in a magnetic grip. The magnet turns the mouse 90 degrees and propels it forward. If the copper whiskers make contact with a fence, closing a circuit, the magnet backs away, turns the mouse again, and tries anew to move it forward. Each successful sally is recorded in the mouse's brain, which is controlled by 50 relays. Interpretively, this brain considers the maze as a number of square sections. When the mouse moves without interference from one section to another, the brain registers in its memory the equivalent of: "turn North in section 5." By the time the mouse has visited every section, its brain has learned how to steer it clear of all blind alleys.

Important as they may be to telephone engineers, Shannon's machines may eventually prove to be even more significant in the life of the average citizen — the man who knows little about telephones beyond how to use them. For Shannon's machines promise to be progenitors of a new breed of super-gadgets, using the control principles which he is working out. From the mouse it is only a short step of engineering imagination to an automatic lawnmower which could be instructed to pick its way through an ornamental garden, clipping the grass without ever blundering across a flower bed. Another might retrieve balls for tennis players. Still another might mix and bake a cake from a selection of factory-tested recipes.

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# PROBLEM CORNER

**Contributed by**
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### Problem 681: Integer Part of a Number Given in Floating Point Form

Pete Programmer was complaining. "We should never have accepted this KLUDGE 007 without the complete software package. Now I can't do this job."

"Well," soothed his boss, "It does have full floating-point arithmetic with five-significant-digit capacity. What is it you can't do with that?"

"In these engineering specs," answered Peter, "the requirement is that we give dimensions in feet and inches. But the input data are in feet and decimal fractions, and floating point form at that. So where I have a word like 12500E-3, it means 12,500 x $10^{-3}$ or 12.5 feet. That's 12 feet, 6 inches, and that's the way I have to format the output data. And my program should also be able to convert 61666E-4 to 6 feet, 2 inches; or 22025E-2 to 220 feet, 3 inches. But that can't be done without being able to take the integer part of a number given in floating point form. And the KLUDGE software doesn't have that instruction; only floating point operations. And on those, it doesn't even round results to five significant figures; it just truncates."

"Sure it can be done," answered the boss. He wrote one short line containing just one addition and one subtraction. "Here's how to take the integer part."

What did he write? And how can Pete use it to get feet and inches?

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*Solution to Problem 6712: Maximum Efficiency.*

She must type either the 5 or 20 minute report first and the other next, the 15 minute report third and the 10 minute report last, reproducing each as soon after typing as possible. She will thus be able to finish the job in exactly one hour. If she types or reproduces the reports in any other order it will take longer.

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

# ACROSS THE EDITOR'S DESK

## Computing and Data Processing Newsletter

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## APPLICATIONS

### ANALOG COMPUTER SIMULATES FRUIT TREES TO DETERMINE REACTIONS TO VARYING FORCES

Automated fruit harvesting, while not a new concept, is subject to one severe limitation — the amount of force needed to shake loose all the ripe fruit (but only the ripe fruit) is rarely controlled effectively. Techniques such as ultrasonic and mechanical tree shaking have been employed with varying degrees of success in the past. The main problem with such methods has been in determining the exact amount of force needed to shake loose, for instance, all the ripe, juicy and red apples without bringing down, and hence wasting, all the tart little green ones.

In order to make such determinations, scientists at Rutgers University, New Brunswick, N.J., are using a small analog computer, manufactured by Electronic Associates, Inc., West Long Branch, N.Y., to simulate fruit trees and to learn their reactions to varying forces.

According to David Mears of Rutgers' Department of Agricultural Engineering, "Because of our dwindling farm labor force, there is a growing need for mechanized harvesting and handling equipment. Thus far we have found such automated equipment highly successful in harvesting crops like nuts, but when used with more sensitive fruits, the results have been disappointing."

As used in the Rutgers studies, the desk-top size EAI TR-20 computer performs several functions. First, it amplifies signals from accelerometers and strain gauges placed on an actual fruit tree, then records the signals on FM tape. Next, it analyzes the data, from which equations are derived profiling the tree. These are placed on the computer for mathematical computation and indication of changes in the tree caused by the varying amounts of force applied.

Such information, Mr. Mears said, may enable scientists to develop optimum harvesting equipment.

### C-E-I-R'S MULTI-ACCESS COMPUTING SERVICE USED FOR POISON CONTROL

Poisoning, particularly of children, happens every day in cities throughout the nation, and finding an immediate treatment is of the essence. To speed up the process, the National Biomedical Research Foundation in Silver Spring Md., has set up a "show case" computerized approach to treatment using C-E-I-R's Multi-Access Computing (MAC) Service.....and it holds the promise for a real break-through in the field.

Working with MAC, Dr. Robert S. Ledley, NBRF president and eminent authority on the application of computers for medical purposes, and Dr. Robert Kwok, pediatrician and research physician at NBRF, have devised a system which stores information on various poisonous substances and their antidotes into the memory of a central C-E-I-R computer.

This vital data can be retrieved from remote locations by the use of a standard teletype machine and ordinary telephone lines. Right now the system includes information on approximately 200 poisons but this can be expanded to hold data on as many as 10,000 poison elements. In addition to antidotes, the central file would list toxicity, ingredients, symptoms, and other pertinent data.

### COMPUTER 'DEVOURING' TORONTO FOR PUBLIC WORKS DEPT. REPAIR PROGRAM

Toronto (Canada) is slowly being 'devoured' by a computer. The department of public works hopes the computer will enable it to keep Toronto's 525 miles of roads and sewers and more than 1,000 miles of sidewalks in good repair.

Civic officials have warned on various occasions that pavements, water mains and sewers were deteriorating and that a large-scale program of replacements was necessary. Homeowners have often wondered why streets were torn up for new sewers or watermains, repaired and then torn up again for some other job.

With the aid of the computer, sewer installation would mean that ideally other repairs — watermains, underground hydro liners, replacement of TTC tracks and new sidewalks — would be completed at the same time. Until the computer was obtained, such an objective was almost impossible to achieve.

Ray Bremner, public works commissioner, says the computer will help him and his staff of engineers and planners to co-ordinate the city's 25-year, $154,000,000 sewer rebuilding program with the overhaul and improvement of other basic services. Here is how it is supposed to work.

Inspectors would gather information on each street which would be fed into the computer. It would then produce a priority list.

But it is not that simple. The city can afford to do only so much. Programs must take into account the plans of the Bell Telephone Co., the TTC and Metropolitan Toronto. The future development of high-rise apartments also must be considered.

While the computerized approach is not yet perfected, engineers hope that when the computer has been fed all the information available and the new system is put into operation, replacements of sidewalks, pavements and sewers will march together.

### COMPUTERS PLAY A MAJOR ROLE IN MASSIVE HEART DISEASE STUDY

Computers are playing a major role in a massive clinical study that will determine whether drugs can increase the life expectancy of victims of coronary heart disease, the nation's No. 1 killer. Over a nine-year span — from 1965 to 1974 — the nation-wide clinical trial, known as the Coronary Drug Project (CDP), will have enrolled some 8500 volunteer patients in more than 50 cooperating medical centers, generating a mountain of data that would virtually be impossible to process without computers. The clinical trial is sponsored by the National Heart Institute of the National Institutes of Health and financed by funds appropriated by Congress specifically for the study.

Each of the patients, all male heart attack victims between the ages of 30 and 64 who have no other life-endangering diseases, will be treated over a five-year period with one of four lipid-lowering drugs or a placebo, an inert substance to provide a control comparison. The drugs and the placebo preparation are being assigned randomly by computer at the CDP's co-ordinating center at the University of Maryland Medical School in Baltimore. The Center's electronic data processing facilities are the focal point for the processing of all project data and study forms.

— Computing the enzyme reaction rate is a special purpose analog computer

An entirely different type of computer is being employed in the monitoring of possible liver toxicity from the study drugs. Computing the enzyme reaction rate of patient blood samples is a special-purpose analog computer developed by Honeywell Inc.'s Industrial Division and interfaced with the multiple absorbance system. It digitally prints on paper tape the result of each sample along with the patient number, date, and run number. The computer, only one of its kind, has enabled the National Communicable Disease Center (NCDC) in Atlanta, Ga., to increase the number of patient assays by as much as 50 per cent. By the time CDP is completed, the NCDC will have handled approximately 800,000 serum samples and will have made 2,227,500 analyses, equivalent to about 275 per patient.

The special goal of the Coronary Drug Project is to determine if any of the four drugs, which all are free from evidence of serious toxicity, can reduce by as much as 25 per cent the mortality rate of men who have had a previous heart attack. Coronary heart disease affects some 5.5 million Americans and is responsible for more than a half-million deaths annually.

### COMPUTER'S ELECTRONIC VOICE SERVES CUSTOMERS OF THE WISCONSIN TELEPHONE COMPANY

The electronic voice of a computer is as familiar as the sound of a dial tone to customers of Wisconsin Telephone Company, Milwaukee, Wis. The Rate and Route Computer System (RRCS) provides spoken responses to about 30,000 questions a day, answering nearly one a second in peak calling periods. With the computer, operators at any of the company's 1100 switchboard positions in Wisconsin can quickly learn the amount of long distance charges or the special dial codes needed to reach operators in other cities for help in completing their calls.

An IBM System/360 Model 30 is the control unit that makes the operation possible. It is linked to an IBM 7770 audio response unit which contains a vocabulary of 21 words and 10 numbers electronically stored on a magnetic drum. The computer contains information on charges for interstate calls to any of the 49 continental states, U.S. possessions, and Canada, along with intrastate information for Wisconsin, Illinois and Michigan.

In programming the computer, the company's data processing department and business information systems group created a set of written instructions to provide electronic answers within a tenth of a second to 25 billion separate questions. The computer even takes into account the time of the day to calculate rates in effect at the time of the call.

To use the computer, the operator punches out a special code on her standard 10 button keyset, used in placing all long distance calls. (The procedure for obtaining routing information uses a different code, but the same principle.) After reaching the computer, the operator keys in the needed information, consisting of a rate code, the area code, first three digits of the number called, the home area code, and the first three digits of the caller's number.

"Rate.....three minutes...... eight-five.....plus tax," would be the computer's reply to a question on the minimum rate for a night rate call from Milwaukee to Los Angeles. If the charge is being sought for a call beyond the minimum period, the computer also would be given the length of the conversation.

In the case of coin phones, the computer would calculate charges, add the tax and reply with the amount to be deposited, rounded off to the nearest nickel. "Often a caller hears the computer's response and begins depositing the coins without waiting for the operator to relay the information," said John D. Fitzpatrick, assistant vice president of operations for Wisconsin Telephone. "The voice is very life-like."

Since the introduction of RRCS, the computer system has helped reduce customer waiting time and has improved the accuracy of information. The average time it now takes to obtain a rate or a charge is approximately 15 seconds. At the present time, the Wisconsin company's computer is the only one in the Bell System designed to tabulate and quote charges for calls of any given length. Other systems provide merely the basic or minimum rates, and the operator has to perform her own arithmetic.

### UNEMPLOYMENT CHECKS PREPARED 'ON-THE-SPOT' FOR WAITING CLAIMANTS IN MASSACHUSETTS PROGRAM

The first automated unemployment benefits system that prepares checks "on-the-spot" for waiting claimants and eliminates fraudulent claims has gone into operation in the Commonwealth of Massachusetts when a remote terminal in Worcester was linked to an RCA computer at the Massachusetts Division of Employment Security in Boston. The RCA 3301 computer-communications system is a pilot program that eventually will be expanded to transmit information on 300,000 claims to any of Massachusetts' 43 local unemployment offices.

J. William Belanger, director of the Division of Employment Security, explained that when a claimant enters a local office to collect an unemployment check, he will simply present an identification card, containing his name and social security number, and a ledger card to the terminal operator. Both cards are placed into the terminal — the ID in a special reader slot and the ledger card in a split-platen which also holds the check. The information on the ID card is transmitted electronically over telephone lines to the Boston computer which verifies the claimant's record and eligibility, and tabulates his benefits. While the computer is recording the ID information, it is simultaneously typing out the check at the other end of the line.

At the same time, it updates the ledger card with the date, amount of payment and the claimant's balance. At the end of the day, all claimant's records for that period are updated and recorded in an RCA random access memory file.

Mr. Belanger said the RCA computer at division headquarters in Boston eventually will be linked to more than 100 remote typewriter-type communications devices throughout the state to provide faster benefit payments, more accurate claims checking procedures, and improved service. It also will serve as a deterrent against fraudulent claims, he said.

### SMALL COMPUTER HELPS GRADE GIANT TIMBER

The Puget Sound Log Scaling and Grading Bureau (Tacoma, Wash.) is using an IBM System/360 Model 20 computer to assist in calculating and summarizing information for some 300 customers in the timber industry. The bureau, a private service organization, acts as an independent third party in transactions between its customers in western Washington and southeastern Alaska. The bureau determines the volume and grade of each log after it leaves the woods.

Scaling bureau field personnel, called scalers, record basic information about each log. This data includes the ownership, destination, species, grade and the log's actual diameter and length. The scaler also determines the "adjusted" diameter and length to compensate for defects in the log. This information is mailed to the bureau's office, where it is punched onto cards and fed into the Model 20 computer.

Based on the scalers' reports, the computer prepares scale bills which include a summary of all pertinent information, with primary emphasis on the volume for each species and grade segration. The scale bills are sent to landowners, contractors, and truckers. The information is used by all parties involved in a transaction as the basis for payments between them. Besides calculating payments, the scale bill can be used by timber companies to aid in determining the types and grade of logs to be purchased and to help landowners in the management of timber lands.

## ORGANIZATION NEWS

### DATA DOCUMENTS PURCHASES FOUR DATA CARD PLANTS FROM SPERRY RAND

In a transaction which took place at Sperry Rand Corporation's New York offices, Data Documents, Inc. of Omaha, Neb., purchased four data card plants which were part of Sperry Rand's Univac Division. The plants are located at Holyoke, Mass.; Genoa, Ill.; Tiffin, Ohio; and Torrance, Calif. Data Documents manufactures and markets everything for computer centers except the hardware. These supplies include tab cards, continuous business forms, pressure sensitive labels, magnetic computer tapes and ribbons.

The addition of the new plants will increase the Omaha-based operation by approximately fifty per cent in terms of size and sales volume. John E. Cleary, president of Data Documents, stated that the new plants will also give his firm nationwide distribution. "The nine plants we have at present are all located west of the Mississippi," said Mr. Cleary, "and, while we have supplied data centers in the east, these additions will make marketing much easier and faster."

### COMPAGNIE GENERALE DE GEOPHYSIQUE TO OPEN CALGARY PROCESSING CENTER

Compagnie Generale de Geophysique (CGG), international geophysical contractor of Paris, has announced the establishment of a digital seismic processing center in Canada. The center will include an ADVANCE 6070 digital processor supplied by the Computer Division of Electro-Mechanical Research, Inc. (EMR), Minneapolis—based computer manufacturer. The processor will have full seismic capability including digital stacking, filtering, deconvolution, and all other seismic programming functions.

In order to provide more efficient service to the expanding Canadian oil market, CGG will establish the Calgary, Alberta-based division as a fully operational digital processing seismic center, offering a processing capability equal to CGG's international processing center in Paris. Further details including the name, location, personnel, etc., are not now available.

### CONTROL DATA ACQUIRES C-E-I-R, INC.

William C. Norris, Chairman of the Board and President of Control Data Corporation, and Dr. Herbert W. Robinson, Chairman of the Board and President of C-E-I-R, Inc., jointly announced the consumation of the acquisition of C-E-I-R by Control Data.

The transaction, which was approved late November by C-E-I-R stockholders, involved the exchange of approximately 267,000 shares of Control Data Common Stock for all of the outstanding common stock of C-E-I-R. Mr. Norris said that C-E-I-R will operate as a wholly-owned subsidiary of Control Data Corporation.

### COMPUTING AND SOFTWARE, INC. ACQUIRES WEST COAST TRADE SCHOOLS, INC. OF LOS ANGELES

Computing and Software, Inc. (C&S), Panorama City, Calif., has announced the acquisition of West Coast Trade Schools, Inc. (West Coast) of Los Angeles.

West Coast is prominent in the field of providing instruction in data processing and other educational areas in the metropolitan Los Angeles community.

C&S President Norman E. Friedmann, said that "the addition of West Coast to the business of C&S significantly expands the company's involvement in the educational field."

### COMPUTER INDUSTRIES INC. HAS ANNOUNCED A NEW GRAPHICS SYSTEMS DIVISION

Computer Industries Inc., Van Nuys, Calif., has created a new division specializing in devices and systems which translate raw computer data into visual information. Computer Industries is an affiliate of University Computing Company. The announcement was made by UCC President Sam Wyly, signifying the first major move into hardware manufacturing by the rapidly-growing computer specialist organization.

The new Graphic Systems Division is said to be in full-scale production of a broad line of graphics and peripheral equipment. Marketing and engineering service offices for the Division are located in major cities throughout the nation.

Computer Industries President Robert Dee said that the nucleus for the new organization was created out of the acquisition by Computer Industries of Benson-Lehner, a firm with over 15 years experience as a plotter and graphic systems manufacturer.

### RECOGNITION EQUIPMENT HAS ACQUIRED TELETRANS CORPORATION

Recognition Equipment Inc., Dallas, Texas, has completed the acquisition of the Teletrans Corp., of Farmington, Mich., in exchange for Recognition Equipment common stock. Announcement of an agreement in principle for the acquisition was made in October.

Teletrans has developed an automated airport baggage handling system. Recognition Equipment is a leading manufacturer of optical character recognition systems and has as its customers several major airlines.

### CHARLES BRUNING COMPANY TO MARKET AUTOMATED DRAFTER FOR MERGENTHALER LINOTYPE CO.

The Charles Bruning Company, Div. Addressograph Multigraph Corp., Mount Prospect, Ill., and Mergenthaler Linotype Company, Plainview, N.Y., have concluded an agreement under which Bruning will market Mergenthaler's Diagrammer in four key eastern markets. An automated drafting machine, the Diagrammer turns out finished engineering drawings of pin point accuracy at three times the speed of manual production.

Bruning will act as manufacturers representatives on the Diagrammer in the cities and metropolitan areas surrounding Boston (Mass.), Philadelphia (Pa.), Atlanta (Ga.), and Miami (Fla.). Mergenthaler has three other distributors for the new product: Anger Associates, Inc. of Dearborn, Mich., for the midwest; Kemco, Inc. of Irving, Texas, for the southwest; and L & M Engineering, Inc. of Santa Clara, Calif., for the west coast.

### JAPAN'S FOREIGN INVESTMENT COUNCIL APPROVES LICENSE AGREEMENT BETWEEN NIPPON CALCULATING MACHINE CO. AND WYLE LABORATORIES

Japan's Foreign Investment Council recently approved a license agreement between Nippon Calculating Machine Company, Tokyo, and Wyle Laboratories, El Segundo, Calif., under which NCM will manufacture and market a new desk calculator, designed and developed by Wyle. According to an announcement by Frank S. Wyle, President, the machine's new design concept permits it to be produced at a fraction of the cost of machines presently available with comparable capabilities.

NCM's commitment to Wyle is for a royalty equivalent to a guaranteed minimum sales of 12,000 machines. NCM reports that studies conducted in Japan and other major user countries, including principally the United States, indicate that the potential market for both business and scientific use will be for several times that number of units.

Wyle's commitment to NCM includes design, development, and production engineering, including the manufacture of initial production samples. A fully operative machine was shown in November at a Tokyo press conference.

### UNIVERSITY OF RHODE ISLAND ESTABLISHES DEPARTMENT OF COMPUTER SCIENCE

A Department of Computer Science was established at the University of Rhode Island (Kingston) early in November. Dr. William J. Hemmerle was named chairman of the new academic unit which was placed within the College of Arts and Sciences. The Department is currently offering six courses in computer science and two in statistics to 325 graduate and undergraduate students.

There are six persons with faculty rank teaching "Digital Computation," "Introduction to Digital Computers," "Problems in Computer

Science" (two semesters), "Scientific Application of Digital Computers" (two semesters), and "Statistical Methods in Research I and II". Students in the program have access to URI's new IBM System/360 Model 50 computer and related laboratory facilities.

### SOFTWARE RESOURCES TO MARKET GENERALIZED RETRIEVAL SYSTEM (GRS)

Software Resources Corp., Los Angeles, Calif., has signed an agreement with Information Science Incorporated, New City, Rockland County, N.Y., to market ISI's Generalized Retrieval System (GRS). GRS is designed to allow non-programmers to interrogate a master data base of computer files and records by means of simple English statements.

Robert V. Head, Software Resources President said that the system, which is written in COBOL for the IBM 360, is "fully operational and can be installed within 30 days of contract date".
(For more information, designate #41 on the Reader Service Card.)

### ELLIOTT PROCESS AUTOMATION AND COMPAGNIE GENERALE D'AUTOMATISME TO POOL EXPERIENCE

An agreement to pool experience on computer-based automation systems has been signed between Elliott Process Automation, a subsidiary of Elliott-Automation, and the Compagnie Générale d'Automatisme of France. Initially, the agreement is expected to lead to significant savings in design and development costs of automation systems.

## NEW PRODUCTS

### Digital

### EAI 8400 MOD II, SCIENTIFIC DIGITAL COMPUTING SYSTEM

A scientific digital computing system — the EAI 8400 MOD II — with a "fetch-ahead" instruction execution technique, and a base register which provides for program relocation and memory protection, has been developed by Electronic Associates, Inc., West Long Branch, New Jersey.

"Fetch-ahead" is a technique in which the central processor — while it is executing one instruction — looks ahead to the next. As a result, execution times have been significantly reduced in each of the processor's three principal operating modes — 32-bit floating and fixed point, 16-bit and 8-bit byte modes. Time is also saved when operating in the 56-bit double precision floating point mode.

Another major feature, the base register, provides for automatic relocation of user programs in blocks of 256 words under monitor control. In essence, the base register improves the system's ability to simultaneously handle a number of programs. Co-resident programs are protected from interfering with each other by the register. One programmer does not have to worry about confusing his program with information from another; nor can he put bugs into other programs by unknowingly storing his data in another program's physical area of memory.

The MOD II has all silicon and micro-logic circuitry and a core memory capacity of 8,192 32-bit words in the basic configuration. Magnetic core memory can be expanded to 65,536 words with the addition of banks of either 8,192 or 16,384 words. Memory cycle time is 1.00 microseconds. Each data word contains 32 bits of information plus two EXEC bits for selective memory protection and two bits for parity.

The new system, an offspring of the EAI 8400 Digital Computing System, has been designed to speed up instruction execution times by an average of 25 per cent. There are no significant software changes. The new system has been designed primarily for general-purpose scientific and engineering computation, digital and hybrid simulation and complex on-line monitoring and control. A complete software package is standard with the system.
(For more information, designate #42 on the Reader Service Card.)

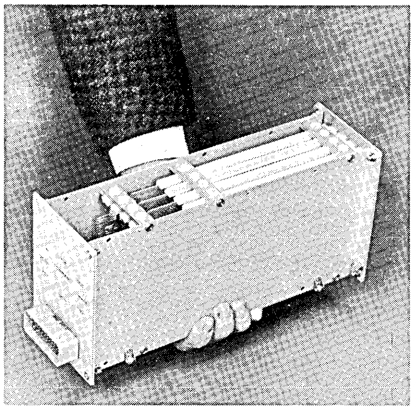
### Memories

### FERROXCUBE ANNOUNCES COMPACT, LOW-COST MEMORY SYSTEM WITH RANDOM ACCESS

A compact, low-cost, 1024 word by one bit coincident memory occupying only 214 cubic inches has been announced by Ferroxcube Corporation's Memory Systems Division, Englewood, Colo. The FI-1 Core Memory System, which incorporates integrated circuits, is suitable for a wide variety of applications such as data transmission buffering, CRT refresh, data logging, formatting and general storage requirements.

The FI-1 contains address decoding, ferrite core drivers, data input/output circuits and internal timing logic for half cycle operation. A card slot is provided for an extender card or universal card to provide different operating modes. Read or write cycle time for the new memory system is 1 usec and the access time is 900 nsec.

The FI-1, designed to provide a miximum of flexibility for integration into a variety of packaging methods, is provided with a dust cover for bench use or remote mounting. The new memory weighs less



than 5 pounds and measures 3-11/16 x 11-1/8 x 5-7/32 inches with the dust cover.
(For more information, designate #43 on the Reader Service Card.)

### DATA PRODUCTS ANNOUNCES NEW DISCFILE, MODEL 5065

A new random access disc memory system, designated the Model 5056 DISCfILE, has been announced by Data Products Corp., Culver City, Calif. The Model 5065 has twice the capacity of the Model 5045 DISCfILE, is twice as fast, and offers more than 16 times the cylinder data base.

In addition, it introduces a new concept in read/write head positioning, utilizing a newly developed "voice coil" technique for precise head positioning control. The Mark-II positioner is a damped closed-loop servo device using electrical and optical feedback. The 5065 contains eight independent Mark-II positioners. Each positioner accesses eight tracks on each of four discs, or a total of 32 tracks, and is capable of stepping through 128 discrete positions.

The device contains two separate and independent data channels. A dual control unit provides communication between two independent computer interfaces and the dual channel disc module. This dual channel capability permits two computers to independently and simultaneously access and transfer data. Each servo positioner is an independent addressable entity; i.e., all eight positioners may be sequentially addressed and simultaneously placed in motion. This capability effectively eliminates positioner motion time as a factor in gaining access to data.
(For more information, designate #45 on the Reader Service Card.)

### SMOOTHER SURFACED MAGNETIC DISCS INTRODUCED BY DATA DISC, INC.

Data Disc, Inc., Palo Alto, Calif., has introduced a new line of nickel-cobalt magnetic discs. Murray Shaw, vice president of the Disc Division, says the discs are far smoother than any others readily available. The discs, 8 to 24 inches in diameter, exhibit average surface variations of only one microinch. A uniform magnetic coating, consistent from one disc to another, produces readout signals of unvarying amplitude.

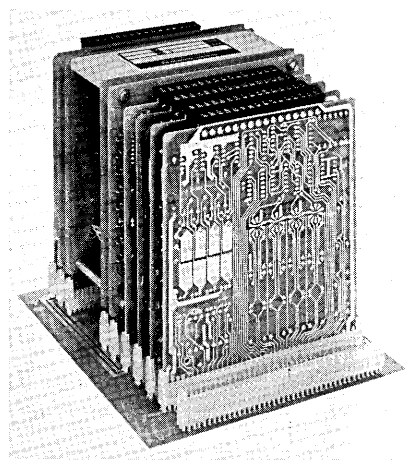
The smooth surface permits read/write heads to be positioned closer to the disc, thereby improving the resolution and frequency response of memories in which the discs may be used. For example, a 12-inch disc turning at 3600 rpm will reproduce a video signal only 6 db down at 12MHz, enabling one high-resolution TV field to be recorded on every track. An over-all flatness of 10 microinches per inch permits heads to track close to the surface without difficulty.

The discs are the same as those used in Data Disc's "in-contact" memories, in which the heads actually contact the disc, thereby permitting storage densities up to 5000 bits per inch.
(For more information, designate #44 on the Reader Service Card.)

### SMALL CAPACITY CORE MEMORY SYSTEM FROM ELECTRONIC MEMORIES

A compact commercial memory system has been developed by Electronic Memories, Inc., Hawthorne, Calif., which is designed for applications requiring small amounts of digital storage at an economical price. Despite a low price, the new MICROMEMORY® 1000 system offers a number of normally high priced benefits, including pluggable magnetics and electronics, integrated circuitry, a 2.5 microsecond cycle time, and storage capacities ranging from 512 to 4,096 words of 8-bits.

Because the MICROMEMORY 1000 is not encased in a standard 19-inch wide rack, it literally can be treated as a component and mounted among other electronics to reduce overall system size and allow consistency in external equipment appearance. Its total size is 400 cubic inches; weight is 6 pounds maximum.



The new system is expected to be used in a number of non-severe environment applications for format conversion, speed conversion, or fixed and variable program storage.
(For more information, designate #46 on the Reader Service Card.)

## Software

AUTODIAGRAMMER / ARIES Corporation, McLean, Va. / An automatic program flowcharting system, known as AutoDiagrammer, is ARIES first product in a new field of endeavor, proprietary software products. AutoDiagrammer is available now for IBM System/360, Model 30 and

40 computers. The firm is marketing the new system on an outright purchase basis.
(For more information, designate #47 on the Reader Service Card.)

COGENT II / Computer Sciences Corporation, El Segundo, Calif. / This semi-automatic programming system will enable computer users to save as much as 75% of the programming time required for most business applications of computers. Cogent II includes a file management system, a report generator, a data description generator, and a high-level shorthand programming language which generates source programs in Cobol. Cogent II operates on IBM System/360 configurations from Model 30 machines on up. The system requires only 32K bytes of core storage and capacity for three external data sets in a Disk Operating System (DOS), and 128 bytes in an Operating System (OS) configuration. As a file management system, Cogent II provides all the major data processing functions required for the storage, maintenance, retrieval and presentation of data.
(For more information, designate #48 on the Reader Service Card.)

DATA ACQUISITION MULTIPROGRAMMING SYSTEM (DAMPS) / IBM Corporation, White Plains, N.Y. / This new computer program links IBM's System/360 Model 44 directly to research tools such as wind tunnels, cyclotrons and analog computers. The program enables the Model 44 to process a wide range of on-line, real-time scientific jobs, particularly those requiring quick response to many external events. It also reduces the programming effort required to implement such applications. DAMPS is scheduled to be available in the third quarter of 1968.
(For more information, designate #49 on the Reader Service Card.)

GENERAL COMPREHENSIVE OPERATING SUPERVISOR III (GECOS III) / General Electric Co., New York, N.Y. / GECOS III integrates requirements for on-line batch, remote batch, and time-sharing into one system using a common data base. "Heart" of GECOS III is a centralized file system of hierarchical, tree-structured design which provides multiprocessor access to a common data base, full file protection, and access control. It offers full user program compatibility with GECOS II, but its internal organization and logic flow are completely new. GECOS III consists of three distinct elements, or types of routines: (1) a resident executive (known as the "hard core monitor"); (2) a small number of "system programs" (such as the job input processor) which perform services for the community of user programs within the system; and (3) a library of system subroutines which perform service functions (such as I/O) for individual user programs. Through the use of GECOS III, the ease with which a GE-600 System may be extended and modified has been advanced greatly.
(For more information, designate #50 on the Reader Service Card.)

OMEGA / Sperry Rand Corp., UNIVAC Division, Philadelphia, Pa. / The advanced linear programming service package, designated OMEGA, was designed for the UNIVAC 1107/1108 Computer Systems. Prepared for UNIVAC by Bonner & Moore Associates, the OMEGA system integrates the operation of problem generation, solution, and reporting with extensive data storage, retrieval and reprocessing facilities. OMEGA has inherent operational ease for the engineer or economist using the service package. The system now is available on a use-basis at any of the UNIVAC Data Processing Centers offices in the United States.
(For more information, designate #51 on the Reader Service Card.)

RPG LISTING AID / Computer Results Corp., West Springfield, Mass. / This program provides a formatted listing of source programs with headings that quickly and easily identify all fields. The RPG LISTING AID facilitates debugging new programs before compilation, provides more readable program listing for backup or library purposes, and quickly generates duplicate listings for program changes. Multiple source programs may be listed at one time. A copy of the program may be obtained free from the company.
(For more information, designate #52 on the Reader Service Card.)

SCORE (Selection COpy and REporting system) / Programming Methods Inc., New York, N.Y. / The easy-to-use software package for generalized selection and reporting is the first in a series planned by the company. A SCORE program can be developed and executed in a few hours since its simple instructions require no program logic, and no computer debugging. The user simply simplifies on a SCORE card the basic criteria for selection and reporting. The system, designed for the IBM System 360/30 and above, has considerable flexibility and may be used for many functions other than report generation.
(For more information, designate #53 on the Reader Service Card.)

VEHICLE SCHEDULING PROGRAM / IBM Corporation, White Plains, N.Y. / The program, also known as VSP/360, enables the System/360 computer to calculate faster, more economical routes from among thousands possible in any given area. It can aid trucking operations that serve a large number of customers on a regular basis. Potential users include such diverse businesses as chain and wholesale grocers, bakeries, department stores, utilities and repair services. VSP/360 is expected to be available to System/360 users in the third quarter of this year.
(For more information, designate #54 on the Reader Service Card.)

## Peripheral Equipment

### POTTER ADLOGIC MAKES 50% STORAGE CAPACITY INCREASES POSSIBLE FOR ALL DISC PACKS AND 1,600 BPI TAPE HANDLERS

Potter Instrument Co., Inc., Plainview, N.Y., has developed a low-cost adaptive logic circuit attachment, ADLOGIC, which can benefit greatly the entire data processing industry. Although no circuit changes are necessary in connecting the ADLOGIC to disc packs, random access memories, high density tape handlers, or any device using phase encoding, ADLOGIC increases effective packing densities by 1.5 to 1.7 times normal densities.

The 50% storage dividend is achieved by Potter's ADLOGIC without imposition of any additional requirement on the recording or playback response of a particular system. Nor does the device increase the recorded density. Instead, it achieves the increased throughput by means of electronic coding techniques. It is simply connected between the input and output of each disc pack, random access memory, tape handler or phase encoding unit.

ADLOGIC requires no circuit changes in the normal operating circuits of the equipment on which it is installed. Essentially, the Potter device is a circuit box inserted between a peripheral's control unit and a specific peripheral device. In tape systems or disc systems utilizing a group of peripherals connected to a single controller, ADLOGIC is located in the controller, and is shared by the group of peripherals.

The effective density of recording in ADLOGIC is increased by increasing the ratio of information transitions to clocking transitions while still retaining the self-clocking characteristics of phase encoded recording. If two, three, or more information transitions are provided for each clock transition, the derived recording density may be increased by a factor that is asymptotic to two. Practically, factors of 1.5 to 1.7 can be obtained.

The basic concept for the ADLOGIC is set forth in U. S. Patent 3,226,685. It is felt that ADLOGIC will benefit the entire data processing industry. Therefore, Potter Instrument Company, Inc., is offering this system as a package for the whole EDP industry.
(For more information, designate #55 on the Reader Service Card.)

## "DIGINET SERIES" IS GE'S ENTRY INTO THE DIGITAL COMMUNICATIONS BUSINESS

General Electric Company has announced its full-scale entry into the digital communications business with the unveiling of eight new data transmission products. The "DigiNet Series" is the trade name for the broad new family of solid state data sets to be manufactured and marketed by the General Electric Company's Communications Products Department, Lynchburg, Va.

The new family of products will be used to translate computer and business machine language into special radio and telephone signals for long-distance transmission, and then reconvert them at the other end. The series includes voice speed desk sets which permit computers to call automatically and "talk" to other machines; acoustic couplers for connecting portable teleprinters by telephone to central time-sharing computers without special wiring; and high speed devices for sending computer information long distances via microwave or satellite.

The product line covers speed and bandwidth requirements ranging from 300 to 230,000 bits per second. The DigiNet 100 and 200 Series operate in single voice channel circuits offering various options of speed from 300 to 2400 bits per second, simplex or duplex, direct or acoustically coupled, with or without a reverse signalling channel. The DigiNet 400 and 500 Systems operate at bit rates of 50,000 to 230,000 bits per second with means to get these signals over single wire pairs to local exchanges where they can be picked up to be carried further within a multiplex group or supergroup.

Richard P. Gifford, general manager of General Electric's Communication Products Department said the equipment will be marketed to the more than 2,000 independent telephone companies across the nation, to major industries having their own private communications systems, to original equipment manufacturers, and to government agencies. Initially the equipment will be sold, not leased.
(For more information, designate #57 on the Reader Service Card.)

## IBM 2680 CRT PRINTER SETS TYPE SIX TIMES FASTER

Scores of printing jobs can be typeset up to six times faster than before with a computer-controlled photocomposition unit announced by IBM Corporation, White Plains, N.Y. The new device, called the IBM 2680 CRT printer, is the first of its kind to tap the full power of a computer. It can be used for a variety of typesetting jobs, including books, newspapers, catalogs and directories. Linked directly to an IBM System/360, it can set graphic—quality type at speeds ranging as high as 6,000 characters a second.

The 2680 CRT printer is operated completely under the control of System/360. Draft copy is usually fed into the computer on paper tape or magnetic tape, but it can be entered through any System/360 input device. A user can choose from a large variety of type styles and sizes — all stored magnetically on the disc files seen in the foreground of the picture.

The computer formats and justifies the copy, automatically hyphenating words that break between lines. It then commands the 2680 to write the finished text electronically on a television-like cathode-ray tube (CRT). Simultaneously, the text on the face of the tube is picked up by a moving

— Computer-based Phototypesetting: It takes this new IBM photocomposing unit less than eight seconds to typeset a full page for a telephone directory. Controlled by an IBM System/360 computer, it can set a newspaper page in ten seconds and a full-length novel in about ten minutes.

roll of photosensitive film or paper. Characters are positioned on the tube so that they appear in even lines of the same length on the moving film. Lines can be set up to 50 picas (8-1/3 inches) long.

The film — 9.4 inches wide and up to 800 feet long — is housed in the portable cartridges mounted on the front of the device at the right in the photo. The cartridge of the exposed film is removed from the 2680, developed, and used to make printing plates.

The system was designed to advance the new technology of automatic photocomposition by adding the speed and flexibility of computers. It is a special development effort, and the company plans to market the printers to a limited number of users with high-volume typesetting requirements. The 2680 CRT printer is being built to IBM specifications by Alphanumeric Inc., Lake Success, N.Y. Initial shipments are scheduled for the first quarter of 1969.
(For more information, designate #58 on the Reader Service Card.)

### CONTROL DATA DEVELOPS HIGH PERFORMANCE MAGNETIC TAPE TRANSPORT

Control Data Corporation, Minneapolis, Minn., has announced the development of a high performance magnetic tape transport capable of transferring data 15 times faster than conventional tape transports.


Two of the new devices have already been delivered to Bell Telephone Laboratories, Greensboro, N.C., for use in a military research and development program.

The new Control Data tape transport transfers data at the rate of 12.8 megabits per second, with a 150 inch-per-second tape speed. Approximately four billion bits of data can be stored on a single 3,600-foot reel of tape. The two-inch magnetic tape used on the transport is certified by the firm.

The new tape transport has a 36-track head which records in two modes: a continuous mode of variable length records with no inter-record gaps; and the standard mode of variable length records with one-inch inter-records.

Integrated circuit techniques enabled Control Data engineers to fit the high performance, high reliability unit into a cabinet only four inches deeper than the typical cabinet used to house conventional tape transports.
(For more information, designate #59 on the Reader Service Card.)

### MIDWESTERN'S TAPE TRANSPORT IS PLUG-TO-PLUG REPLACEMENT FOR IBM 2401 TAPE DRIVE

A new digital tape transport, the 4800 Series, has been introduced by Midwestern Instruments, Inc., Tulsa, Okla., a subsidiary of the Telex Corp. The device is described by Midwestern President William Seiden as "a significant step forward in reducing the cost and increasing the efficiency of data processing equipment".

The 4800 Series is completely engineered as a plug-to-plug replacement for the IBM 2401 tape drive for use in conjunction with third generation IBM 360 computers. It uses the same IBM power and signal connectors. Computer interface circuitry, programs and tape loading are identical. Diagnostics for preventive maintenance remain exactly the same. No modification of the main frame or controller is required.

The versatility of the 4800 Series is pointed up by the fact that a complete line of replacements is available for the IBM 2401 MOD2 through MOD6. Conversion kits are available to transform the 4800 Series from seven to nine track, from 800 to 1600 BPI capability and to convert any of Midwestern's 4700 Series (IBM 729 replacements) to any 4800 Series drive.

Total system reliability, data accuracy and tape life are augmented by the firm's patented positive pressure pneumatic drive. In continuous operation the 4800 has provided a "transport to computer" availability average of 98%.
(For more information, designate #61 on the Reader Service Card.)

### OPTIMAT — AUTOMATED SYSTEM FOR CIRCUITRY ARTWORK

The availability of Optimat, a computerized layout system for the production of integrated and printed circuit artwork, has been announced by Ex-Cell-O Corporation. Wayne Norton, General Manager of Optical Gaging Products, Inc., (a unit of Ex-Cell-O-Corp.), Rochester, N.Y., disclosed that rigorous testing of the prototype model showed Optimat was producing precision finished artwork as much as ten times faster than conventional methods. Combined with the inherent flexibility generated by the system's digital computer, this high-speed production capability offers a solution to the problems involved in handling today's mushrooming volume of circuitry layouts.

Two Aristo Coordinatographs, one for readout and one for layout, are the basic elements in the Optimat system. A small computer, custom electronic interface, teleprinter/tape punch, and teleprinter/tape reader round out the system. Operation of the system is quite simple and does not require a skilled operator. A complete operating data tape with coordinate points and "command" information is generated smoothly and accurately by even the novice operator.

In addition to offering Optimat as a complete system, Optical Gaging Products will retro-fit the automated concept to existing manual Aristo Coordinatographs. The automated system fully retains the accuracy of the manual unit.

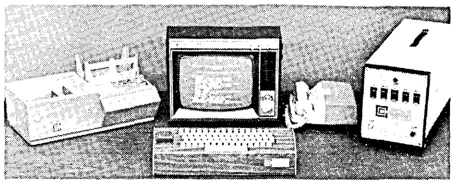
While pricing was not finalized, Mr. Norton said that, "Optimat will be sold for approximately a third less than comparable equipment now available."
(For more information, designate #56 on the Reader Service Card.)

### CC-30 COMMUNICATIONS STATION — PORTABLE SYSTEM USES A STANDARD TELEVISION SET

The CC-30 Communications Station from Computer Communications, Inc., Inglewood, Calif., is a low-cost, portable, input/output terminal designed to provide immediate "on-line" access to a computer.

The system uses a standard television set for alphanumeric or graphic visual displays. The station also can be used off-line to provide the usual utility operations at a remote site.

304 Light Pen, the CC-305 Line Printer, and the CC-306 Card Reader (shown at the left) are available and add flexibility to the design of the CC-30 Communications Station.



— Components of a typical CC-30 Communications Station

A typical CC-30 Communications Station consists of the following components: a CC300 TV Display, utilizing a standard television set (center, rear in photo); a CC-301 TV Display Controller (far right); a CC-302 Telephone Coupler or Data Phone Interface (second from right); and a CC-303 Alphanumeric Keyboard, using a regular typewriter keyboard with added factors (center, front). Additional options such as the CC-

The modular design and wide selection of models and options enable the CC-30 to be specifically tailored for any of a wide variety of applications. Typical applications include information storage and retrieval, on-line compilation and execution, data inquiry services, computer-aided instruction, and simulation.
(For more information, designate #60 on the Reader Service Card.)

## IKOR'S NEW APPROACH TO KEYBOARDS REDUCES CODING ERRORS

A new electronic keyboard, developed by IKOR, Inc., Burlington, Mass., to provide error-free code generation for computer and other information handling and display systems, provides a simplified design which eliminates specific problems associated with electro-mechanical and photo-optical keyboards.

The IKOR Keyboard (patents pending) contains all solid-state circuits. There are no mechanical links to fail and no lights to burn out or become masked by dirt thus contributing to coding errors. The coding for each key is completely self-contained within the key module, and the code generation uses universal Transmit and Receive Bars which serve the same function for all keys. Therefore, the IKOR keyboard permits a wide variety of keyboard configurations as well as the addition of other keys at any time.

The principle of operation in the IKOR keyboard is simple. Each key contains its own character or function code (compatible with standard ASCII 7-bit format). When the key is depressed, an AC couple is established between Transmit and Receive Bars thus generating a code unique to that key. Normally, activation of a key generates a standard 7-bit code plus 1 bit for odd or even parity. A strobe output (flag) at the interface insures that all character bits have reached equilibrium before they can be transmitted. Inherent in the system is a closed loop circuit which provides a detection system for effective discrimination against spurious signals on a basis of both signal level and time.

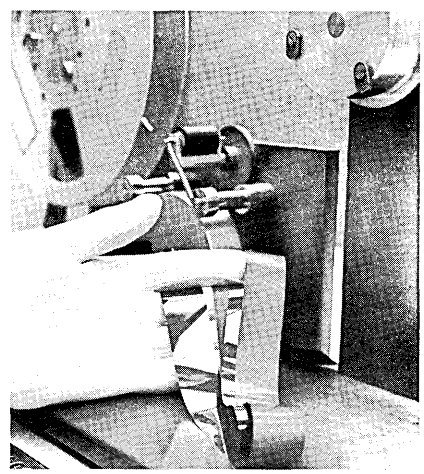
As supplied, the standard IKOR Model 6000 keyboard has 44 keys and spacebar with provision for use of up to 73 keys. Changing or adding keys involves merely snapping the desired keys into and out of their position without any modification of basic circuitry or need to "wire in" the new keys. The Model 6000 keyboard provides either serial or parallel inputs to any information system, using standard 7-bit ASCII code format. It provides clocked output and may be directly interfaced with digital printers, computers, CRT's, alphanumeric display systems, etc. The keyboards are supplied for mounting in customer console or as self-contained units.
(For more information, designate #63 on the Reader Service Card.)

## Data Processing Accessories

### EXTREME ENVIRONMENT TAPE MAKES COMPUTER OPERATION POSSIBLE IN EXTREMES OF HEAT AND COLD

A digital magnetic computer tape which can be used in extremes of hot or cold temperatures has been developed by U. S. Magnetic Tape Company, Huntley, Ill., a subsidiary of Wabash Magnetics, Inc. Wabash Magnetics' President, William F. Boyd, announced that the new tape will permit extended use of computers in aviation, aerospace, and other applications where it is not feasible to control environmental conditions.

"Extreme environment tape", Mr. Boyd said, "performs at temperatures ranging from -55° F. to +180° F. Rapid fluctuations between these temperature extremes — as might be encountered by a jet interceptor rising quickly to the stratosphere from a jungle airstrip — have no adverse effects on X-N tape performance. Also, it is not affected by humidity extremes."



X-N tape uses a polyimide substrate. Polyimide is stable at temperatures ranging from -100° F. to +400° F. The special formulation for X-N tape is an outgrowth of U. S. Tape's development of Duramil 7 coating for conventional computer use. The new X-N tape has the performance capability of 1600 BPI, a measure of data storage capacity required in the computer industry today.

Present concentration of X-N tape development is heaviest on applications in military and commercial aircraft; in spacecraft and satellites; in computers which would be operated in polar, tropical or desert areas where environmental control is not available, especially for the military; in seismic explorations for oil and natural gas; and in remote industrial processing and manufacturing sites.

U. S. Magnetic Tape Company is offering X-N tape in widths of 1/4 through one inch and in lengths of 200 feet through 1,000 feet.
(For more information, designate #62 on the Reader Service Card.)

## AUTOMATION

### REMOTE CONTROL EQUIPMENT USED TO RUN TRAINS OF UNUSUAL LENGTHS

The Norfolk and Western Railroad recently ran a 500-car coal train from West Virginia to Ohio — a distance of 157 miles. The train had a total weight of more than 47,000 tons and was about four miles long. It was powered by three 3600-horsepower diesel units at the head end and by three "slave" (radio-controlled) units of the same horsepower 300 cars in the rear. A normal train without the use of remote control would be made up of 200 cars.

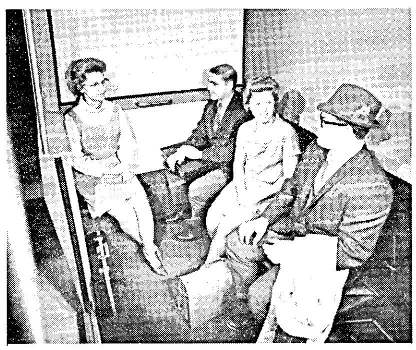
The radio control equipment, called Locotrol, was manufactured and installed by engineers of the Control Division of Radiation Inc., Melbourne, Fla. Locotrol uses solid state logic to translate the commands of the engineer in the lead locomotive. The information is transmitted by two-way radio to the equipment in the slave locomotive. As each set of lead and slave locomotives has its own address code, other units receiving the RF signal will not act upon the commands. A message consists of a total of 50 bits. Total message time is less than 200 milliseconds, including address code, control information and an error-check code.

To insure that each transmission is received accurately, an algebraic problem is inserted in each control message. The slave unit equipment must solve the problem for a zero answer before the command is acted upon. If the answer is something other than zero, the slave requests the message be repeated again.

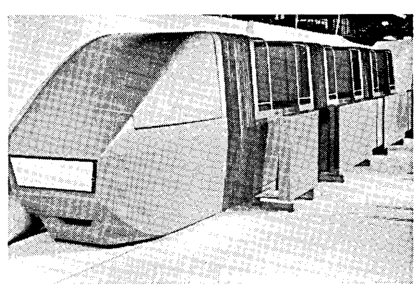
Locotrol offers many advantages to railroad operation such as smoother starts, better dynamic braking, more evenly distributed air supply, and more rapid air recharging.

### FIRST SUPERSONIC AIRPORT GETS FIRST DRIVERLESS, TRACKLESS PASSENGER TRAIN

Houston Intercontinental Airport (Texas), the first commercial airport designed from the start for supersonic aircraft, also has a "first" in its passenger transportation system within the massive airport. Four Barrett "Guide-O-Matic" trains (designed and manufactured by Barrett Electronics Corporation of Northbrook, Ill.) take passengers and their hand luggage more than a third of a mile



in less than four minutes and have a peak capacity of more than 23,000 passengers a day. The trains, each comprising the electronic power and guidance unit and three passenger cars, are expected to be fully loaded only at peak periods. The free-ride trains will run at two-minute intervals, 24 hours a day, connecting terminals and parking area escalators.



The electronic train, driverless and trackless, finds its way precisely through an underground route by sensors and guidance devices which respond to instructions from a wire imbedded in the concrete floor and from safety signals throughout the route. Train interval of approximately two minutes is maintained by a traffic control called zone blocking.

Massive batteries supply power to dual rear-wheel motors, controlled by solid state circuitry for smooth starts and stops. Electromagnetic brakes execute precision stopping with a two-inch tolerance at the stations. This feat, accomplished from full speed to stopping smoothly in less than six seconds, is described by Barrett as one of the outstanding design and engineering achievements in the entire system.

Barrett kept passenger safety and comfort the principle factor in designing the system. One safety and convenience provision is emergency standby power. Another is an optical scanner which initiates an unscheduled stop if it "sees" another train ahead. An electronic monitor sends malfunction alerts to the central control station attendant, who mans an electronic "railroad type" panel-map and console.

The long-range plan calls for Houston's initial 3,000-foot installation to be expanded to a route of nearly two miles as work on the airport progresses. Twelve or more trains will be running constantly when the airport approaches capacity, according to the plan. Barrett designed the "Guide-O-Matic" train so that it could easily be adapted to use in such areas as amusement parks, industrial complexes, shopping centers, motels, universities and as metropolitan shuttles. In industrial applications, the systems are being used in steel, paper and automotive industries and by the military.

## NEW CONTRACTS

| TO | FROM | FOR | AMOUNT |
|---|---|---|---|
| IBM Corporation, Owego, N.Y. | LTV Aerospace Corp., Dallas, Texas | A navigation and weapons delivery system; the System/4 Pi computer is part of the new avionics system — work will be done during the next four years | about $168,500,000 |
| LTV Electrosystems, Inc., subsidiary of Ling-Temco-Vought, Inc., Dallas, Texas | Sacramento Air Materiel Area (SMAMA) | Production of one of the most advanced airborne weapons control systems yet developed — a fixed price contract for $11.7 million, with options for $7.1 million additional work | $18.8 million |
| Creed and Company Ltd., a subsidiary of International Telephone and Telegraph Corp. | British Post Office | Teleprinter equipment for use in Britain's public Telex customer-to-customer teleprinter service | $5.5 million |
| Wyle Laboratories, El Segundo, Calif. | Computicket Corp., a subsidiary of Computer Sciences Corp. | The initial production of computer terminals to be used in Computicket's instant ticketing system for sports and theater events | $3.3 million |
| Honeywell Inc., Wellesley Hills, Mass. | Defense Supply Agency (DSA) | Leasing 22 computers valued at $8.6 million which will be installed in 11 Defense Contract Administration Services Regions (DCASRs) of DSA to process data on over 270,000 Defense Department contracts totaling $49 billion | per month, about $172,000 |
| The National Cash Register Co., Dayton, Ohio | U. S. Army | Thirty-five additional mobile computers; these are constructed around the NCR Series 500 computer system | $1,725,000 |
| Planning Research Corp., Los Angeles, Calif. | U. S. Army Electronics Command | Two contracts to provide computer systems support for the U. S. European Command (EUCOM) | $1.2 million |
| EPSCO, Inc., Westwood, Mass. | Naval Air Systems Command | Additional contract funding to produce synchro data converters for the avionics system of the U. S. Navy's Orion anti-submarine patrol aircraft | $531,000 |
| URS Corporation, San Mateo, Calif. | U. S. Army's Mobility Equipment Research and Development Center | Automating selected logistics functions at the Army Division level and testing the concept of a Division Data Center | $390,800 |
| Computer Sciences Corp., El Segundo, Calif. | U. S. Army on behalf of the Military Traffic Management and Terminal Service (MTMTS) | Development of a computer-oriented information and control system which will provide up-to-the-moment information for controlling overseas shipments of vital military air cargo | $200,000 |
| Systems Engineering Laboratories, Fort Lauderdale, Fla. | Grumman Aircraft, Computer Engineering Dept., Bethpage, L.I., N.Y. | A SEL 840A Computer System which will be used to drive F-111B aircraft electronic equipment in a real-time simulated flight | $195,000 |
| IRA Systems Inc., Lexington, Mass. | Naval Air Development Center, Johnsville, Pa. | Design, development and fabrication of an Analog Computer Function Generator (ACFG) | $113,000 |
| Aerojet-General Corporation's Sacramento Plant | State of California Franchise Tax Board | Development and implementation of two new electronic data processing systems | $103,000 |
| Baldwin-Wallace College, Berea, Ohio | National Science Foundation | Establishment of a computer center which will be used in all academic areas with special interest in the humanities | $50,000 |
| Bryant Computer Products, Walled Lake, Mich. | Bailey Meter Co., Wickliffe, Ohio | One Auto-Lift memory drum, including 9000 Series electronics; this is to be interfaced with Bailey Meter Company's 855 Process Computer System that is being supplied for the new Metropolitan Edison Nuclear Power Station | over $37,000 |
| Aerojet-General Corporation's Sacramento Plant, Calif. | Sacramento County District Attorney's office, Sacramento, Calif. | An 18-week contract to develop a computerized system to help monitor child support records | $23,250 |
| Ecco Consulting, Inc., Pittsburgh, Pa. | Columbia University | The development of a simulation model to study the reproductive patterns in underdeveloped countries based on existing and proposed family planning programs | — |
| Arma Division of American Bosch Arma Corp., Garden City, N.Y. | U. S. Air Force | Designing a miniaturized data processing system that will compute navigation and guidance information on manned space flights — the hand-held data processor will consist of a computer, input keyboard, illuminated display panel and battery in a self-contained package weighing less than 15 pounds | — |
| Recognition Equipment Inc., Dallas, Texas | Atlantic Richfield Company, Philadelphia, Pa. | Lease of optical readers and high-speed sorting equipment with a value of about $2.5 million for use at data processing centers in Philadelphia and in Los Angeles, Calif. | — |
| Informatics Inc., Sherman Oaks, Calif. | TRW Systems Group, Redondo Beach, Calif. | Producing a computer program used to calculate the lateral bending modes and frequencies of single and double beams — the new program will be used to help analyze the stability of missile structures | — |

| OF | AT | FOR |
|---|---|---|
| GE 115 computer system | British Oxygen Co., Ltd., London, Birmingham, Sheffield and Glasgow (4 systems) | Development of data processing procedures in the company's regional centers |
| | Peat, Marwick, Mitchell and Co., New York, N.Y. | A "hands on" training of all accountants who have been with the staff more than two years |
| Honeywell 120 computer | Fruin-Colnon Contracting Co., St. Louis, Mo. | Critical-path reporting, to plan, schedule and control major engineering and construction projects |
| Honeywell 2200 computer system | Associated Hospital Service of New York (Blue Cross), New York, N.Y. | Reducing time required to answer subscribers' questions from as much as 48 hours to as little as a few seconds; later, visual display stations also will be installed in other departments and finally hospitals will be linked to the system on-line |
| IBM System/360 | United Data Processing, Portland, Ore. | Increasing computer time available to businesses using UDP services; is UDP's third computer system (system valued at $500,000) |
| IBM System/360 Model 30 | Rich Equipment Co., subsidiary of Bluefield Supply Co., Bluefield, W. Va. | Controlling distribution of replacement parts for heavy construction equipment |
| | Detroit Public Schools, Detroit Board of Education, Detroit, Mich. | Correlating and evaluating aptitude, achievement, psychological and intelligence test scores; experimental computer training programs for students; and scheduling high school students, business data processing and administrative reports |
| IBM 1240 computer | American National Bank, Vincennes, Ind. | Check accounting and transit operations, trust accounting and payroll, and savings and loan accounts |
| NCR 315 computer system | The Royal Liver Friendly Society (venerable British insurer), Liverpool, England | Branch renewal notices, agency accounting, calculation of bonuses and issue of bonus certificates are among initial applications; other uses also are being planned |
| | Data Processing of the South, Inc., Charlotte, N.C. | Expanding services to customers in all areas, with special emphasis on inventory management programs |
| NCR 315 RMC system | Sumitomo Bank Ltd., Japan (9 computers and associated equipment) | An electronic data processing network expected to be one of the most extensive and advanced "on-line" financial systems in the world — Sumitomo plans to have on-line processing of all bank business completed in its 141 branches in Tokyo and Osaka area by the end of 1969 (systems valued at about $16 million) |
| | Midland Bank, London, England (2 systems) | Completely automating the institution's clearing operations |
| NCR 500 computer system | W. Purdy Ltd., The Brunswick, Great Yarmouth, England | Implementing new budgetary control system as well as handling general accounting and statistical work for five companies in the restaurant-bakery firm group |
| | Peterborough Building Society, London, England | Processing society's mortgage accounts, insurance policies and later investment accounts |
| RCA 3301 computer | The Massachusetts Division of Employment Security, Boston, Mass. | An automated unemployment benefits program which will eventually be expanded to transmit information on 300,000 claims to any of the state's 43 local unemployment offices (see 'Applications') |
| RCA Spectra 70/35 computer | Memphis Police Department, Memphis, Tenn. | Processing, storing, retrieving and transmitting vital criminal information |
| RCA Spectra 70/45 computer | Lederle Laboratories, a division of American Cyanamid, Pearl River, N.Y. | Streamlining the complex production and worldwide distribution of more than 1,000 different drug products |
| | General Cable Corp., Perth Amboy, N.J. (2 computers) | The hub of a nationwide management information system for the company's more than 70 plants and warehouses |
| | New England School Development Council, Harvard Univ., Cambridge, Mass. | Research and development of new teaching methods, instructional aids and administrative practices |
| | State Farm Life Insurance Co., Bloomington, Ill. | Maintaining more than 700,000 policyholder records; system eventually will link 21 regional offices to the computer in a communications network |
| SDS 940 computer | Computer Sharing, Inc., Philadelphia, Pa. | Accommodating up to 200 Teletype terminals located at remote user stations |
| SDS Sigma 7 computer | University of Houston, Houston, Texas | Teaching the nature and use of computers to students in every field |
| UNIVAC 494 computer system | Ohio Bell Telephone Co., Cleveland, Ohio | The center of a business information system (system valued at $2 million) |
| | Travelers Insurance Companies, Hartford, Conn. (2 systems) | Replacing UNIVAC 490 and 492 systems; also provides capacity for increased growth in business |
| UNIVAC 1108 computer system | C.E.I.R. Ltd., London, England | The heart of a utility service designed to provide the data processing needs of a large number of users (system valued at about $5 million) |
| UNIVAC 9200 computer system | Southern Memorial Services, Birmingham, Ala. | Maintaining an up-to-date accounts receivable, inventory, for processing of a perpetual care fund, for updating commission payments, and payroll operation |
| | Anglo-American Aviation Co., North Hollywood, Calif. | Processing of orders, inventory control, maintenance of an up-to-the-minute quote file, and general accounting procedures |
| | Spatola Thompson Inc., Philadelphia, Pa. | Invoicing, accounts receivable, sales analysis, calculating commissions and for inventory control |
| UNIVAC 9300 computer system | Pioneer Telephone Co., Waconia, Minn. | Billing purposes |

# MONTHLY COMPUTER CENSUS

The number of electronic computer systems installed or on order changes rapidly. The following is a summary made by "Computers and Automation" of reports and estimates of the number of general purpose electronic digital computers manufactured by companies based in the United States. These figures include installations and unfilled orders inside and outside of the United States.

These figures are mailed to the individual computer manufacturers from time to time for their information and review and for any updating or comments they may care to make.

Our readers are also invited to submit information that would help make these figures as accurate and complete as possible.

The following abbreviations apply:

(R) – figures derived all or in part from information released directly or indirectly by the manufacturer, or from reports by other sources likely to be informed

(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

X – no longer in production

C – figure is combined in a total (see adjacent column)

E – figure estimated by "Computers and Automation"

? – information not received at press time

AS OF DECEMBER 15, 1967

| NAME OF MANUFACTURER | NAME OF COMPUTER | AVERAGE OR RANGE OF MONTHLY RENTAL (S: SALE ONLY) | DATE OF FIRST INSTALLATION | NUMBER OF INSTAL-LATIONS | MFR'S TOTAL INSTAL-LATIONS | NUMBER OF UNFILLED ORDERS | MFR'S TOTAL ORDERS |
|---|---|---|---|---|---|---|---|
| Autonetics (R) | RECOMP II | $2495 | 11/58 | 30 | | X | |
| | RECOMP III | $1495 | 6/61 | 6 | 36 | X | 0 |
| Bunker-Ramo Corp. (R) | BR-130 | $2000 | 10/61 | 160 | | X | |
| | BR-133 | $2400 | 5/64 | 62 | | X | |
| | BR-230 | $2680 | 8/63 | 15 | | X | |
| | BR-300 | $3000 | 3/59 | 18 | | X | |
| | BR-330 | $4000 | 12/60 | 23 | | X | |
| | BR-340 | $7000 | 12/63 | 19 | 297 | X | X |
| Burroughs (R) | 205 | $4600 | 1/54 | 38 | | X | |
| | 220 | $14,000 | 10/58 | 31 | | X | |
| | B200 Series, B100 | $5400 | 11/61 | 800 | | 31 | |
| | B300 Series | $9000 | 7/65 | 340 | | 150 | |
| | B2500 | $5000 | 2/67 | 20 | | 60 | |
| | B3500 | $14,000 | 5/67 | 16 | | 50 | |
| | B5500 | $22,000 | 3/63 | 71 | | 19 | |
| | B6500 | $33,000 | 2/68 | 0 | | 6 | |
| | B7500 | $44,000 | 4/69 | 0 | | 4 | |
| | B8500 | $200,000 | 8/67 | 0 | 1310 E | 3 | 320 E |
| Control Data Corp. (R) | G-15 | $1600 | 7/55 | 285 | | X | |
| | G-20 | $15,500 | 4/61 | 23 | | X | |
| | LGP-21 | $725 | 12/62 | 159 | | X | |
| | LGP-30 | $1300 | 9/56 | 322 | | X | |
| | RPC-4000 | $1875 | 1/61 | 73 | | X | |
| | 046/136/636 | ? | - | 28 | | C | |
| | 160*/8090 Series | $2100-$12,000 | 5/60 | 594 | | X | |
| | 924/924A | $11,000 | 8/61 | 30 | | X | |
| | 1604/A/B | $45,000 | 1/60 | 59 | | X | |
| | 1700 | $3500 | 5/66 | 48 | | C | |
| | 3100/3150 | $10,000 | 12/64 | 87 | | C | |
| | 3200/3300 | $16,250 | 5/64 | 132 | | C | |
| | 3400 | $18,000 | 11/64 | 20 | | C | |
| | 3600/3800 | $48,750 | 6/63 | 57 | | X | |
| | 6400/6500/6600 | $52,000-$117,000 | 8/64 | 49 | (as of | C | |
| | 6800 | $130,000 | 6/67 | 0 | 1938 June 30) | C | 320 E |
| Digiac Electronics, Inc. (R) | DIGIAC 3080 | $19,500 (S) | 12/64 | 10 | 10 | 1 | 1 |
| Digital Equipment Corp. (R) | PDP-1 | $3400 | 11/60 | 59 | | X | |
| | PDP-4 | $1700 | 8/62 | 55 | | X | |
| | PDP-5 | $900 | 9/63 | 114 | | X | |
| | PDP-6 | $10,000 | 10/64 | 22 | | X | |
| | PDP-7 | $1300 | 11/64 | 165 | | C | |
| | PDP-8 | $525 | 4/65 | 1050 | | C | |
| | PDP-8S | $300 | 9/66 | 549 | | C | |
| | PDP-9 | $1000 | 12/66 | 80 | | C | |
| | PDP-10 | $7500 | 2/67 | 2 | 2096 | C | 450 E |
| Electronic Assoc., Inc. (R) | 640 | $1200 | 4/67 | 13 | | 23 | |
| | 8400 | $12,000 | 7/65 | 19 | 32 | 4 | 27 |
| EMR Computer Div. (R) | ASI 210 | $3850 | 4/62 | 26 | | X | |
| | ASI 2100 | $4200 | 12/63 | 7 | | X | |
| | ADVANCE 6020 | $4400 | 4/65 | 14 | | 11 | |
| | ADVANCE 6040 | $5600 | 7/65 | 7 | | 3 | |
| | ADVANCE 6050 | $9000 | 2/66 | 18 | | 8 | |
| | ADVANCE 6070 | $15,000 | 10/66 | 7 | | 2 | |
| | ADVANCE 6130 | $1000 | 8/67 | 5 | 84 | 36 | 60 |
| General Electric (N) | 115 | $1340-$8000 | 12/65 | 500 E | | 600 E | |
| | 205 | $2500-$10,000 | 6/64 | C | | X | |
| | 210 | $16,000-$22,000 | 7/59 | C | | X | |
| | 215 | $2500-$10,000 | 9/63 | C | | X | |
| | 225 | $2500-$26,000 | 4/61 | 200 E | | X | |
| | 235 | $6000-$28,000 | 4/64 | 100 E | | C | |
| | 255 | $15,000-$26,000 | 10/67 | C | | C | |
| | 265 | $17,000-$28,000 | 7/64 | C | | C | |
| | 405 | $5120-$10,000 | 11/67 | C | | C | |
| | 415 | $4800-$13,500 | 5/64 | 300 E | | 70 E | |
| | 420 | $18,000-$28,000 | 7/67 | C | | C | |
| | 425 | $6000-$20,000 | 6/64 | 100 E | | C | |
| | 435 | $8000-$25,000 | 9/65 | C | | C | |
| | 625 | $31,000-$135,000 | 4/65 | C | | C | |
| | 635 | $35,000-$167,000 | 5/65 | C | | C | |
| | 645 | $40,000-$250,000 | 7/66 | C | 1490 E | C | 850 E |
| Hewlett-Packard (R) | 2116A | $600 | 11/66 | 64 | | C | |
| | 2115A | $412 | 11/67 | 9 | 73 | C | 24 E |
| Honeywell (R) | DDP-24 | $2500 | 5/63 | 85 | | X | |
| | DDP-116 | $900 | 4/65 | 190 | | 30 | |
| | DDP-124 | $2050 | 3/66 | 46 | | 33 | |
| | DDP-224 | $3300 | 3/65 | 50 | | 8 | |
| | DDP-516 | $700 | 9/66 | 70 | | 154 | |
| | H-120 | $3900 | 1/66 | 650 | | 240 | |
| | H-200 | $8400 | 3/64 | 1130 | | 87 | |
| | H-400 | $8500 | 12/61 | 120 | | X | |
| | H-800 | $28,000 | 12/60 | 89 | | X | |
| | H-1200 | $3800 | 2/66 | 160 | | 130 | |
| | H-1400 | $14,000 | 1/64 | 12 | | X | |
| | H-1800 | $42,000 | 1/64 | 21 | | 1 | |
| | H-2200 | $12,000 | 1/66 | 65 | | 71 | |
| | H-4200 | $20,500 | 6/67 | 0 | | 20 | |
| | H-8200 | $35,000 | 4/68 | 0 | 2700 E | 5 | 780 E |

| NAME OF MANUFACTURER | NAME OF COMPUTER | AVERAGE OR RANGE OF MONTHLY RENTAL (S: SALE ONLY) | DATE OF FIRST INSTALLATION | NUMBER OF INSTAL-LATIONS | MFR'S TOTAL INSTAL-LATIONS | NUMBER OF UNFILLED ORDERS | MFR'S TOTAL ORDERS |
|---|---|---|---|---|---|---|---|
| IBM (N) | 305 | $3600 | 12/57 | C | | X | |
| | 360/20 | $3000 | 12/65 | 5000 E | | 6000 E | |
| | 360/30 | $9340 | 5/65 | 5000 E | | 4000 E | |
| | 360/40 | $19,550 | 4/65 | 3000 E | | 2000 E | |
| | 360/44 | $12,180 | 7/66 | C | | C | |
| | 360/50 | $32,960 | 8/65 | C | | C | |
| | 360/65 | $56,650 | 11/65 | C | | C | |
| | 360/67 | $138,000 | 10/66 | C | | C | |
| | 360/75 | $81,400 | 2/66 | C | | C | |
| | 360/90 Series | - | 10/67 | C | | C | |
| | 650 | $4800 | 11/54 | C | | X | |
| | 1130 | $1545 | 2/66 | 2100 E | | 4500 E | |
| | 1401 | $6480 | 9/60 | 7650 E | | X | |
| | 1401-G | $2300 | 5/64 | C | | X | |
| | 1401-H | $1300 | 6/67 | C | | C | |
| | 1410 | $17,000 | 11/61 | C | | C | |
| | 1440 | $4300 | 4/63 | 3600 E | | C | |
| | 1460 | $10,925 | 10/63 | 1400 E | | X | |
| | 1620 I, II | $4000 | 9/60 | 1500 E | | C | |
| | 1800 | $4800 | 1/66 | C | | C | |
| | 701 | $5000 | 4/53 | C | | X | |
| | 7010 | $26,000 | 10/63 | C | | C | |
| | 702 | $6900 | 2/55 | C | | X | |
| | 7030 | $160,000 | 5/61 | C | | X | |
| | 704 | $32,000 | 12/55 | C | | X | |
| | 7040 | $25,000 | 6/63 | C | | C | |
| | 7044 | $36,500 | 6/63 | C | | C | |
| | 705 | $38,000 | 11/55 | C | | X | |
| | 7070, 2, 4 | $27,000 | 3/60 | C | | X | |
| | 7080 | $60,000 | 8/61 | C | | X | |
| | 709 | $40,000 | 8/58 | C | | X | |
| | 7090 | $63,500 | 11/59 | C | | X | |
| | 7094 | $75,500 | 9/62 | C | | X | |
| | 7094 II | $82,500 | 4/64 | C | 36,000 E | C | 18,000 E |
| Interdata (R) | Model 2 | $200-$300 | - | 0 | | 3 | |
| | Model 3 | $300-$500 | 3/67 | 24 | | 75 | |
| | Model 4 | $400-$800 | - | 0 | 24 | 5 | 83 |
| National Cash Register Co.(R) | NCR-304 | $14,000 | 1/60 | 24 | | X | |
| | NCR-310 | $2500 | 5/61 | 14 | | X | |
| | NCR-315 | $8500 | 5/62 | 575 | | 150 | |
| | NCR-315-RMC | $12,000 | 9/65 | 65 | | 50 | |
| | NCR-390 | $1850 | 5/61 | 600 | | 6 | |
| | NCR-500 | $1500 | 10/65 | 1436 | 2710 E | 580 | 790 E |
| Pacific Data Systems Inc. (R) | PDS 1020 | $550-$900 | 2/64 | 135 | 135 | 20 | 20 |
| Philco (R) | 1000 | $7010 | 6/63 | 16 | | X | |
| | 2000-210, 211 | $40,000 | 10/58 | 16 | | X | |
| | 2000-212 | $52,000 | 1/63 | 12 | 44 | X | X |
| Radio Corp. of America (R) | RCA 301 | $7000 | 2/61 | 635 | | C | |
| | RCA 3301 | $17,000 | 7/64 | 75 | | C | |
| | RCA 501 | $14,000 | 6/59 | 96 | | X | |
| | RCA 601 | $35,000 | 11/62 | 3 | | X | |
| | Spectra 70/15 | $4500 | 9/65 | 160 | | 125 | |
| | Spectra 70/25 | $6500 | 9/65 | 85 | | 57 | |
| | Spectra 70/35 | $10,400 | 1/67 | 52 | | 135 | |
| | Spectra 70/45 | $22,000 | 11/65 | 80 | | 107 | |
| | Spectra 70/46 | $34,400 | - | 0 | | C | |
| | Spectra 70/55 | $34,300 | 11/66 | 5 | 1190 E | 14 | 420 E |
| Raytheon (R) | 250 | $1200 | 12/60 | 175 | | X | |
| | 440 | $3500 | 3/64 | 20 | | X | |
| | 520 | $3200 | 10/65 | 27 | | 0 | |
| | 703 | S | 10/67 | 7 | 229 | 22 | 22 |
| Scientific Control Corp. (R) | 650 | $500 | 5/66 | 23 | | 1 | |
| | 655 | $1800 | 10/66 | 3 | | 19 | |
| | 660 | $2000 | 10/65 | 4 | | 0 | |
| | 670 | $2600 | 5/66 | 1 | | 0 | |
| | 6700 | $30,000 | 10/67 | 0 | 31 | 1 | 21 |
| Scientific Data Syst., Inc. (N) | SDS-92 | $1500 | 4/65 | 100 E | | 20 | |
| | SDS-910 | $2000 | 8/62 | 200 E | | 30 | |
| | SDS-920 | $2900 | 9/62 | 200 E | | 20 | |
| | SDS-925 | $3000 | 12/64 | C | | C | |
| | SDS-930 | $3400 | 6/64 | 200 E | | 30 | |
| | SDS-940 | $10,000 | 4/66 | C | | C | |
| | SDS-9300 | $7000 | 11/64 | C | | C | |
| | Sigma 2 | $1000 | 12/66 | 30 | | 160 | |
| | Sigma 5 | $6000 | 8/67 | C | | C | |
| | Sigma 7 | $12,000 | 12/66 | C | 920 E | C | 360 E |
| Standard Computer Corp. (N) | IC 6000 | $10,000-$22,000 | 5/67 | 6 | 6 | 10 E | 10 E |
| Systems Engineering Labs (R) | SEL 810 | $1000 | 9/65 | 24 | | X | |
| | SEL 810A | $900 | 8/66 | 30 | | 26 | |
| | SEL 810B | ? | - | 0 | | 7 | |
| | SEL 840 | $1400 | 11/65 | 4 | | X | |
| | SEL 840A | $1400 | 8/66 | 16 | | 26 | |
| | SEL 840 MP | ? | - | 0 | 74 | 6 | 65 |
| UNIVAC, Div. of Sperry Rand (R) | I & II | $25,000 | 3/51 & 11/57 | 23 | | X | |
| | III | $20,000 | 8/62 | 67 | | X | |
| | File Computers | $15,000 | 8/56 | 13 | | X | |
| | Solid-State 80 I, II, 90, I, II & Step | $8000 | 8/58 | 222 | | X | |
| | 418 | $11,000 | 6/63 | 118 | | 33 | |
| | 490 Series | $35,000 | 12/61 | 160 | | 50 | |
| | 1004 | $1900 | 2/63 | 3200 | | 20 | |
| | 1005 | $2400 | 4/66 | 900 | | 160 | |
| | 1050 | $8000 | 9/63 | 285 | | 16 | |
| | 1100 Series (except 1107 & 1108) | $35,000 | 12/50 | 9 | | X | |
| | 1107 | $55,000 | 10/62 | 33 | | X | |
| | 1108 | $65,000 | 9/65 | 70 | | 75 | |
| | 9200 | $1500 | 6/67 | 60 | | 900 | |
| | 9300 | $3400 | 7/67 | 20 | | 650 | |
| | LARC | $135,000 | 5/60 | 2 | 5180 E | X | 1900 E |
| Varian Data Machines (R) | 620 | $900 | 11/65 | 75 | | 0 | |
| | 620i | $500 | 6/67 | 41 | 116 | 277 | 277 |
| | | | | TOTALS — | 56,750 E | | 24,800 E |

# NEW PATENTS

**Raymond R. Skolnick**
**Patent Manager**
**Ford Instrument Co.**
**Div. of Sperry Rand Corp.**
**Long Island City, N.Y. 11101**

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

### October 31, 1967

3,350,694 / Arthur A. Kusnick, Peekskill, N.Y., and Wilhelm G. Spruth, Boeblingen, Germany / International Business Machines Corp., New York, N.Y., a corporation of New York / Data storage system.

3,350,695 / Samuel Kaufman, New York, and Joseph J. Magnino, Jr., Yorktown Heights, N.Y. / International Business Machines Corporation, New York, N.Y., a corporation of New York / Information retrieval system and method.

3,350,700 / Edward A. Aron, Needham, Mass. / The United States of America as represented by the Secretary of the Air Force / Track selection logic for magnetic storage drum.

### November 7, 1967

3,351,909 / Hermann Hummel, Meersburg, Germany / Telefunken Patentverwertungsgesellschaft m.b.H., Ulm (Danube), Germany / Information storage and transfer system for digital computers.

3,351,910 / William G. Miller, West Babylon, and Charles A. Burt, Oscawana, N. Y. / Communitron, Inc., New York, N. Y. / Apparatus for collecting and recording data.

3,351,913 / Buddie J. Pine, Phoenix, Ariz. / General Electric Co., a corporation of New York / Memory system including means for selectively altering or not altering restored data.

3,351,917 / George T. Shimabukuro, Monterey Park, Calif. / Burroughs Corporation, Detroit, Mich., a corporation of Michigan / Information storage and retrieval system having a dynamic memory device.

3,351,920 / David C. Harper, Rochester, Raymond T. Wright, West Webster, and James E. Young, Pittsford, N. Y. / Xerox Corporation, Rochester, N. Y., a corporation of New York / Thermoplastic computer memory storage system.

3,351,921 / Peter George Briggs, Tewin, near Welwyn, England / International Computers and Tabulators Limited / Magnetic core data storage matrix.

3,351,922 / Richard L. Snyder, Fullerton, Calif. / Hughes Aircraft Company, Culver City, Calif., a corporation of Delaware / Collapsing domain magnetic memory.

### November 14, 1967

3,353,105 / Reginald Hugh Allmark and James Raymond Ellison, Stoke-on-Trent, England / The English Electric Company Limited, London, England, a British company. / Logical electric circuits.

3,353,159 / Edwin S. Lee III, West Covina, Calif. / Burroughs Corp., Detroit, Mich., a corporation of Michigan / Associative memory with variable word length capacity.

3,353,167 / Howard L. Daniels, West St. Paul, Minn. / by mesne assignments, to Sperry Rand Corporation, New York, N. Y., a corporation of Delaware / Head positioner for a magnetic data storage device.

### November 21, 1967

3,354,295 / Raymond Kulka, Wappingers Falls, N. Y. / International Business Machines Corporation, New York, N. Y., a corporation of New York / Binary counter.

3,354,324 / Jack S. Cubert, Willow Grove, and Francis J. Ash, Philadelphia, Pa. / Sperry Rand Corporation, New York, N. Y., a corporation of Delaware / Tunnel diode logic circuit.

3,354,429 / Charles E. Macon, Altadena, Robert S. Barton, Pasadena, Paul A. Quantz, Thousand Oaks, and George T. Shimabukuro, Monterey Park, Calif. / Burroughs Corporation, Detroit, Mich., a corporation of Michigan / Data processor.

3,354,430 / Carl Zeitler, Jr., and Lawrence J. Boland, Poughkeepsie, N. Y. / International Business Machines Corporation, Armonk, N. Y., a corporation of New York / Memory control matrix.

3,354,439 / Roscoe W. Mitchell, Jr., Tulsa, Okla. / by mesne assignments, to Esso Production Research Co., Houston, Tex., a corporation of Delaware / Electrochemical memory.

### November 28, 1967

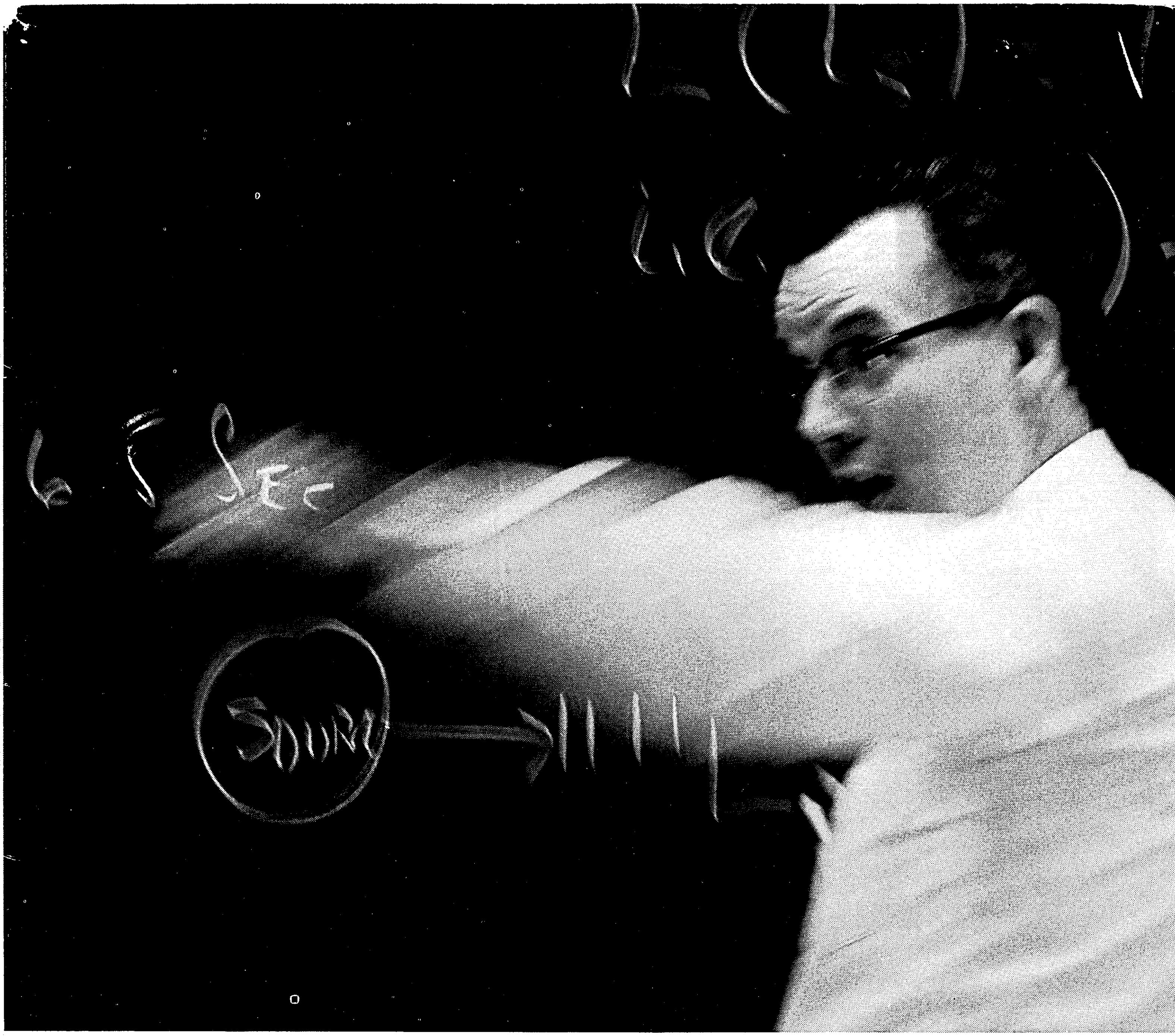
3,355,598 / James W. Tuska, Hopewell Township, Mercer County, N. J. / Radio Corporation of America, a corporation of Delaware / Integrated logic arrays employing insulated-gate field-effect devices having a common source region and shared gates.

3,355,718 / Anthony R. Talarczyk, Bloomington, Minn. / Sperry Rand Corporation, New York, N. Y., a corporation of Delaware / Data processing system having programably variable selection for reading and recording interlaced data on a magnetic drum.

3,355,719 / Stephen Richard Fox, Los Angeles, Calif. / by mesne assignments, to the United States of America as represented by the Secretary of the Navy / Analog voltage memory circuit.

# ADVERTISING INDEX

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



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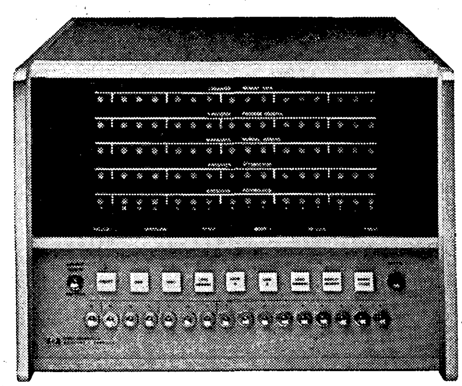

The 2115A has 16-bit words, 2 $\mu$sec cycle time, 4K memory (expandable to 8K) and a $16,500 price including Teleprinter.

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