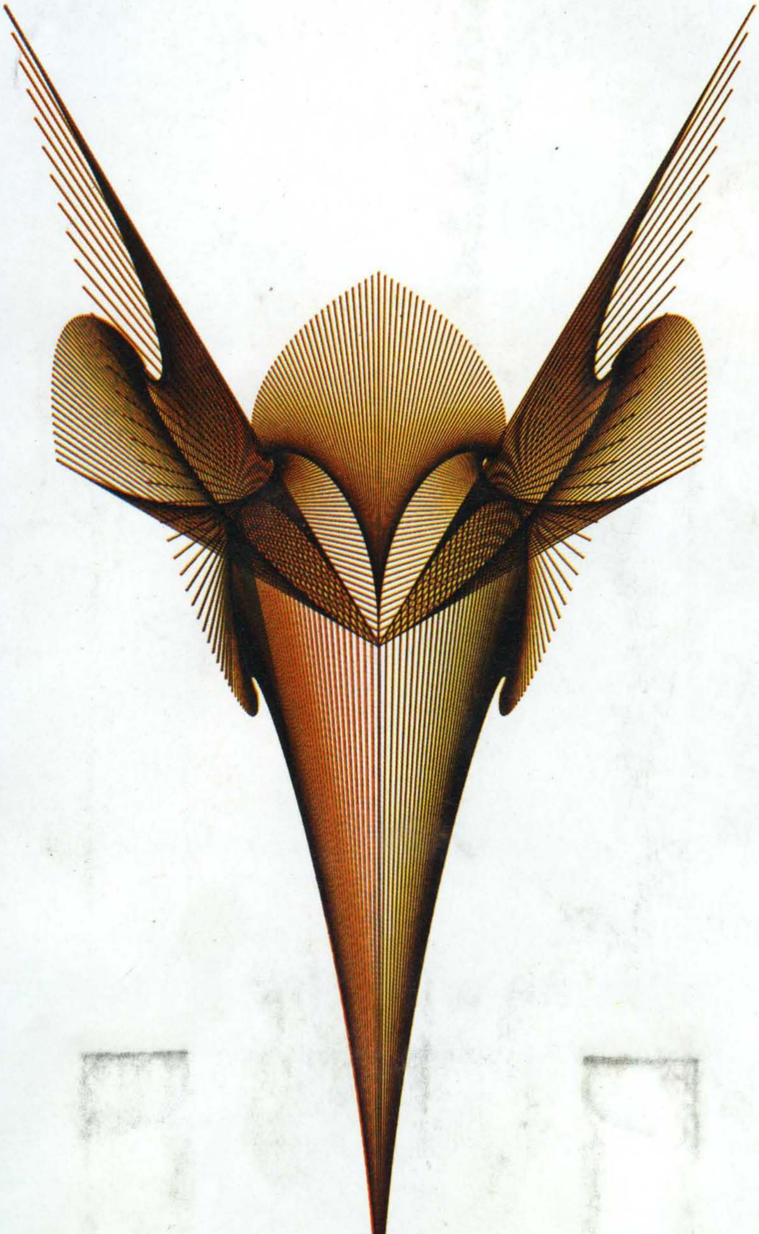
August, 1968

computers and automation



6th Annual Computer Art Contest
— First Prize: "Hummingbird"

COMPUTERS & AUTOMATION
AUGUST 196
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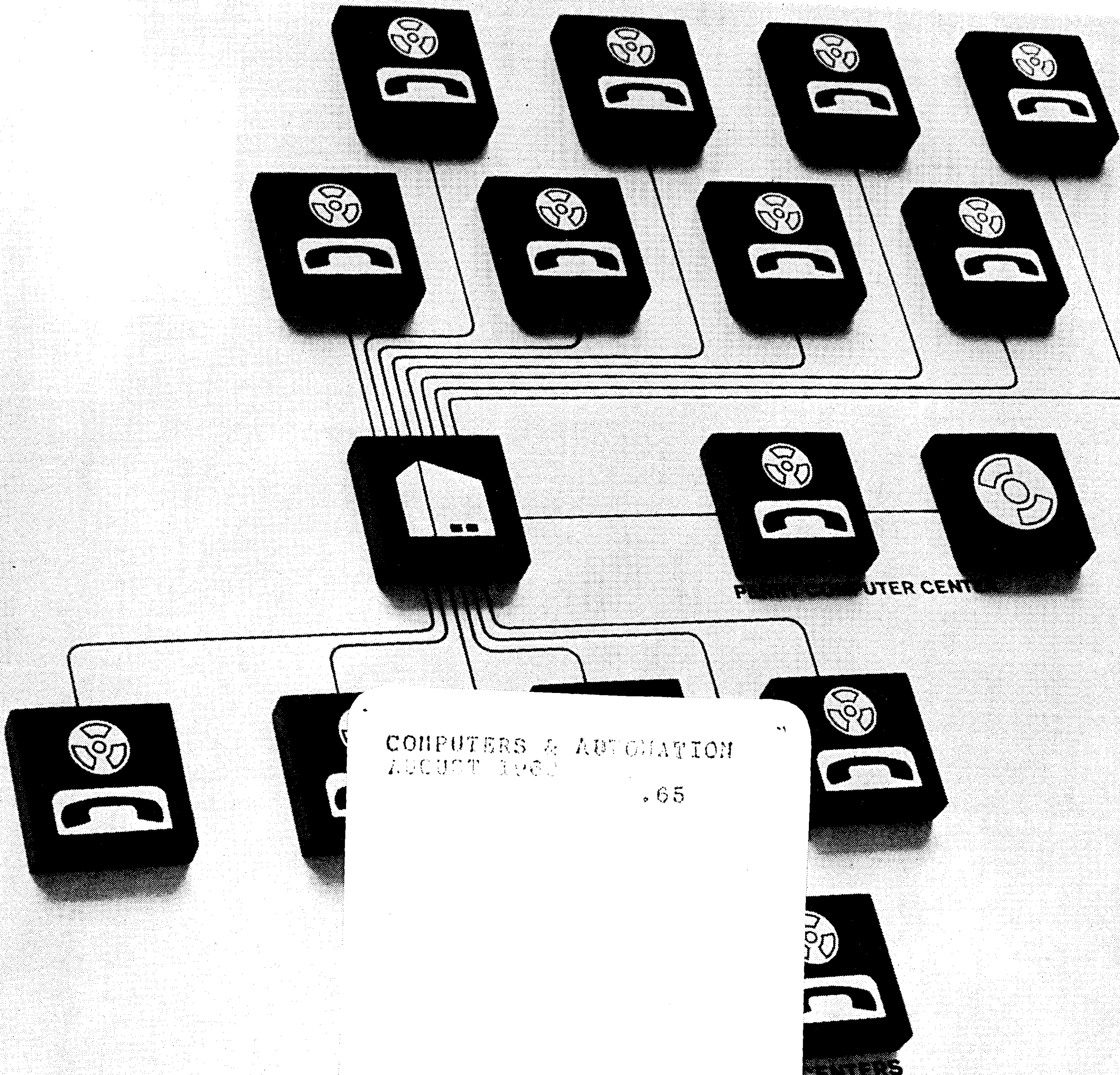

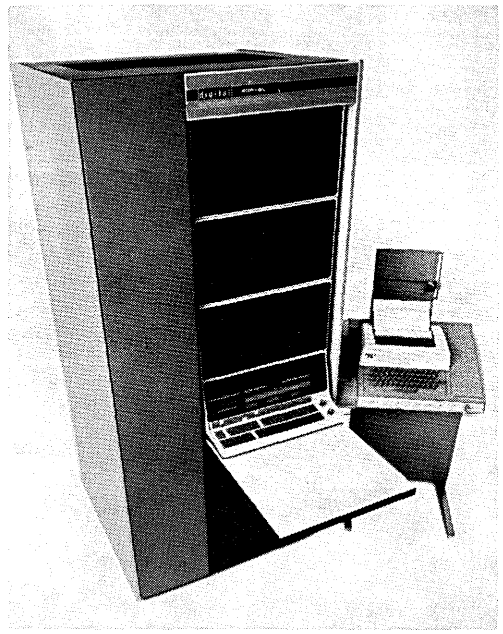

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Letters To The Editor

Computers and Education

The March issue of *Computers and Automation* was especially interesting to me. I am a mathematics teacher in high school in suburban Minneapolis and have recently taken some computer courses and become interested in this area of mathematics-related work in high schools. The topic of "Computers and Education" decided for me that I would accept your invitation for comments and suggestions.

Are there any publications specializing in computers and/or programming for teachers? It seems to me that a good many math teachers might appreciate such a publication or such a department in a current publication. If it were known by math teachers that such a department existed in a computer magazine it would be quite a good way to keep informed in the field and should be a good source of potential subscribers. Why not put such a department in C&A, make it known through such an organization as National Council of Math teachers, or the various state organizations of math teachers, and see if there is enough demand for a section aimed at secondary school use of computers and programming?

I enjoy your magazine and feel it is a good way of keeping informed on developments in the field of programming at a nominal cost.

CHARLES HUTCHINSON
Crystal, Minn. 55427

(Ed. Note — *There are publications specializing in computers and programming for teachers and people in education, and there will be more and more. As to our having a department on this subject, we like your idea, and we will try to find someone who might handle this as a department.*)

Notice to Ing Jaroslav Kucera, Prague

We thank you for your letter of March 18, and we wish to reply to it — but your letter does not have your street address. Would you please tell us your street address?

The Editor

The Ten-Mile Gap — Comments

I read with great interest the article in your March issue, "The Ten-Mile Gap — Part I: The Problem". I felt that the article clearly set out one of the major causes of unrest in our cities today. It is very encouraging to see someone in a position of responsibility take positive action to help correct some of our social problems today. While your article did not mention specific methods of overcoming the problem, I'm sure you are well aware that defining the problem is usually the hardest part of solving it.

I hope that this letter, along with any others that you may have received, will help spur you to greater efforts in attacking the problem created by those of us who do not have the proper attitude toward social concern.

R. M. MERRITT
Manager
ISD Systems & Procedures
Wilcox Electric Company, Inc.
Kansas City, Mo. 64127

Law and Computer Technology

It may please you to know that my article, "The Impact of Data Processing Technology on the Legal Profession", in your April issue has generated many more inquiries than the first publication of the article in a legal magazine.

If I write anything I think you might be interested in, I'll surely advise you.

VAUGHN C. BALL
Univ. of Southern Calif.
Law Center
Los Angeles, Calif. 90007

CAUML Comments

Your January editorial ("Access to Information and a Mailing List of All Computer People") has us in complete agreement. We would like to have our names included in your name and address files: . . .

I find your magazine very helpful in this rapidly changing field.

KENNETH W. KEMNER
Vice President
Automated Data Processing, Inc.
St. Mary's, Pa. 15857

computers and automation

Vol. 17, No. 8 — August, 1968

Editorial Offices
BERKELEY ENTERPRISES, INC.
815 WASHINGTON STREET,
NEWTONVILLE, MASS. 02160

CIRCULATION AUDITED BY
AUDIT BUREAU OF CIRCULATIONS

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computers and automation

August, 1968, Vol. 17, No. 8 — *The magazine of the design, applications, and implications of information processing systems.*

Special Feature: Sixth Annual Computer Art Contest

Regular Features

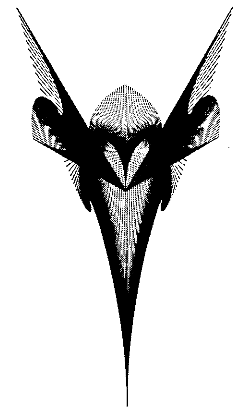
Editorial

C&A Worldwide

Fifteen Years Ago in "Computers and Automation"

Ideas: Spotlight

Multi-Access Forum



The front cover shows the entry which won first prize in the Sixth Annual Computer Art Contest of Computers and Automation *— "Hummingbird", by Kerry Strand and Gary Craigmile. A description of this picture, and other entries in the contest, are in the computer art section of this issue beginning on page 8.*

Departments

How to Spoil One's Mind—as Well as One's Computer

Anybody who has been in the computer field for some time is bound to consider the differences and similarities between the way in which programmed computers solve problems and the way in which human beings solve problems.

The programmed computer solves a problem because the combined brainpower of a number of human beings (a number that may range from two or three up to several hundred or even a thousand) has been organized and adapted, so that when appropriate data are put into the computer, correct answers come out. And as a corollary, with wrong data or incorrect programs, the computer produces wrong answers; as we say in the computer field, "garbage in, garbage out." We spoil the functioning of the computer.

A human being solves a problem because his brainpower (capacity to program himself) and his education (programming from many other human beings) and his data (observations, experiences, the statements he accepts from other people, his emotions, etc.) are organized and adapted to producing a correct answer. And the same corollary is true for human beings, "put garbage into the mind and garbage will come out." We spoil the functioning of the mind.

Just as one of the most potent sources of error for computers is wrong data, so one of the most potent sources of error for human beings is wrong data. However, there is an extremely important difference between the way a computer processes information and the way a human being processes information: The memory of a computer can be completely changed at enormous speed. Usually the entire contents of the core memory of a computer can be changed in less than a second. And the computer will afterwards remember literally nothing of what it previously stored.

This is not true for a human being. Once erroneous information is stored in the mind, it is hard to get rid of it. All of us know the difficult problem of unlearning wrong information. Errors and lies spoil the mind.

There are many sources of errors and lies for spoiling the mind, and we will try to consider a few of them here. As usual nowadays, the most important sources are man-made.

A great many people are inclined to believe what a democratic government says officially to them; and the fact that the government may be deliberately lying is not usually taken into account. For example, for a number of months the figures given by the United States government about U.S. airplane losses in Vietnam carefully excluded certain classes of losses. As a result, many people in the United States thought that the Democratic Republic of Vietnam was lying when it claimed that U.S. plane losses were far greater. Finally, the United States government admitted that plane losses were at least twice as high. Now, there is no possible military advantage in concealing from an enemy how many airplanes have been shot down over enemy territory. The enemy knows. The main advantage to the lying was that the administration of the United States government was able to deceive the people of the United States and persuade them to continue to accept certain policies for a while longer.

At least a dozen big and important lies have been told by the United States government from 1960 to the present, under three presidents: Eisenhower (the U 2 incident), Kennedy (the Bay of Pigs incident), and Johnson (the polite name for that collection of lies is the "credibility gap"). (A list will be furnished by the editor on request.)

Members and former members of the United States government have even defended the right of a government to lie to its people. It seems to me that this argument is demonstrably wrong. People all over the world have the right to be told the truth by their government, so that the people can decide whether or not to continue that government in power over them. And even if there is often some question about what is the precise truth, there is usually no doubt whatever about what is a big lie.

Foreign countries who are harmed by a lie should have the right to come into the courts of the country where the lie has been told and sue for damages — in the same way as an individual harmed by libel has the right to sue.

Another great source of lies for spoiling the minds of people — and producing wrong results if the lying data are fed into computers — is in the advertising of commercial products. Take for example cigarettes. There now exists profoundly convincing evidence that, for great numbers of people if not all, cigarette smoking produces lung cancer, circulatory diseases and other serious physical harm. Furthermore, there is evidence that some people can stop smoking easily, but that other people find it extremely hard to stop because they have become addicted, "hooked." Dr. Sigmund Freud, the founder of psychoanalysis, tried to stop smoking more than a dozen times, and even had more than thirty surgical operations for removing cancer due to smoking from his mouth and jaw (until he no longer had his own jaw) — and still he could not stop smoking, and he died from cancer. Consequently, until scientists can predict which people can smoke with impunity (like Winston Churchill) and which cannot, the only safe course of action for young people who have never started smoking is never to begin.

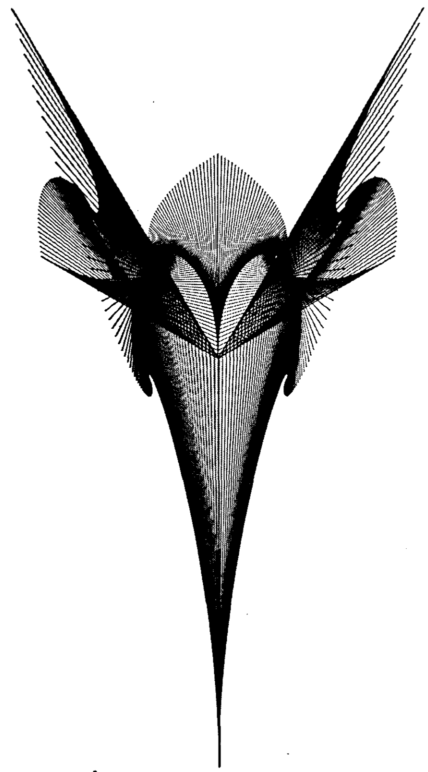
Yet this logical course of action is largely drowned out in radio advertising, TV advertising, magazine advertising, etc., where the companies that sell cigarettes are freely able to entice young people who have never begun to start smoking.

The human mind is one of the most remarkable developments of two thousand million years of evolution. Yet it is easy to spoil: just put into the mind information that is not true; hammer it in with continual repetition and fallacious arguments; and insulate the mind from opportunities to test the information against the real world and contrary arguments.

It is unreasonable to argue for no exposure to wrong information. Thus it is vital for people to learn how to distinguish between what is correct and useful information for

(Please turn to page 46)

THE SIXTH ANNUAL COMPUTER ART CONTEST OF COMPUTERS AND AUTOMATION



HUMMINGBIRD
— Kerry Strand
Gary Craigmile

The first prize in our 1968 Computer Art Contest has been awarded to Kerry Strand and Gary Craigmile, both of California Computer Products, Inc., Anaheim, Calif. Their winning entry appears in color on the front of this issue, and is entitled "Hummingbird". It was designed and programmed by Mr. Strand; the color coordination and plotting techniques were executed by Mr. Craigmile.

The artists describe their work as follows:

> The "Hummingbird" is an extension of the "three bug problem". The basic design produced by the "three bug problem" is modified by drawing only two sides of the triangle. This pattern is then mathematically manipulated into the desired position. Three different line widths, each with a different color, were plotted overlaying each other.

Mr. Strand and Mr. Craigmile submitted several more entries in the contest which are shown on the following pages.

The other computer art published in this issue receives honorable mention. For some of the drawings the explanation is obvious or can be inferred easily; for others, explanations are given. In a number of cases, the computer and the peripheral equipment which produced the computer art have not been specified as much as we would like because the information did not reach us by the close of the contest, July 5. We would, of course, like to identify the equipment that produced the art. Supplementary information of this kind should be sent to us for publication in a future issue.

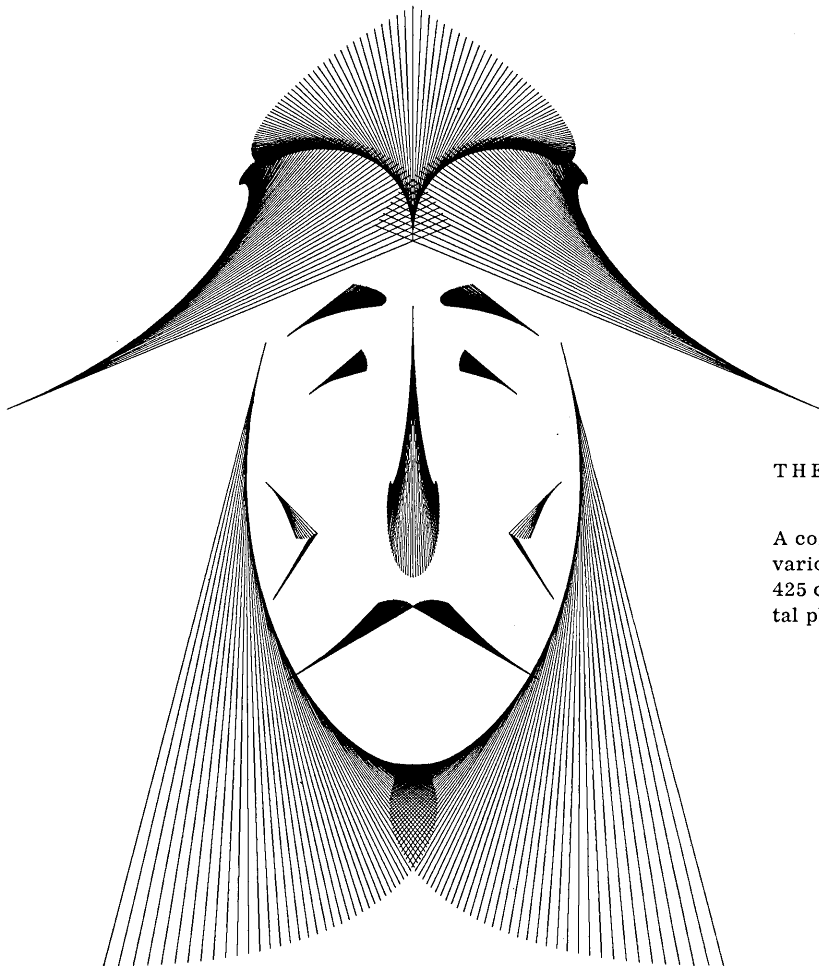
The responses to our Sixth Annual Computer Art Contest have been splendid. We are grateful to all those persons who sent us entries.

It is interesting to note the development in the computer art that we receive from year to year. As with computer technology itself, computer art is becoming more sophisticated, more creative, and more visually appealing. We now find a widespread use of color. We notice artists and professors, as well as technicians, working with the computer to learn more about design, color, and artistic techniques. We find groups being established to explore their mutual interests in computer art. One notable group is the Computer Technique Group (CTG) in Tokyo, Japan, which consists of eight individuals whose professions vary from architectural design to behavioral science to systems engineering.

For August 1969, we plan our Seventh Annual Computer Art Contest, and we cordially invite contributions of computer art from all our readers and others who are interested in computer art.

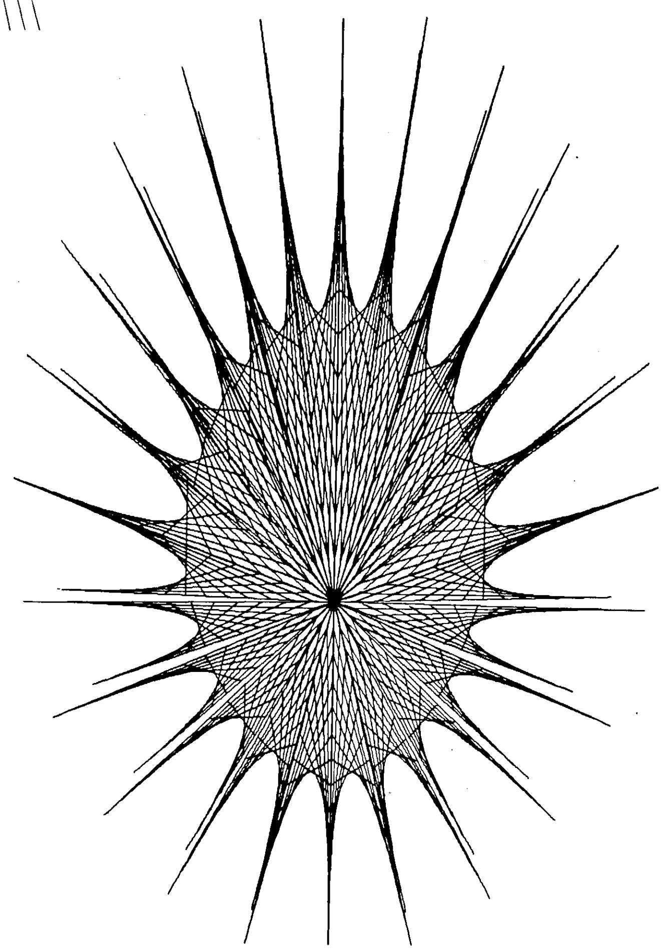
A complete alphabetical listing of the names and addresses of all persons whose art is published in this issue appears on page 27.

Sharry Langdale
Associate Editor



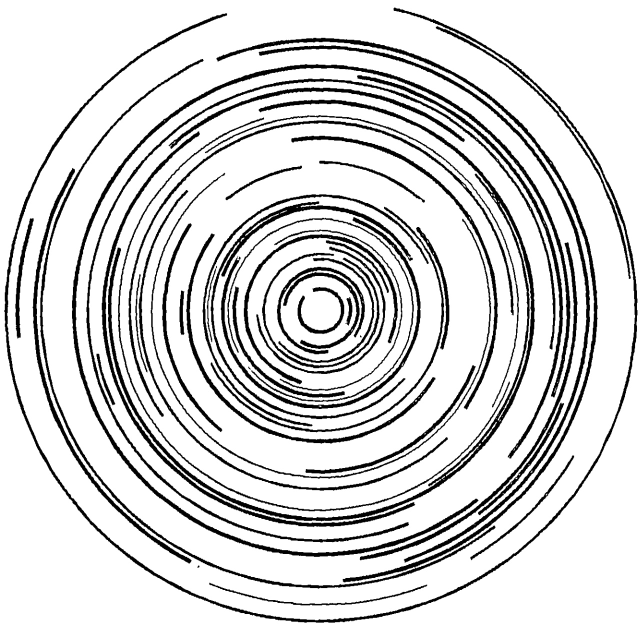
THE FISHERMAN
— Kerry Strand

A composite of one basic design repeated in various positions and shapes. Done on a GE 425 computer and a CalComp 760/502 incremental plotter with a step size of 0. 01 inches.



A SEA STAR
— Petar Milojevic

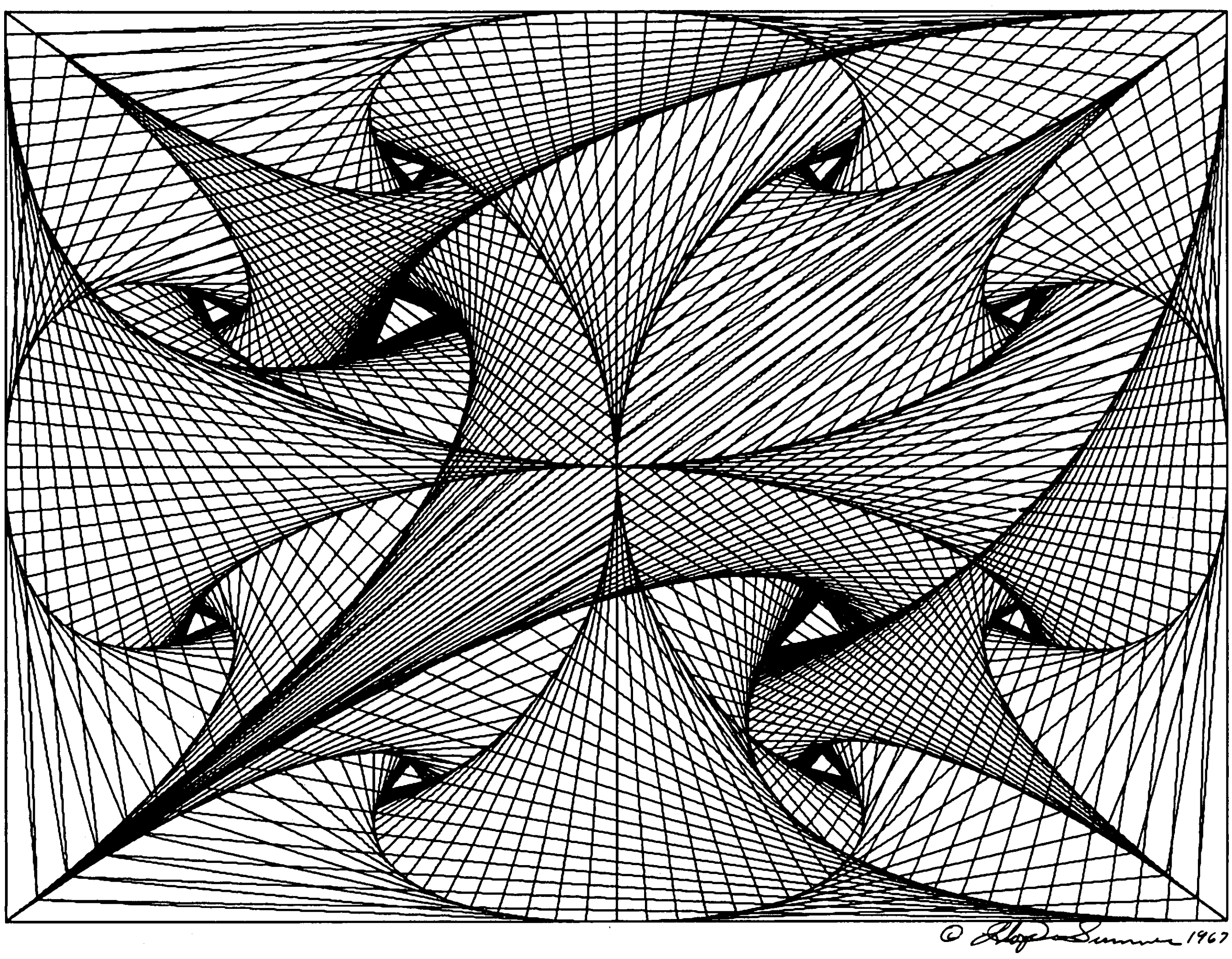
The three-point net technique is used to get a pleasing drawing through some elements for which computers are described as best performers. Programmed in Fortran, and plotted off line on a CalComp 565 digital plotter.



LABYRINTH IN MOTION

— Petar Milojevic

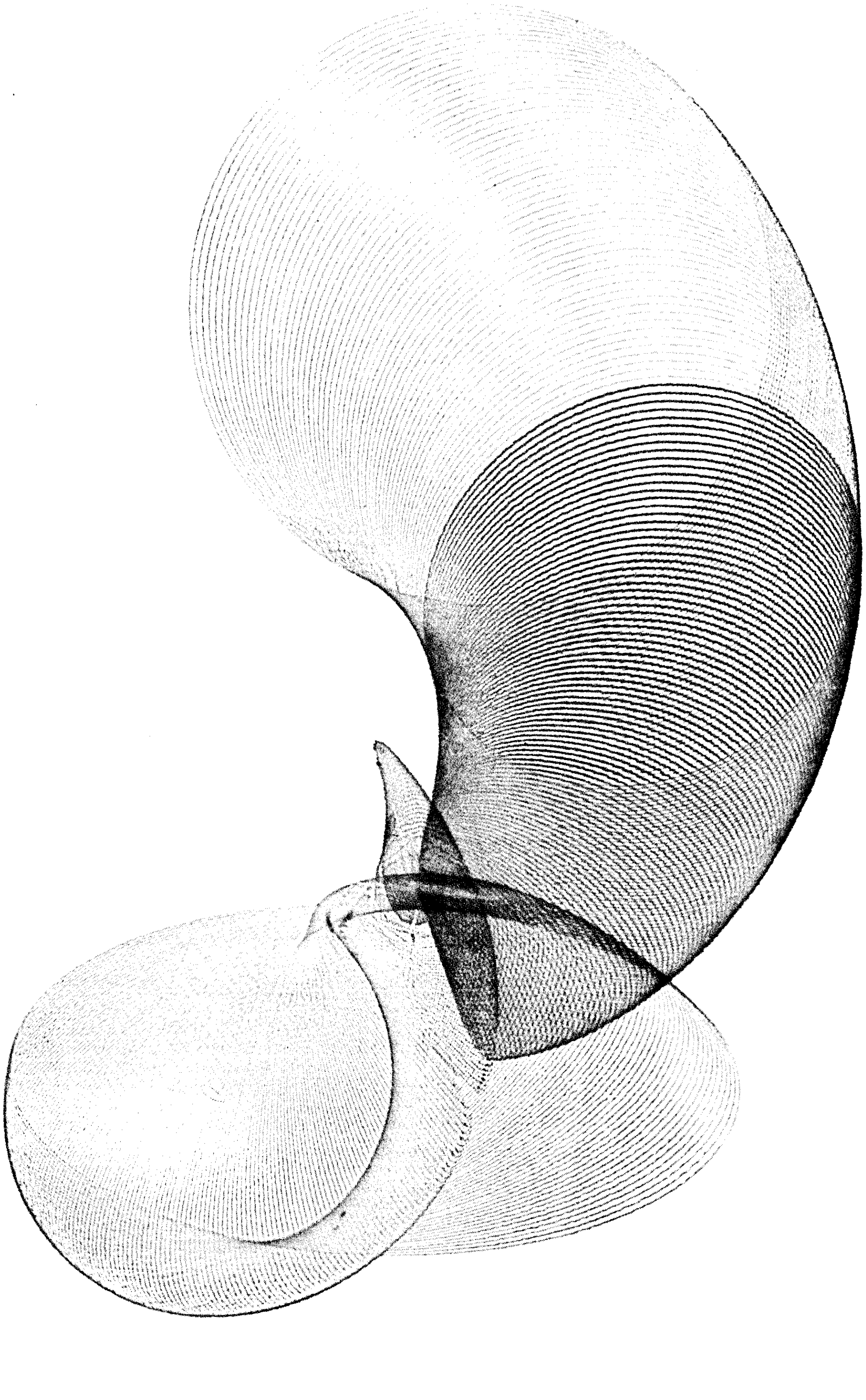
This random design was produced under limited control. It was programmed in Fortran and plotted off line on a CalComp 565 digital plotter.



SPIRES OF CONTRIBUTION

— Lloyd Sumner

Produced with the help of a Burroughs B5500 computer and a CalComp 565 plotter.



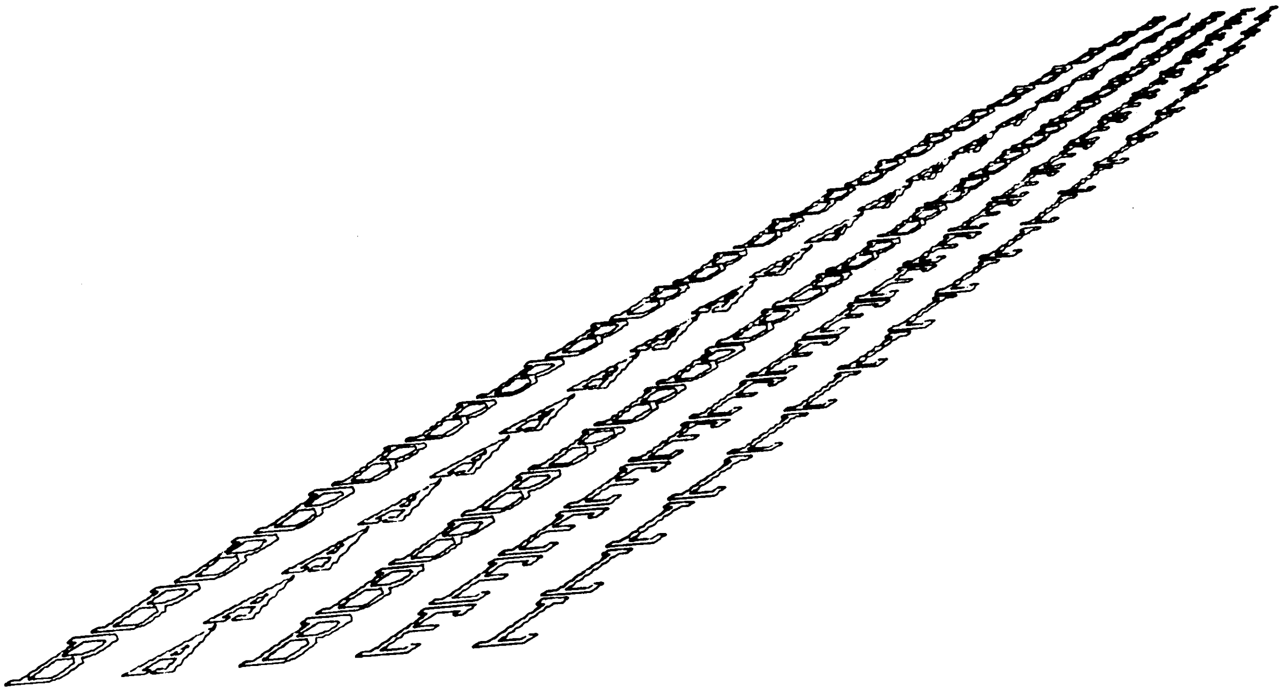
INSPIRALATION
— A. M. France

Repeated ellipses were drawn, with small changes to axis lengths and points of origin being made each time. Program was written in Fortran and executed on an I. C. T. 1905 computer and a CalComp 31" plotter.

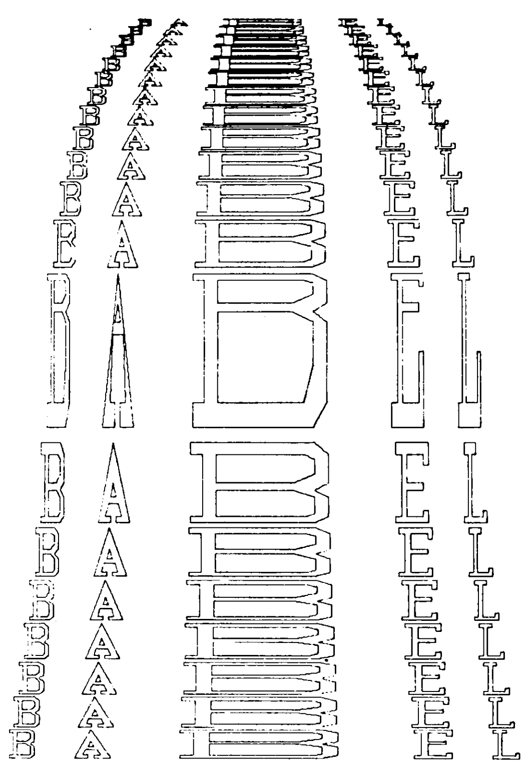
TOWER OF BABEL

— Leslei Mezei, Artist, and David Payne, Programmer

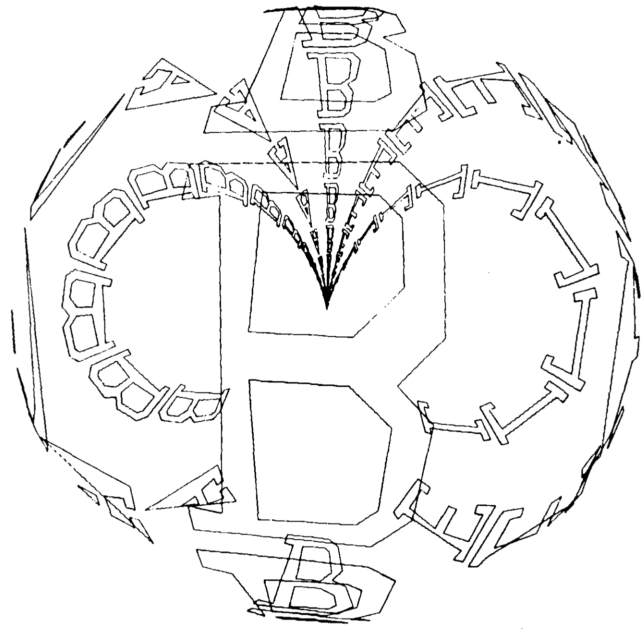
The five pictures shown on this and the adjacent page are part of a series based on a "Tower of Babel". The original tower was made up of the word "BABEL" repeated twenty times, each word placed on top of the last, with the width at the bottom being four times that at the top. Each of the pictures is a mathematical or random distortion of this same tower. The programming language Sparta (a graphic procedure-oriented language consisting of Fortran IV subroutines) was used on an IBM 7094-II.



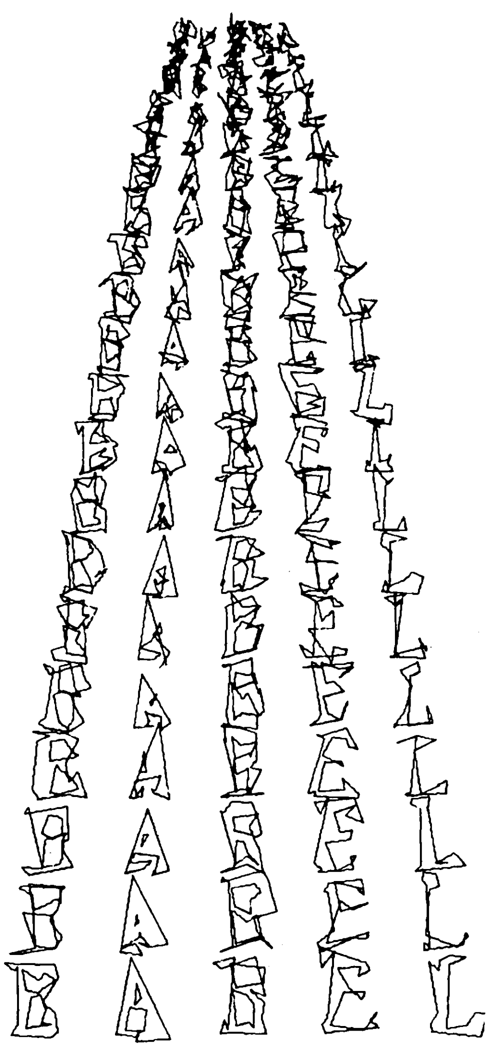
An oblique transformation was applied which in effect transformed the vertical axis through the center of the tower into a line making an angle of 30° with the horizontal axis.



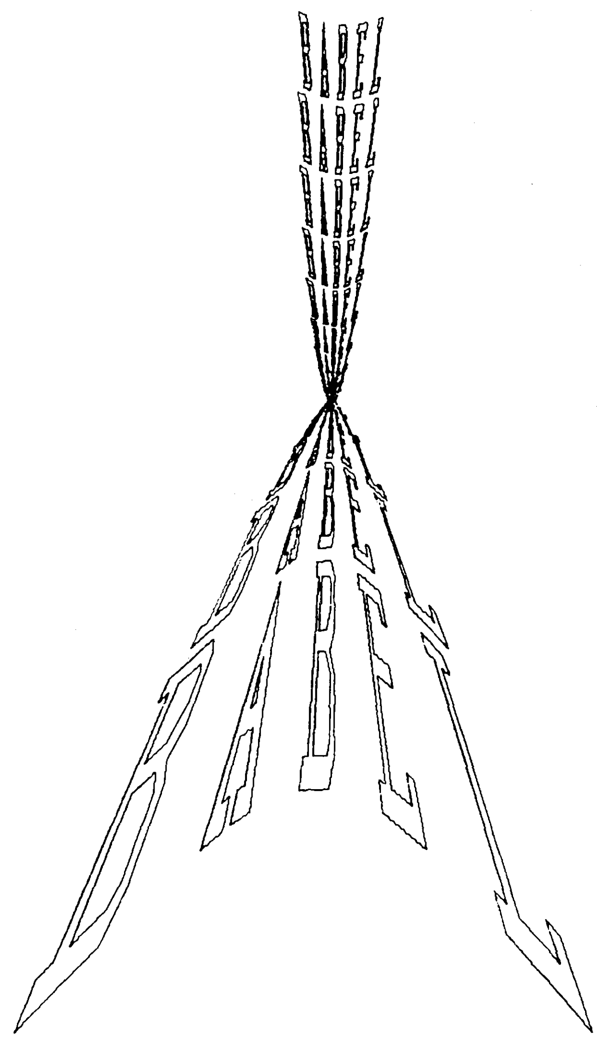
The x and y coordinates of each point (relative to the center of the tower) were replaced by $\sqrt{x}$ and $\sqrt{y}$.



The distance r of each point from a point 1/5 of the way up the tower was replaced by re^{-r}.



Each point of the tower was displaced both horizontally and vertically by a random amount. The random displacement was obtained from a Gaussian distribution with a mean of zero and a standard deviation of 0.05. The maximum displacement allowed was 0.2 inches.

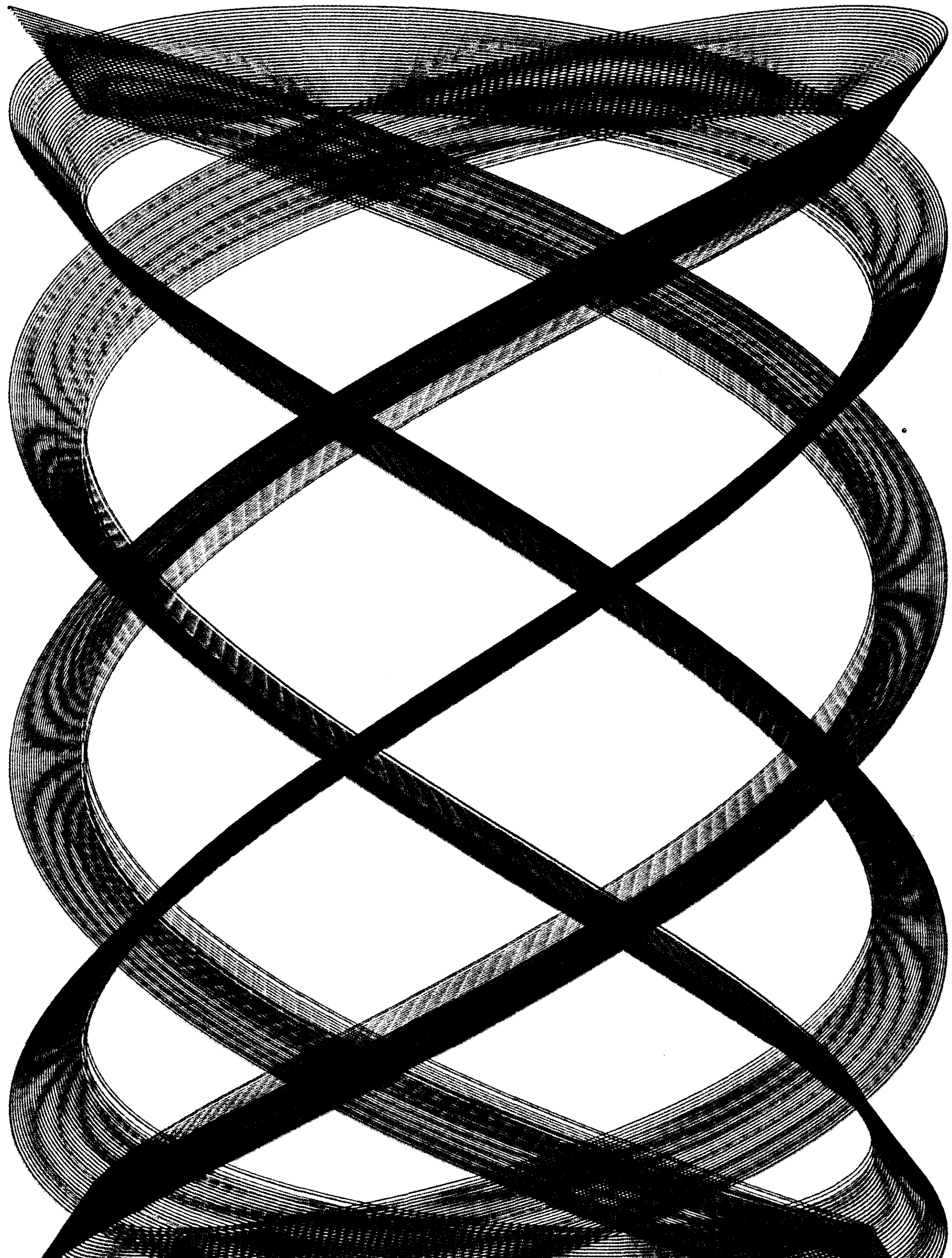


The distance r of each point from the center was replaced by re^{r}.

IDEALIZED BRUSH STROKES
— Dr. Evan Harris Walker

The idea behind this picture is that by studying mathematically the compositional elements employed by the great artists, one might discover artistic principles; and with the aid of a computer, these principles could be tested by using them to generate new examples of art. As a starting point, completely random arrangements of rectangles (idealized brush strokes) were examined. This picture makes use of several concepts that have been developed to produce organization in pattern and color.

The program was written in Fortran for an IBM 7040. The pattern of each sub-element is printed out to scale (using sixteen 9" square blocks of printout) together with the color designation in terms of the Munsell standard color notation. The printing is produced on canvas using acrylic paint.



PLEXUS

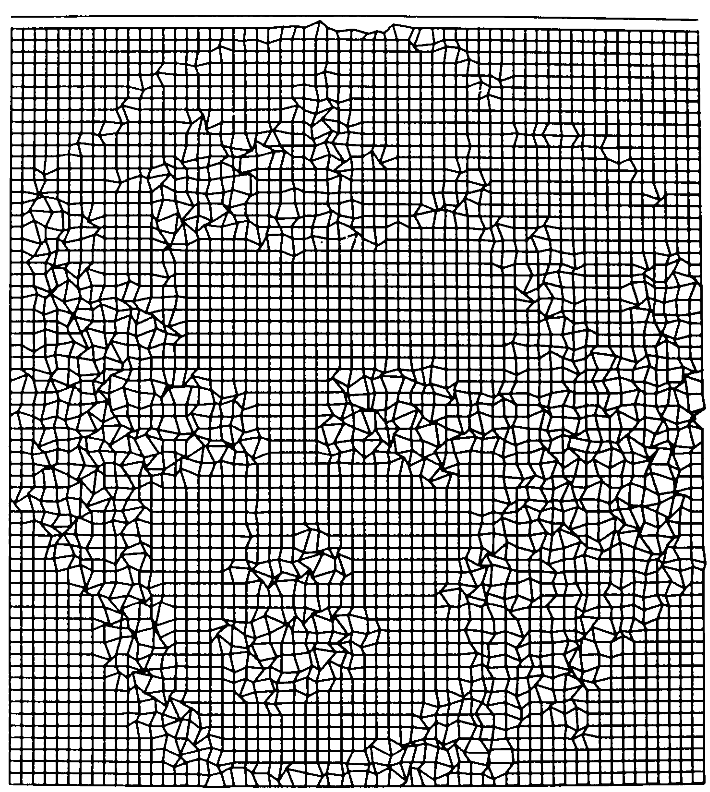
— Designed and programmed by Kerry Strand and Larry Jenkins
Color coordination and plotting techniques by Gary Craigmile

This is an example of the application of parametric equations. To generate the basic shape, T goes through one cycle of the cosine curve, from 0 to 2PI. The X-coordinate is then proportional to COS(5T) and the Y-coordinate is proportional to COS(11T). Three different line widths, each with a different color, were plotted overlaying each other.

STAR KENNEDY

— Designed by Masao Komura
Programmed by Haruki Tsuchiya

A pattern deformation system was applied to a photograph of John F. Kennedy. Stars of random size were put on the point of data from the photo. An IBM 7090 computer and CalComp 563 plotter were used.



MONROE IN THE NET

— Haruki Tsuchiya

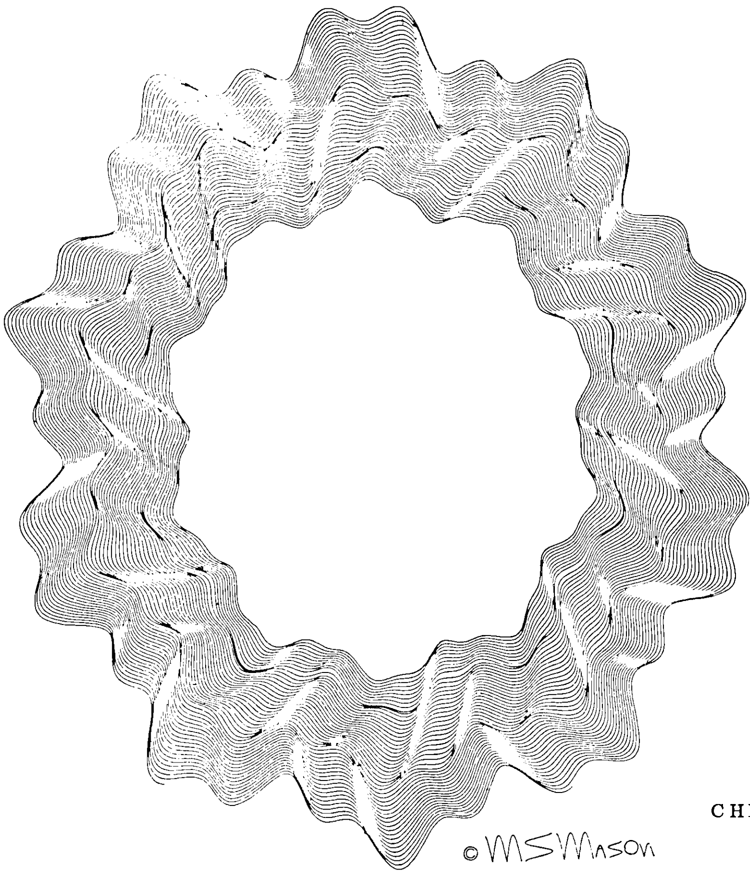
A pattern deformation system was applied to a photograph of James Monroe. The canvas was first set as a net ready for deformation. The data from the photo actuated each element of the net by random number. An IBM 7090 computer and CalComp 563 plotter were used.

RETURN TO SQUARE
— Designed by Masao Komura
Programmed by Kunio Yamanaka

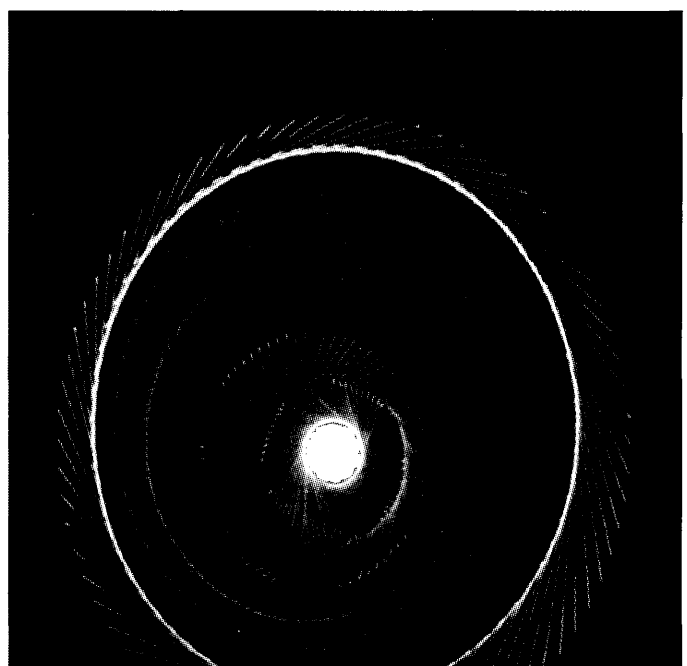
This is a computer metamorphosis. A square is metamorphosed into a profile of a woman, and then returned to a square again. The profile is input data. The process of metamorphosis is visualized as a movement; and metamorphosis itself is presented as an object. An IBM 7090 computer and CalComp 563 plotter were used.

ABRAHAM LINCOLN
— Michael H. Craven

This picture was first digitized by hand, then programmed in 1200 APT statements. One subroutine calculated the tool motion to black in any rectangle when the four sides were defined. A second subroutine assisted in calculating the tool motion for the shadowing made up of .005" lines .02" apart. The picture was drawn directly onto mylar film using a beam of light of varying size.



CHRISTMAS WREATH — COMPUTER STYLE
— Maughan S. Mason



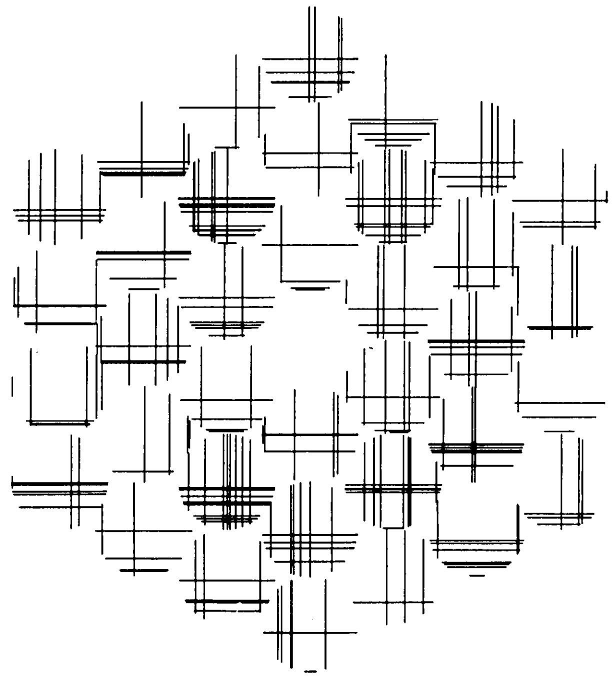
WHIRLPOOL
— (Mrs.) Leigh Hendricks

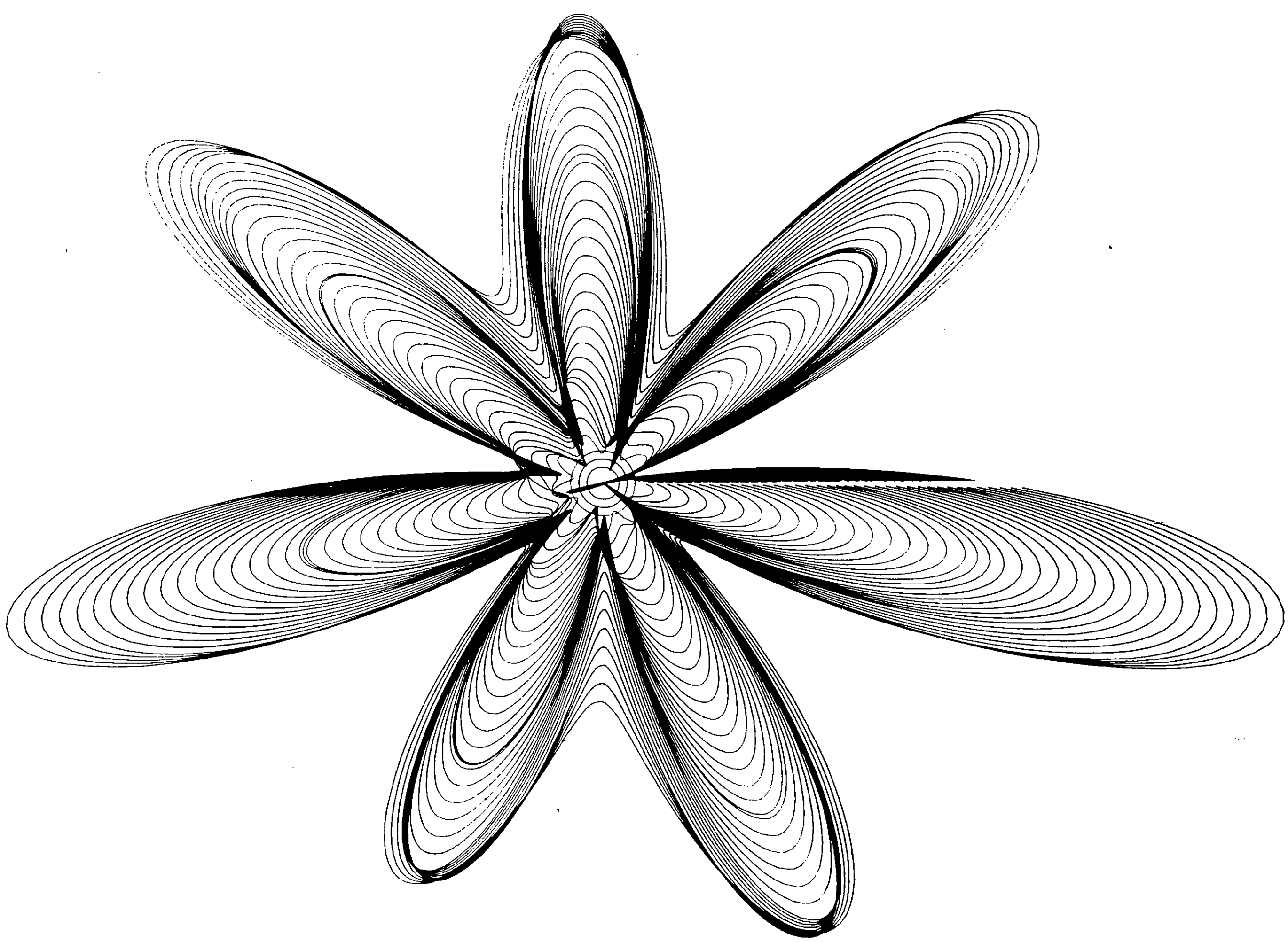
This design resulted from a programming bug in a polar equation using a Fortran program. Initially the coordinates were exposed on black and white film from a CRT (S-C 4020). For the picture shown here, a 35 mm slide was exposed directly on color film on an S-C 4020 which has been modified for color work.

PEEK-A-BOO CIRCLES

— Petar Milojevic

A drawing with random elements exhibiting visual illusions. It was programmed in Fortran and plotted off line on a CalComp 565 digital plotter.

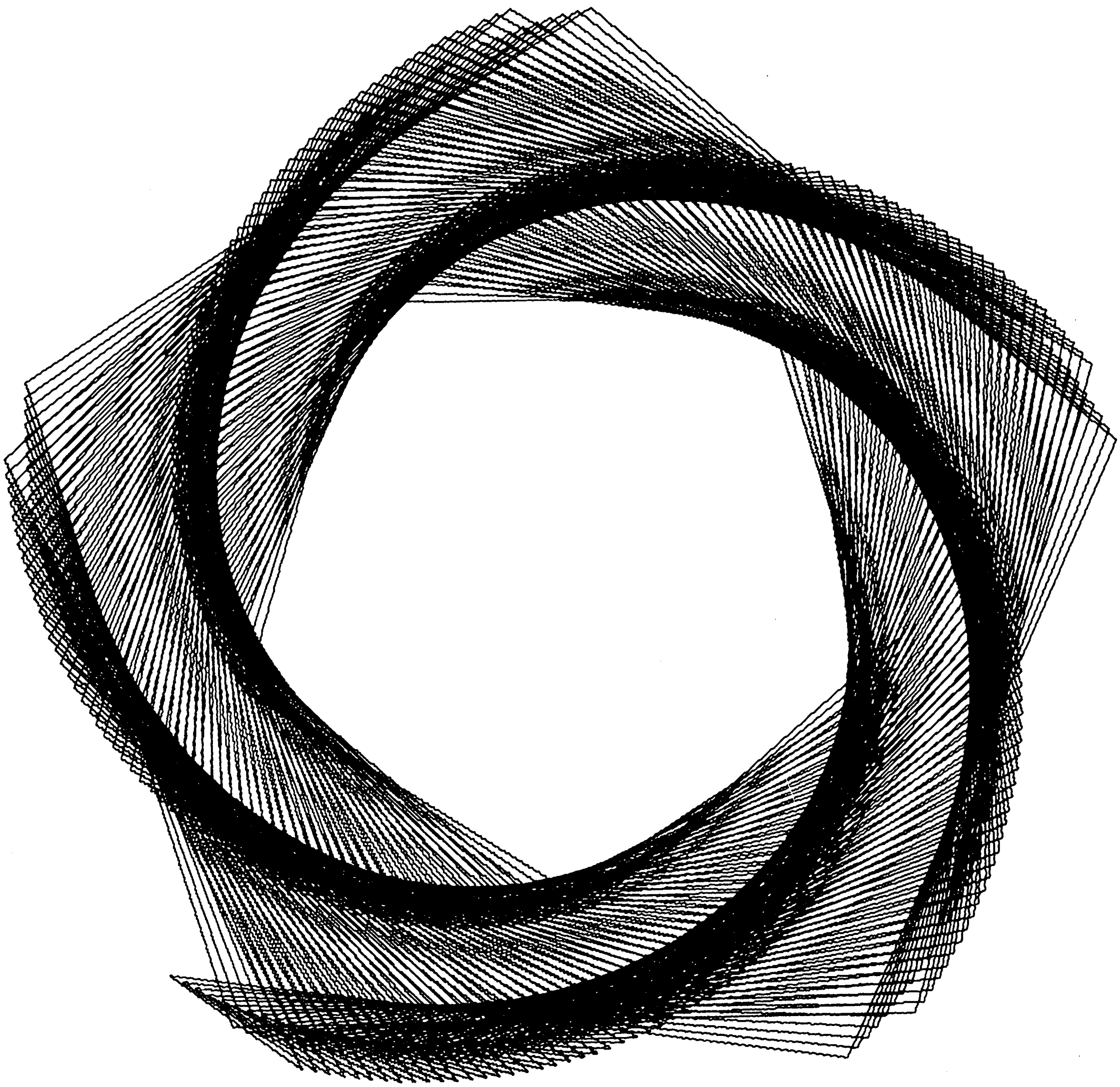




TRAGEDY OF SEVEN

— Haruki Tsuchiya

This is a mathematical pattern including computer improvisation by random number. The computer program indicates only the rough process of the painting; in this case, to plot 50 closed curves which grow mainly in seven directions. Under this condition, the computer calls a random number and increases or decreases the radius of the closed curves by the value of the random number repeatedly. An IBM 7090 computer and CalComp 563 plotter were used.



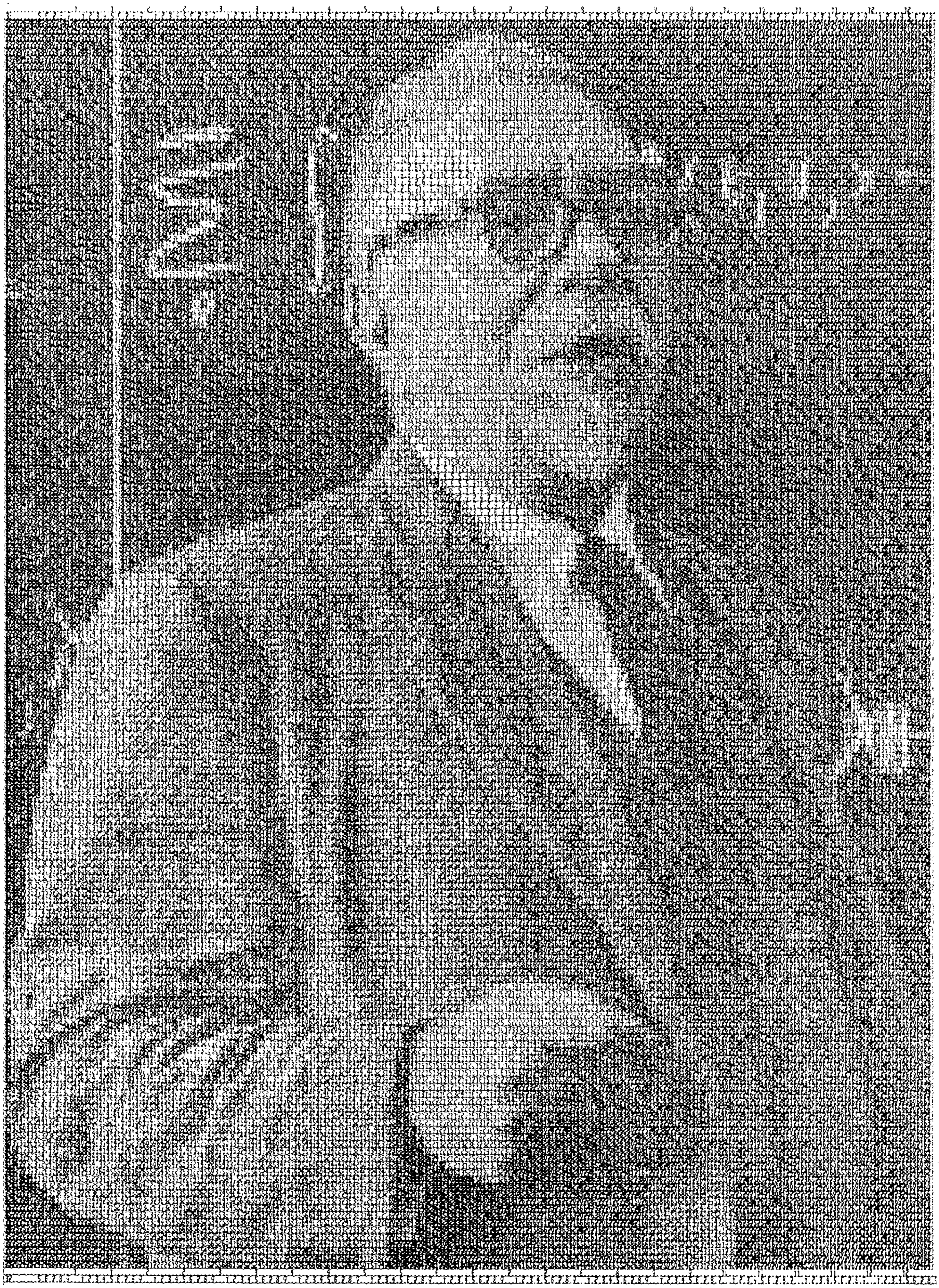
RING MOTIF
— Petar Milojevic

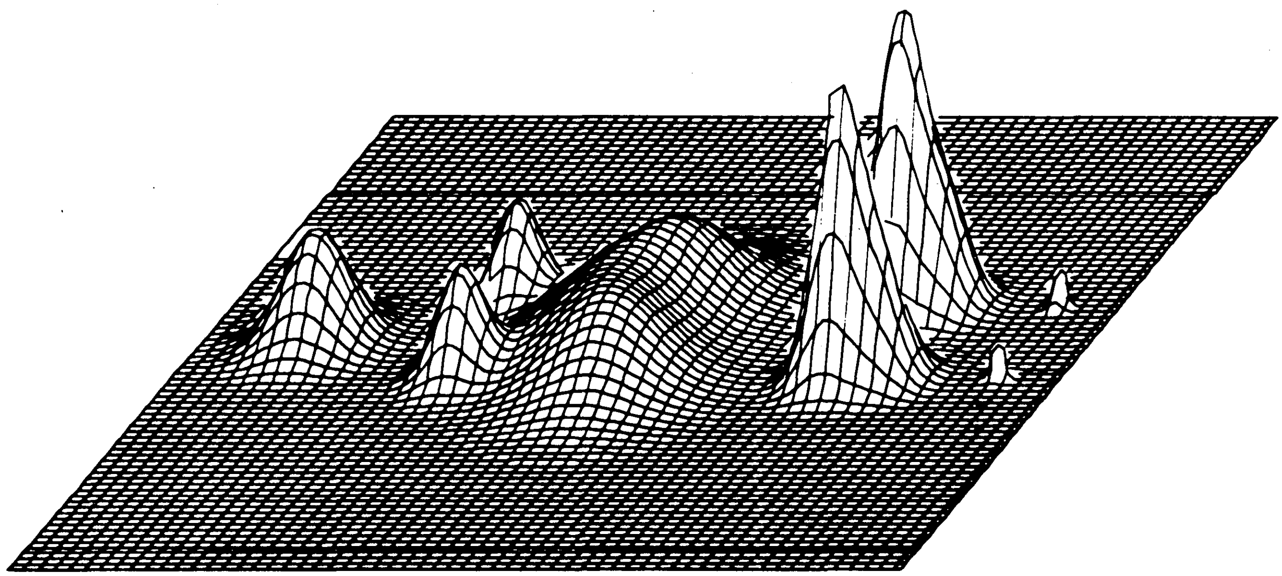
This drawing is done without lifting the pen from the first to the last point. It was programmed in Fortran and plotted off line on a CalComp 565 digital plotter.

CYBERNUMERICS
— H. Philip Peterson

Preprocessing for this digigram of Prof. Norbert Wiener involves correcting the Gamma curve of the film to the "Gamma" of the shaded number set for plotting. A histogram of the scanned numbers (NS) is computed and the low (L) and high (H) ends of the distribution are detected. The number plotted (NP) is calculated in one version as follows: NP(I, J)=(NS(I, J)*(99/H-L). The computer can easily simulate unnatural Gamma curves that no photographer's chemicals can implement.

→



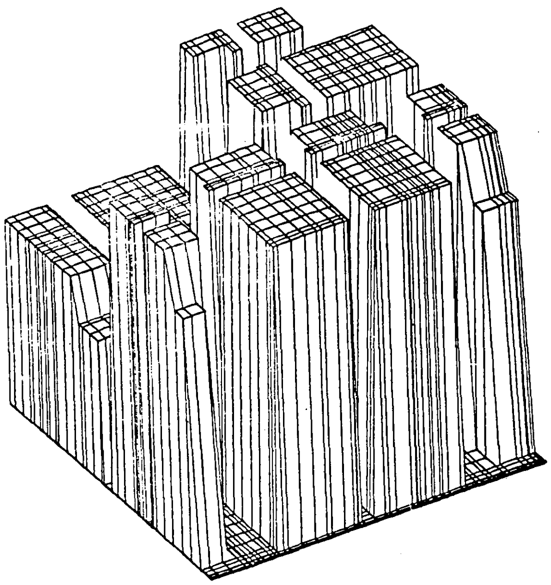


THE SUN BATHER
— Paul H. Sobel

Using a Fortran program on an IBM 7094, a tape was generated for off-line use on an SC 4020, which made the plot. The plotting subroutine interpreted a matrix as the dependent height variable. An angle of 40 degrees was specified, and hidden lines were tested for and removed. The figure is generated by sums of Gaussian functions.

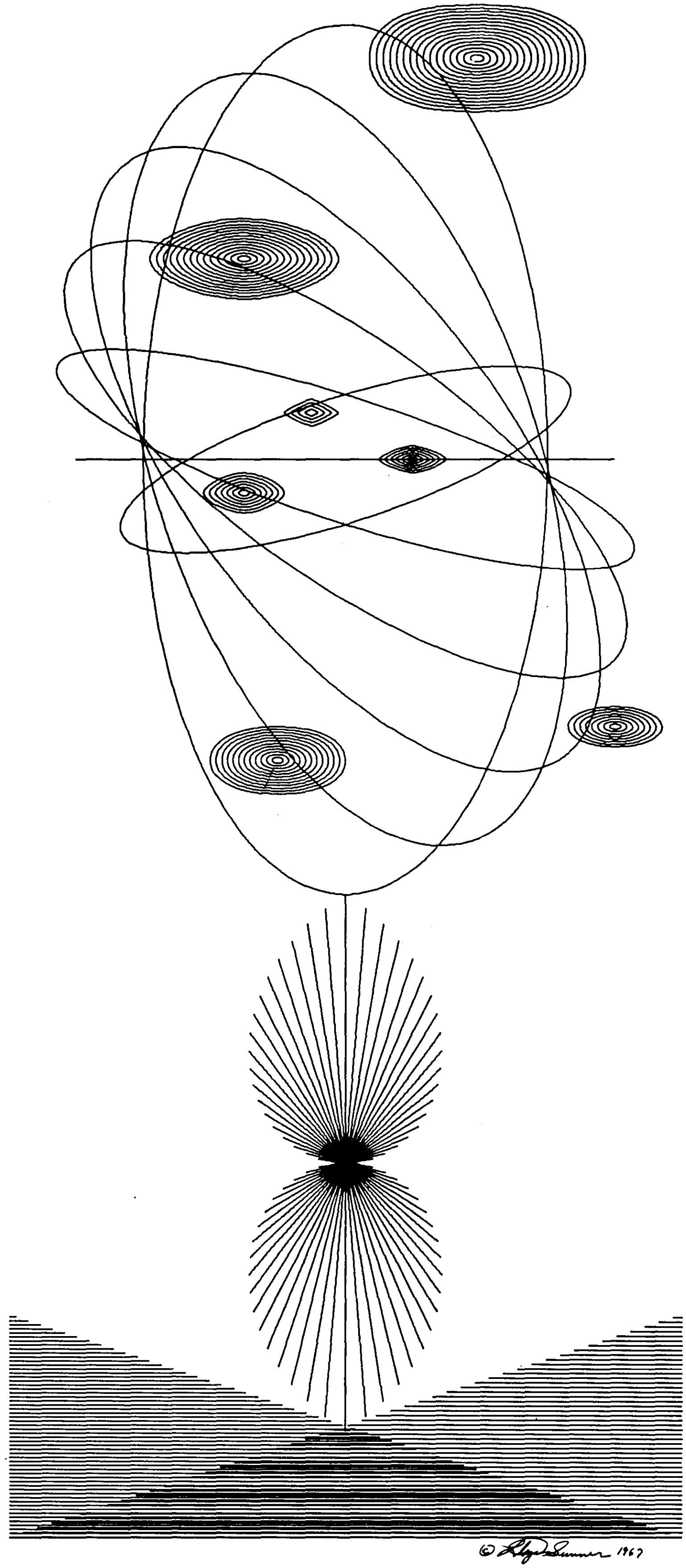
MARCH OF POLYGONS
— Haruki Tsuchiya

This is a mathematical pattern which includes computer improvisation by random numbers. Each polygon is determined according to: (1) number of vertexes from the position; and (2) distribution of vertexes from the random number. An IBM 7090 computer and CalComp 563 plotter were used.



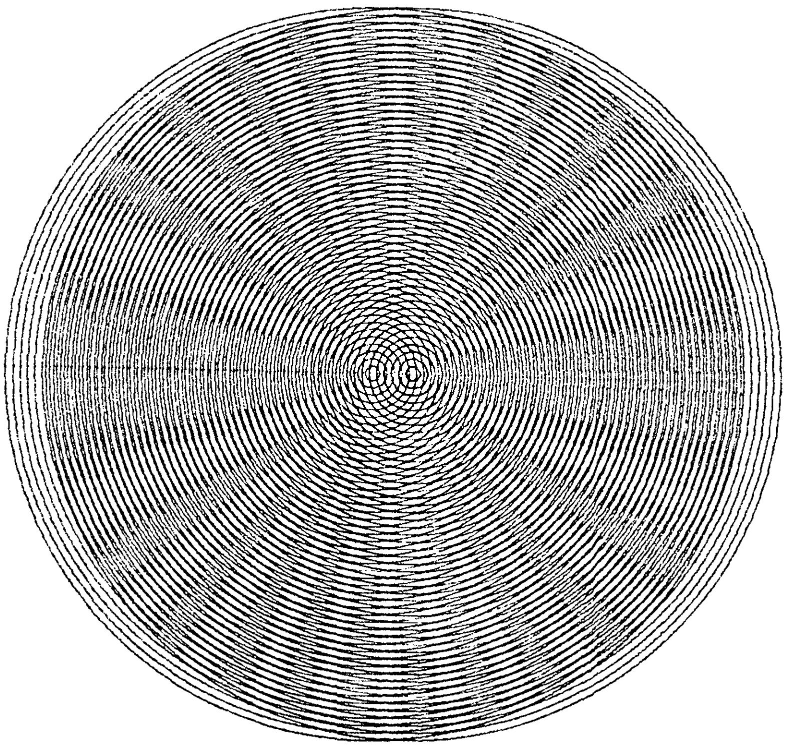
SLICED NUCLEAR REACTOR
— D. J. DiLeonardo

A perspective of the fuel material distribution in a slice through a nuclear reactor. Drawn on a CDC Model 280 Microfilm Recorder using contour and perspective routines run on a CDC-6600 computer.



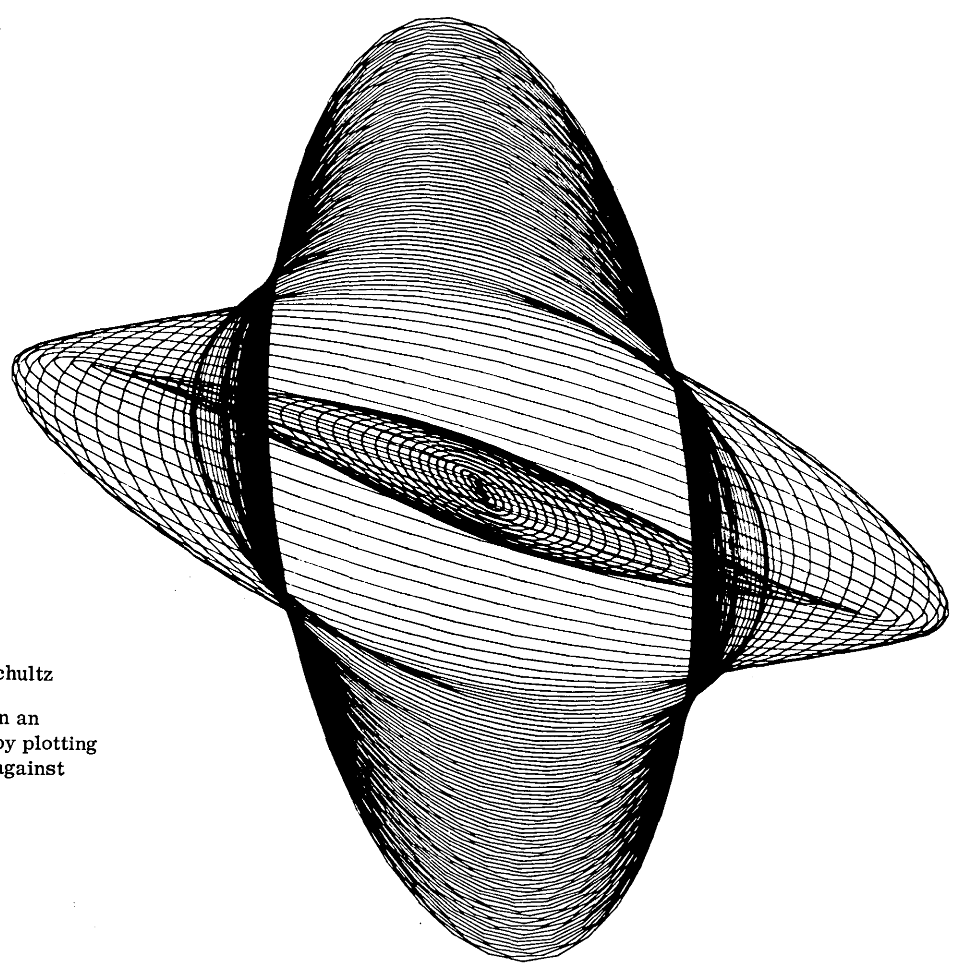
THE ORBIT TREE
— Lloyd Sumner

Produced with the help of a Burroughs B5500 computer and a CalComp 565 plotter.



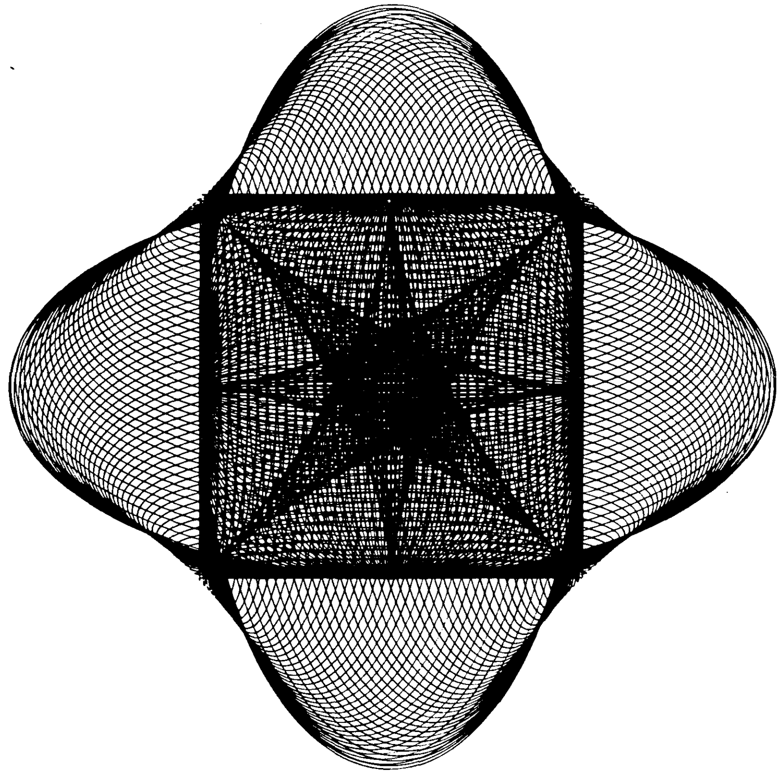
CONCENTRIC CIRCLES
— Lawrence Nolan

This plot shows two families of concentric circles, producing a moire' or nodal pattern, such as would be caused by two point wave sources in a ripple tank. The plot was produced by a Fortran IV program using an IBM 360/50 computer and a CalComp 750 off-line magnetic tape unit with a CalComp 566 plotter.



OUTPUT VS. INPUT
— Bob Schultz

This design was generated on an IBM 360/50 and an SC 4020 by plotting the output of a digital filter against its input.



LINDY STAR

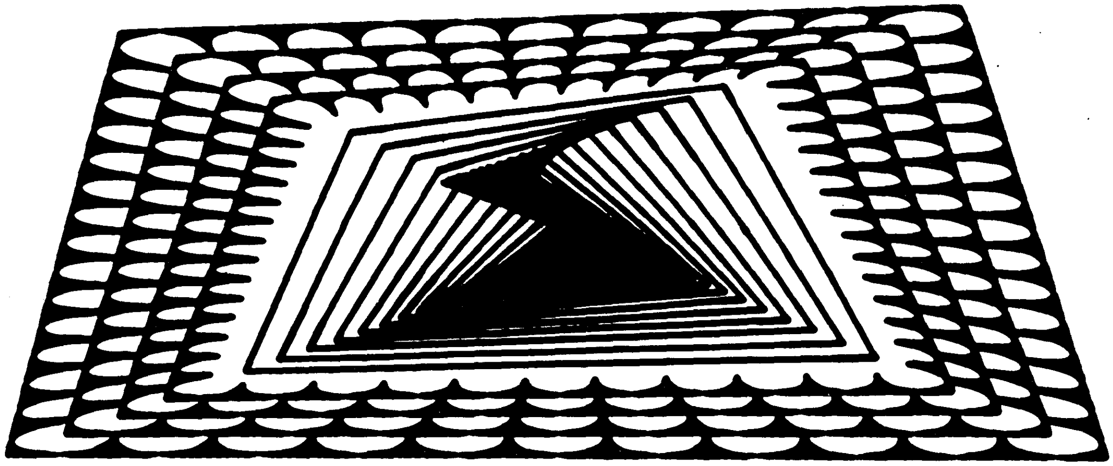
— L. David Anderson

A composite of one basic design which is repeated in various positions and shapes to produce the final drawing. Computer used was a GE 425, with a CalComp 770/702 incremental plotter with a step size of 0.002 inches.

DEFORMATION OF SHARAKU

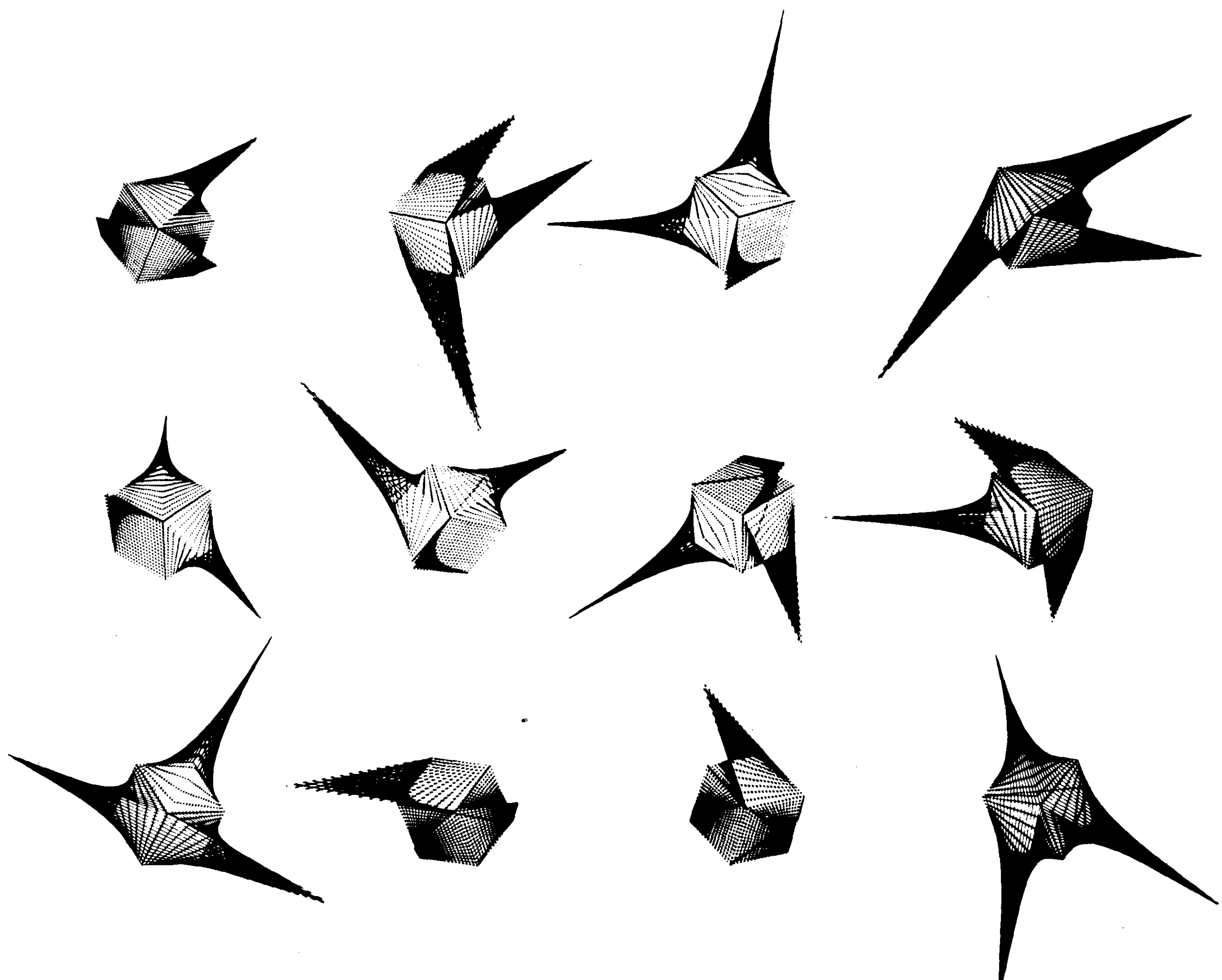
— Idea by Haruki Tsuchiya, Program by Koji Fujino, Data by Kamoto Ohtake

A pattern deformation system was applied to a Ukiyoe of Sharaku. Five kinds of purely mathematical exchanges of coordinates are shown.



OP ART COMPUTERIZED
— Donald Robbins

Here an op art picture by Jeffry Steele (which appeared in Time magazine in 1961) was turned into a subroutine in an investigation of some perspective properties, without actually going through the perspective transformation. Arguments to the subroutine consisted of the length and height, the number of spikes per side, the number of bands, the interior rotation, etc.



UPHEAVAL COLLECTION
— Idea by Masao Komura, Program by Kunio Yamanaka

This is a mathematical pattern including computer improvisation by random numbers. Four rhombics upheaved into random directions at random distances are gathered to represent a cube. An IBM 7090 computer and CalComp 563 plotter were used.

COMPUTER ARTISTS IN THIS ISSUE

The following is a list of persons whose art is published in this issue as part of the Sixth Annual Computer Art Contest of Computers and Automation.

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Robbins, Donald, Div. 9424, Sandia Corp., Sandia Base, Albuquerque, N. Mex. 87115

Schultz, Bob, Polytechnic Institute of Brooklyn, Dept. of Electrical Engineering, 333 Jay St., Brooklyn, N. Y. 11201

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Strand, Kerry, California Computer Products, Inc., 305 N. Muller St., Anaheim, Calif. 92803

Sumner, Lloyd, Computer Creations, P. O. Box 1842, Charlottesville, Va. 22903

Tsuchiya, Haruki, Computer Technique Group, 7-26, 4chome, Kitasuna, Koto-ku, Tokyo, Japan

Walker, Dr. Evan Harris, National Aeronautics and Space Administration, Electronics Research Center, 575 Technology Square, Cambridge, Mass. 02139

Yamanaka, Kunio, Computer Technique Group, 7-26, 4chome, Kitasuna, Koto-ku, Tokyo, Japan

MULTI-ACCESS FORUM

SPECIAL INTEREST COMMITTEE FOR SOCIAL SCIENCE COMPUTING OF THE ASSOCIATION FOR COMPUTING MACHINERY IS PROPOSED

Mr. George Sadowsky
The Brookings Institution, Computer Center
1775 Massachusetts Ave., N.W.
Washington, D.C. 20036

On behalf of a group of members of the Association for Computing Machinery, I am submitting a petition to the Council of the Association to consider the establishment of a Special Interest Committee for Social Science Computing (SICSOC).

The use of computers by social scientists is rapidly increasing in universities, government, and business; yet there does not now exist an organization whose scope is sufficiently broad to appeal to a substantial number of these individuals. We propose SICSOC as an organization that would attempt to focus upon our common interest of the use of computers in the social sciences. Examples of areas the committee might concern itself with are: (1) statistical programming; (2) statistical systems; (3) social science procedural languages; (4) information retrieval in the social sciences; (5) simulation of social models and social systems; and (6) the application of computers to public policy formation. These examples indicate some topics of current interest, and are not intended to exhaust areas of potential committee activity.

Our present conception of the committee's functions is that it serve as an exploratory device to ascertain the most appropriate domain of interest for such a group and to determine the viability of the group as a productive association of individuals. As an initial action, we anticipate holding an organizational meeting at the forthcoming ACM Conference in Las Vegas. Two immediate purposes of this meeting would be (1) to begin a search for a qualified, well-known social scientist who would be interested in heading a more formalized group, and (2) establishing informal channels of communication (probably a newsletter) between interested individuals. In this way, we hope to be able to explore our potential for various kinds of activities informally through the year.

Readers of *Computers and Automation* who are interested in participating in the committee's activities are invited to write me at the address above, outlining the nature of their interest and their suggestions concerning the committee's future.

CONGRESS HAS NOT REALLY ENTERED THE COMPUTER AGE — AND SHOULD

Congressman William S. Moorhead
U.S. House of Representatives
Washington, D. C. 20515

Private enterprise, the executive branch of the federal government, and state legislatures have entered the computer age — but Congress has not really entered the computer age.

Two years ago I spoke before a National Information Retrieval Colloquium and said:

> Today except for one small unit which the Library of Congress uses to handle its payroll, the Congress of the United States does not possess one penny's worth of automatic data processing equipment.

When I tell you this I am expressing my concern for the future of representative government in the United States.

The future of representative democracy, the future of our constitutional government with its delicate system of checks and balances requires that, in the computer age, the legislative branch of government make full use of computer capability.

Since that date there has been very little progress. The Clerk of the House now has an NCR 500 to handle some of the payroll on the House side of the Capitol. I understand the Sergeant-at-Arms of the Senate is considering the acquisition of similar computer facilities.

The Legislative Reference Service has designed a computer-centered system which allows entering synoptic information on bills and resolutions introduced in both chambers of the Congress to be relayed via keyboard terminals to a remote computer. The magnetic tape generated by this system may be utilized in the future by the Government Printing Office "Linotron" System in publishing the Digest of Public Bills.

This is progress, but I would hardly call it an all-out entry into the computer age, and I do believe that Congress should make full use of computer capability.

Writing in the introduction to *Congress Needs Help,* David Brinkley said:

> Congress has great power, more than any other branch of the government. But effective use of power or leadership certainly requires change to accommodate to the changes in society. A leadership institution that fails to change will become an interesting and perhaps charming irrelevance . . . like an elderly gentleman whose oil portrait hangs in the boardroom, who mouths 19th century platitudes, who is ceremoniously honored for his early achievements and always remembered on his birthdays — and otherwise ignored.

Congress has not yet reached this state of honored irrelevance, but it is moving toward it, and unless it makes some changes in itself, it will shortly arrive.

- I believe that the Congress should enter fully into the computer age.
- I believe we should change the name of the Legislative Reference Service to the Legislative Research Service, and give it full computer capability.
- I believe that the Federal Budget should be put on a computer for ready access to the Congress. (This year, the American Enterprise Institute has used automatic data processing to measure and analyze the priorities in the President's 1969 Budget.)
- I believe that we need on Capitol Hill a central read-out facility that could tap the memory banks of all of the other computers in the federal government, not to secure privileged data, but to secure such public factual information as economic statistics, demographic profiles, and figures on such things of daily concern to a Congressman's office as funds allocated to his district, and project and contract awards.
- I propose that there be read-out devices or closed circuit television screens in the offices of Senators and Representatives and in committee offices linked to the Legislative Research Office. And that we need a highly selective staff in the Legislative Research Service to provide Members with research and factual information on a range of topics.
- I propose that there be systems-trained people on all committees of the Congress; if we cannot initially purchase the hardware for the Congress, we can at least make a beginning with the software using the existing computer facilities of the Library of Congress and other agencies, perhaps on a "time-sharing basis", as is currently being done in the business world.

The computer, then, can help us solve problems by providing information that previously was too costly to obtain, took too long to process, or was literally beyond human capacity to obtain. But the choice of problems to be solved, the establishment of priorities and the broad outlook of the attack on these problems, are decisions for men, not computers.

Top leadership in the Congress, as in all organizations, will find that while the computer relieves them of minor burdens, it will enormously increase the demands on them to wrestle with the moral and ethical consequences of the policies they choose and implement.

The Congressman of the future will have to be a perpetual student of the techniques of rationalized decision-making, and even more a student of the humanities.

Computers cannot make congressional decisions, but as our world gets more and more complex, Congress will be unable to make rational decisions without computers.

NATIONAL ACADEMY OF SCIENCES ESTABLISHES A "COMPUTER SCIENCE AND ENGINEERING BOARD"

National Academy of Sciences
2101 Constitution Ave. N.W.
Washington, D.C. 20418

The rapid evolution of computers and their increasing influence on the lives of individuals and the nation has led to the establishment of a Computer Science and Engineering Board within the National Academy of Sciences.

The new Board, which is composed of a distinguished group of academic and industrial experts in computer and information science and related areas, will report directly to the Council of the Academy. In announcing the Board, Academy President Frederick Seitz said:

> The Board's assignment will be, generally speaking, to assess the implications of the enormous and somewhat heterogeneous growth of information processing technology as it affects the public and private sectors of our nation. It will be expected to take a broad view of this subject and of its applications to research and education in other branches of science and engineering as well as to the workaday needs of government, commerce, industry, and education.

Chairman of the 12-member Board is Anthony G. Oettinger, professor of linguistics and applied mathematics at the Aiken Computation Laboratory of Harvard University. The vice chairman is John R. Pierce, Executive Director, Research Communications Sciences Division, Bell Telephone Laboratories, Inc.

In recommending the establishment of the Board, Dr. Oettinger stated:

> During the past several years a number of competent studies have raised fundamental questions regarding the general magnitude, composition, rate of growth, and use of the information store that is the foundation for decisions in our society. These questions demand a national effort to establish an authoritative base of facts and best judgments in areas which in the past have often been laced with controversy.

An early goal of the Board will be to establish priorities for orderly development of the computer field. One such priority may well be the training of computer engineers and technicians to avoid an impending systems failure that some authorities foresee as the result of a shortage of personnel. Another might be the exploration of the pure and theoretical science aspects of the design of hardware, hardware systems, and hardware-software systems.

The Board will begin its task by organizing four committees: (1) Education, to include both the training of computer science and engineering personnel and the role of computers in instruction; (2) Research and Development; (3) National Programs; and (4) Data Base, to compile essential facts on the present and predictable future extent of computer research and development, usage, and manufacture.

The Board will be funded by the Advanced Research Projects Agency of the Department of Defense, the American Federation of Information Processing Societies, and by other private and governmental organizations.

Members of the Board, in addition to the chairman and vice chairman, are: Launor F. Carter, Vice President and General Manager of the Public Systems Division, System Development Corporation, Santa Monica, Calif.; David C. Evans, Director, Computer Science, University of Utah, Salt Lake City; Sidney Fernbach, Head, Computation Laboratory, Lawrence Radiation Laboratory, Livermore, Calif.; Jerrier A. Haddad, Vice President for Engineering, Programming and Technology, IBM Corporation, Armonk, N.Y.; W. F. Miller, Professor of Computer Science, Head of the Computation Group for the Linear Accelerator Center, and Associate Provost for Computing, Stanford University, Stanford, Calif.; Nathan M. Newmark, Head, Department of Civil Engineering, University of Illinois at Urbana; Kenneth Olsen, President of Digital Equipment Corporation, Maynard, Mass.; Alan J. Perlis, Head, Department of Computer Science, Carnegie-Mellon University, Pittsburgh, Penna.; J. Barkley Rosser, Director, Mathematics Research Center, U.S. Army, University of Wisconsin, Madison; and Alan Westin, Department of Public Law and Government, Columbia University, New York City.

VERIFICATION OF COMPUTER DIRECTORY INFORMATION

I. From I. J. Kusel
Data Processing Manager
Walter E. Heller & Co.
105 West Adams St.
Chicago, Ill. 60690

I received my copy of the *Computer Directory and Buyers' Guide, 1968,* and I feel it has some excellent listings. But I have a question: Is there any verification done on the type of services performed by the so-called consulting firms? I am very familiar with two of the firms listed. By reading the reports on them in your magazine I find that these firms will solve all my data processing problems, from instructing basic machine operations to installing a time-sharing computer. Unfortunately, this is not true, and I am wondering what type of verification is done. A major problem in the data processing consulting field seems to be that each and every consulting firm claims to be a "mecca" to the users.

Would you please inform me what type of verification or audit has been done on the listing?

II. From the Editor

As stated in our Directory, the information we publish is compiled from questionnaires which we send to organizations reportedly in the computing and data processing field. We do not publish information received from organizations that we consider not in the field. We often "tone down" and edit over-sanguine descriptions of what is sent to us. But the time and expense involved for verifying or auditing each returned questionnaire would be formidable, and thus far we have not been able to undertake systematic and complete verification.

Some observations which appeared in "How to Choose and Use an EDP Service Bureau" in our March, 1968 issue should perhaps be repeated here:

> The need for careful selection is emphasized by the high mortality rate of the service bureau industry. As an example, the Chicago classified telephone directory listed 32 service firms in 1963. Four years later, less than 20 were still in business. And since 1963, over 60 new service firms have begun business in Chicago. Many are undercapitalized, understaffed, and underequipped. They can use only low prices to attract business.
>
> There are three types of firms to avoid: (1) the "one-man" bureau where the salesman is not just a salesman, but also estimates, programs and controls your job on a continuous basis. If he leaves the firm, so does all knowledge about your job. (2) The one-machine operation, even if it claims back-up on someone else's machine. Back-up equipment has a way of not being available when needed, and your job will be delayed. (3) The bureau whose salesman offers you a "free survey" of your information system. This is a gimmick — adequate surveys require the services of expensive specialists. In the case of a "free" survey, you will probably get just what you pay for — nothing.

Our policy is to publish "factual, useful and understandable information". We invite all our readers at all times to tell us when we fall short of that goal, and corrections are needed.

IS THE COMPUTER AN ARTIST'S PAINTBRUSH?

Daniel T. Langdale
Art Director
Computers and Automation

Is the computer a tool for an artist, as is a brush? And is the work produced "art"? And is the user an "artist"? Let's explore that a minute.

When man picked up a stick and scratched a line in the dirt, a number of things happened. The stick became a "tool", the ground (with line) became a medium, and the man, an artist. And so with pen, pencil, and brush, to name just a few tools. Some of these tools became mechanized — the air brush, for instance substituting for the pig's bristles — lending new results and adding considerably more equipment (an air compressor, a rubber tube or two, a bottle and the mechanical gun itself). Isn't the computer a good bit alike?

It applies ink to paper just as the air brush applies paint to wood. Both can be closely controlled by the user, or loosely controlled. The results, then, can be very precise or quite free — at the user's command.

The difference between the two would seem to be one of degree, rather than kind. Logically speaking then, the computer is a tool, the work is art, and the user an artist. Good art or bad, competent artist or a fraud? That depends on the viewer's personal opinion. But the conclusion — that computer art is art and the machine a very complex brush, seems to be irrefutable.

What do your readers say?

COMPUTERS — A NEW PUBLIC UTILITY

(Based on an article by Len Carter in the Ottawa Journal, **Ottawa, Canada, June 25, 1968.)**

Each year the Canadian government becomes more complex. New departments are created to concern themselves with the welfare of Canadians as their problems become more and more complex. In the past, new departments usually required more space, but now the computer could swing things the other way. Although many government departments already have computers of their own, a number of them are seriously looking into the possibility of tying into a central computer system.

The beginnings of this trend can be seen at Northern Electric's laboratories in Ottawa, where a time-sharing, multi-access computer system is in operation. The system is a fantastic storehouse of scientific knowledge that is almost instantly available, not only to scientists in the laboratory, but to scientists in other cities.

An electrical engineer in Toronto can sit down at a typewriter and outline to the computer the composition of a component he is thinking of adding to some piece of electronic equipment. The computer in Ottawa, in a matter of seconds, will reply either that the component will work — or as much as tell him "back to the drawing board".

Northern Electric's computer system even has a boss monitor that constantly checks to see what the various computers are up to. It checks all incoming lines, jobs in progress, assigns other tasks when one is completed, and in slack times puts the computers to work sorting information.

In the same way, before long, a government information bank in a central computer complex will be tied in with regional outlets across the country. Perhaps the optimum result of this will be when a person can walk into regional tax office and have his form processed immediately. The regional outlet will transmit the information to the central taxation computer in Ottawa and he will have his rebate to spend — if the computer decides he has one coming — in a matter of seconds.

This same principle can be applied to many areas of man's endeavors. In a matter of seconds after stopping a car, a policeman could know if a car is stolen, who owns it, and the history of the person driving it.

France has already tried to use the computer to eliminate the disparity of sentences handed out according to the likes and dislikes of various sentencing officials. Relevant information about the crime and the convicted person's background is fed into a computer. Out comes an appropriate sentence, presumably devoid of individual human prejudice. There are still some bugs to be ironed out, however, according to report.

JAPANESE COMPUTER INDUSTRY IS GROWING RAPIDLY

(Based on a report in the Mainichi Daily News, **Tokyo, Japan, June 5, 1968.)**

Japan has entered the age of computer utility, and is combining computers and communications. Large numbers of qualified personnel are needed and must be trained. More complete and more general data banks are required. These are three main conclusions of a recent report issued by the Japanese Electronic Computer Development Association.

According to the report, there are currently 3,700 computers installed in Japan, which is therefore second to the United States, which had 32,500 units as of June last year. West Germany is third, with 3,300 computers at that time.

Among recent Japanese milestones are these: (1) An information processing division has been created in the Industrial Structure Study Council, and the Japan Information Processing Development Center has been inaugurated; (2) An automatic ticketing system for the Japanese National Railways has been established; and (3) A long-distance information processing system has been adopted by city banks.

The report predicted that Japan will become a center for Asia in the international exchange of information. A plan for Japanese-U.S. data bank is being considered.

But despite the rapid progress of the Japanese computer industry, Japan is far behind the U.S. in the area of management information systems. Recent mergers of big businesses in Japan are giving birth to "conglomerate" firms which increase the need for more sophisticated management information systems.

4TH AUSTRALIAN COMPUTER CONFERENCE, ADELAIDE, SOUTH AUSTRALIA, AUGUST 1969 — CALL FOR PAPERS

Dr. G. W. Hill
Programme Committee Chairman, A.C.C. 69
c/o C.S.I.R.O.
Computer Science Bldg.
University of Adelaide
Adelaide, South Australia 5000

Papers are invited for the 4th Australian Computer Conference to be held in Adelaide, South Australia, August 11-15, 1969. The Conference is being sponsored and organized by the Australian Computer Society.

Papers should be original and should concern the practice or theory of the application or design of computer or information processing systems. Subjects could include all aspects relating to the use of computers in the commercial world, industry, government, technology, and research. All phases in establishing and using computer systems are within the scope of the conference, including systems design, programming, performance, control, management, measurement of effectiveness, and applications for which computer systems are being or can be used. Papers dealing with the effects of computers on the community, on organizations, or on the individual may be included, also those of a survey, tutorial, or interdisciplinary nature.

A summary of each proposed paper is required. Following initial refereeing, recommended authors will be asked to submit final papers complete with any charts, drawings or photographs.

Summaries should be approximately 800 words long. Three copies are required, typewritten, double spaced, one side of paper only. On the first page include the title of the proposed paper, name, address, and affiliation of author.

It is expected that final papers will not usually exceed 6,000 words. Deadline for summaries is Sept. 14, 1968; deadline for final papers is Feb. 14, 1969. Send summaries to Dr. G. W. Hill at the address above.

CONTRIBUTIONS WELCOME TO "WHO'S WHO IN THE COMPUTER FIELD"

The Fifth Edition of *Who's Who in the Computer Field* will be published by *Computers and Automation* during 1968. We plan to include over 10,000 capsule biographies of persons who have distinguished themselves in the field of computers and data processing. If you wish to be considered for inclusion in *Who's Who,* please complete the following form (which may be copied on any piece of paper):

1. Name? (Please print)________________
2. Home Address?________________
3. Organization?________________
4. Its Address?________________
5. Your Title?________________
6. Your Main Interests?

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

7. Year of Birth?________________
8. Education and degrees?________________
9. Year Entered Computer Field?________________
10. Occupation?________________
11. Publications, Honors, Memberships, and Other Distinctions?________________

(attach paper if needed)

12. Associates or friends who should be sent "Who's Who" entry forms?

Name and Address

When completed, please send to:
Who's Who Editor, Computers and Automation,
815 Washington St., Newtonville, Mass. 02160

c.a IDEAS: SPOTLIGHT

Although Computers Can Do Only What They Are Told To Do, It Is Not Possible Practically To Foresee All Of The Consequences

Richard W. Hamming
Bell Telephone Laboratories
Murray Hill, N.J.

One often hears the remark that:
computers can do only what they are told to do.

True, but that is like saying that insofar as mathematics is deductive, once the postulates are given all the rest is trivial. An outsider not well acquainted with mathematics is apt to admit readily the truth of this last statement, but the mathematician knows well how much is being concealed when one says that all of deductive mathematics is trivial.

Similarly, any person who has had reasonably extensive experience with modern computers well knows how much is being concealed when one admits that machines can do only what they are told to do. The truth is that in moderately complex situations such as the postulates of geometry or a complicated program for a computer, it is not possible on a practical level to foresee all of the consequences.

Indeed, there is a known theorem that there can be no program which will analyze a general program to tell how long it will run on a machine without actually running the program (or a direct simulation of the program).

— From "Impact of Computers"
in *The American Mathematical Monthly,* Part II,
"Computers and Computing", February, 1965.

Bob Thomason is your answer-man on the Varian Data 620/i.

And on his nickel.

Bob Thomason knows more about the Varian Data 620/i systems computer and its use in systems than any other man in the company. He should—he's our engineering vice president. And now he is your personal answer-man, with our most authoritative answers on the 620/i and your application.

And he'll get you *immediate delivery on 620/i standard configurations,* a new availability resulting from the expanded production at our brand new plant.

Just to give you a base for talking to Bob Thomason, here are a few facts to start with:

The Varian Data 620/i is designed strictly for systems work, fully IC'd for reliability and small size. It is fast (1.8 μsec cycle time, with hardware registers and our unique Micro-Exec addressing), capable (16- and 18-bit words, 4K to 32K word memory, 100-plus basic commands), versatile (Party Line I/O, proven software, complete peripherals and options), and low price ($13,900, in standard configuration, with teletypewriter).

We've delivered more than 150 620/i's already, so, we've had lots of experience in interfacing the 620/i with all types of systems, and we're currently filling orders for 400 more.

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COMMUNICATIONS DATA PROCESSING OR TIME-SHARING?

Lester A. Probst
Manager, Systems
FAIM
55 West 42nd St.
New York, N.Y. 10036

"It is not unreasonable to state that the cost of a time-shared system is generally several thousand dollars more per month than a comparable communications data processing system because of the extra hardware requirements."

A main current trend of the data processing industry is into the realm of time-sharing. Many recent articles appearing in various trade publications and manufacturers' sales literature concerning on-line commercial applications imply that the requirements of these applications can best be satisfied by a time-sharing system. This article disagrees with these implications and assertions by pointing out that the requirements for the majority of on-line commercial (and many military) applications require a communications data processing system rather than a time-shared system.

The advanced technology of today is the foundation upon which the data processing industry is built. This continually changing technology and the creative and dedicated individuals who make it tick make a combination that has managed to create a unique industry. Unfortunately many hard-to-define aspects of the computer industry have resulted in a great deal of confusion among the potential data processing public concerning what is really available to solve their problems.

A primary reason for this confusion can be attributed directly to responsible people in the data processing industry who have been content to remain passive and allow hardware designers to take total responsibility for systems planning. One can consistently find situations where applications had to be found to fit the characteristics of a hardware system, rather than having hardware systems designed to satisfy the requirements of an application.

Today, many data processing users are preparing to advance beyond what is generally referred to as conventional batched data processing. So responsible data processing people should try to dispel the confusion that occurs because of the misleading and ambiguous definitions associated with the many new terms generated by the data processor.

Subtle but Significant Differences

The differences between communications data processing and time-sharing are significant though subtle. Most of the functional differences between data communications processing and time sharing systems are a little hard to see since one on-line system is effectively a subset of the other. However, the two types of systems do differ in three identifiable ways:

1) the kind of application they can best satisfy;
2) the type of user they best serve; and most important
3) their economic consequences for the user.

Lester Probst performs consulting services in the area of data communications systems for FAIM. This article was written while he was associated with RCA-EDP. He received a BSEE degree from New York University, and has pursued studies for a Masters degree at Stevens Institute of Technology.

Economic Implications

The economic implications, as it affects the user, are material. Almost without exception a system designed for time-sharing applications is more costly than a comparable system designed for communications data processing. This is true mainly because time-sharing systems have special hardware features and larger memory requirements. Both of these features can be translated readily into more dollars per month.

In addition, some time-sharing systems have a need for a smaller "computer" to act as a "communications front-end" to service the large number of messages going in and out of the complex system. It is not unreasonable to assert that the cost of a time-shared system is generally several thousand dollars more per month than a comparable communications data processing system because of the extra hardware requirements. Thus, it is extremely important for the potential user of an on-line system to recognize and understand the different capabilities of each system available to him. Then he can fit the proper system to the application, or at least relate a manufacturer's varied offerings to his gross applicational needs.

New Terms

The combining of communications technology with computer technology has caused several new terms to emerge. A few of these new terms are not only in general use today but are also used to refer to computer/communications systems as opposed to conventional batched data processing systems. These terms are "on-line", "on-time", and "real-time"; they are described below:

- **On-line** often means that supporting data processing is a part of the total "immediate action" flow of the business. "On-line" means integrated and in-line with the physical process.
- **Real-time** means almost instantaneous data processing provided to a physical process whenever demanded.
- **On-time** supporting data processing which immediately recognizes demands from the physical process, and provides results to the physical process, fulfilling requirements in a timely manner.

In this article, "on-line" is used to describe all systems belonging in the domain created by the communications/data processor relationship. However, it is suggested that the term "on-time" be considered by the user or potential user at the specific applicational level because it focuses on a very important point; i.e., that similar systems for similar applications will generally have dissimilar response requirements. The term "real-time" does not really describe a commercial application because real-time systems use responses in milliseconds and microseconds and are used in areas such as air traffic control systems and missile guidance and warning systems.

Categories of Applications

It is important to this discussion that we further identify on-line systems by dividing the total on-line spectrum into a few basic applicational categories, each of which serves a certain general function and involves an identifiable pattern of data flow. From the definitions of these applicational categories, then, one finds that specific on-line applications fall very nicely into one category; or may, in many cases, combine the function of two or more categories. These applicational categories are:

- **Data Collection** - Refers to the collection and transmission of information from many outlying positions to one central point. Thus, data flow is in one direction from multiple remotes to the central processing facility.
- **Data Dissemination** - Refers to the distribution of data generated and/or processed at a central facility and transmitted to one or more outlying locations. Data flow in this type of system is also in one direction, but, this time, from central processing facility to multiple remotes.
- **Inquiry-Response** - Refers to inquiry messages that are originated at one or more outlying locations and transmitted to a central point where a data base(s) is (are) accessed to provide responses which are then transmitted back to the originator. In this type of system data flow is bi-directional between multiple remotes and a central processing facility.
- **Message Switching** - Refers to an application when communications traffic within a large corporation with widely separated locations is high, a computerized message-switching system is generally required. Sending terminals transmit a message to a center which temporarily stores it; performs any processing or code conversions required; and then retransmits the original message to one or more designated receiving terminals. In this kind of a system data flow is two way between multiple remotes via the central processing facility.
- **Time-Sharing** - Refers to the ability of a computer system to process multiple requests by independent users providing responses so rapidly that each user feels the total computer is entirely at his disposal. The basic data flow is two way and similar to the inquiry-response; where input data and operating instructions are transmitted from remote terminals to the central computing facility and the results of computations are transmitted back to the originator.

Many on-line applications can be easily identified because they fall only into one applicational category, and therefore the difference between systems dedicated to data collection, message switching or time-sharing is self evident. However, the majority of commercial organizations that will, in the near future, begin to satisfy their corporate needs by planning the development of an on-line integrated system will find that their specific application consists of some combination of data collection, data dissemination, inquiry-response and perhaps even a small amount of message switching. It is the numerous multi-purpose information systems to come in the near future that will consist of a combination of applicational categories. This author defines these systems as *Communications Data Processing systems* — and they are quite different from Time-Shared systems.

Interactive Dialog

The significant characteristic that separates time sharing and communications data processing is the ability of a time shared system to provide an interactive dialog between user and system in a language developed for and readily understood by the user. Applications that fit a time-sharing system are those of mathematicians solving complex problems; researchers solving highly scientific medical problems; design engineers performing complex engineering design analysis, or utilizing interactive operations to design automobiles or aircraft; or by highly technical or educationally-oriented organizations for on-line interactive program development and debugging, or computer-aided instruction. These kinds of applications and other similar applications can be arrived at by examining the terminology used in the definitions given above. That is, the kind of application associated with remote entry of operating instructions that instruct the central processor to perform an operation or set of operations on remotely entered data, and the subsequent return of computed results implies a class of scientifically or technically oriented individuals in a scientific or advanced educational endeavor.

Service Bureaus

A Service Bureau that sells time to non-related users, generally for administrative related functions, is another time-sharing application. However, the Service Bureau user is most often not using the time-shared system in the same (interactive) way as the scientific or educational user mentioned above, but rather is exercising the multiprogramming* feature of the time-sharing machine to perform remote batch processing. The potential on-line system user that this author is concerned about is the one who will install his own in-house system and therefore the Service Bureau concept discussed above is not really applicable.

From the above discussion then, one can see that the majority of on-line applications can be classified as communications data processing applications. Some of the most common applications that exemplify this today are airlines reservations systems; hotel reservations systems; centralized inventory control systems; telephone rate-quoting systems; medical information systems; library information systems, and business information systems.

*Multiprogramming: The processing of two or more jobs simultaneously in the same computer.

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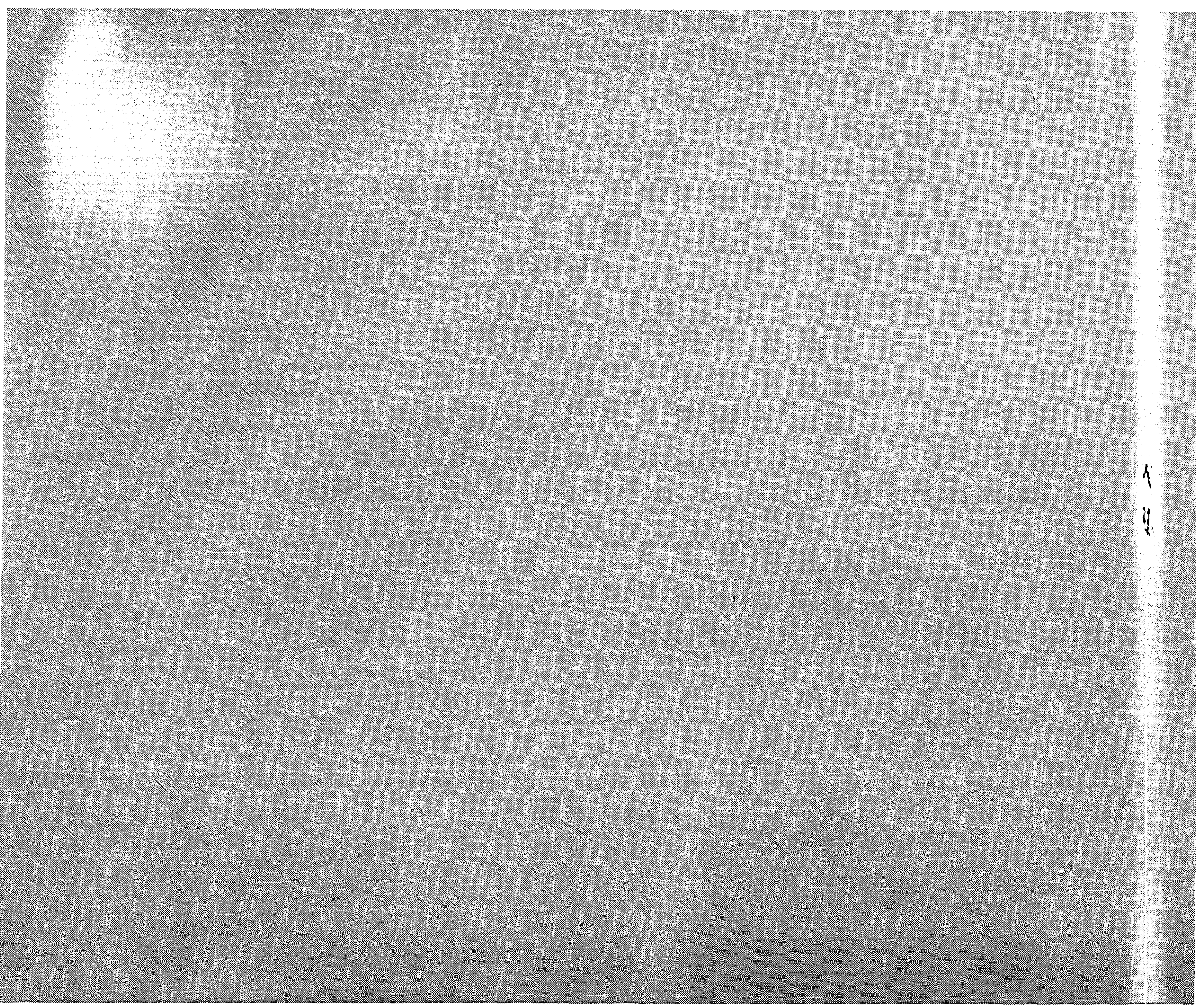

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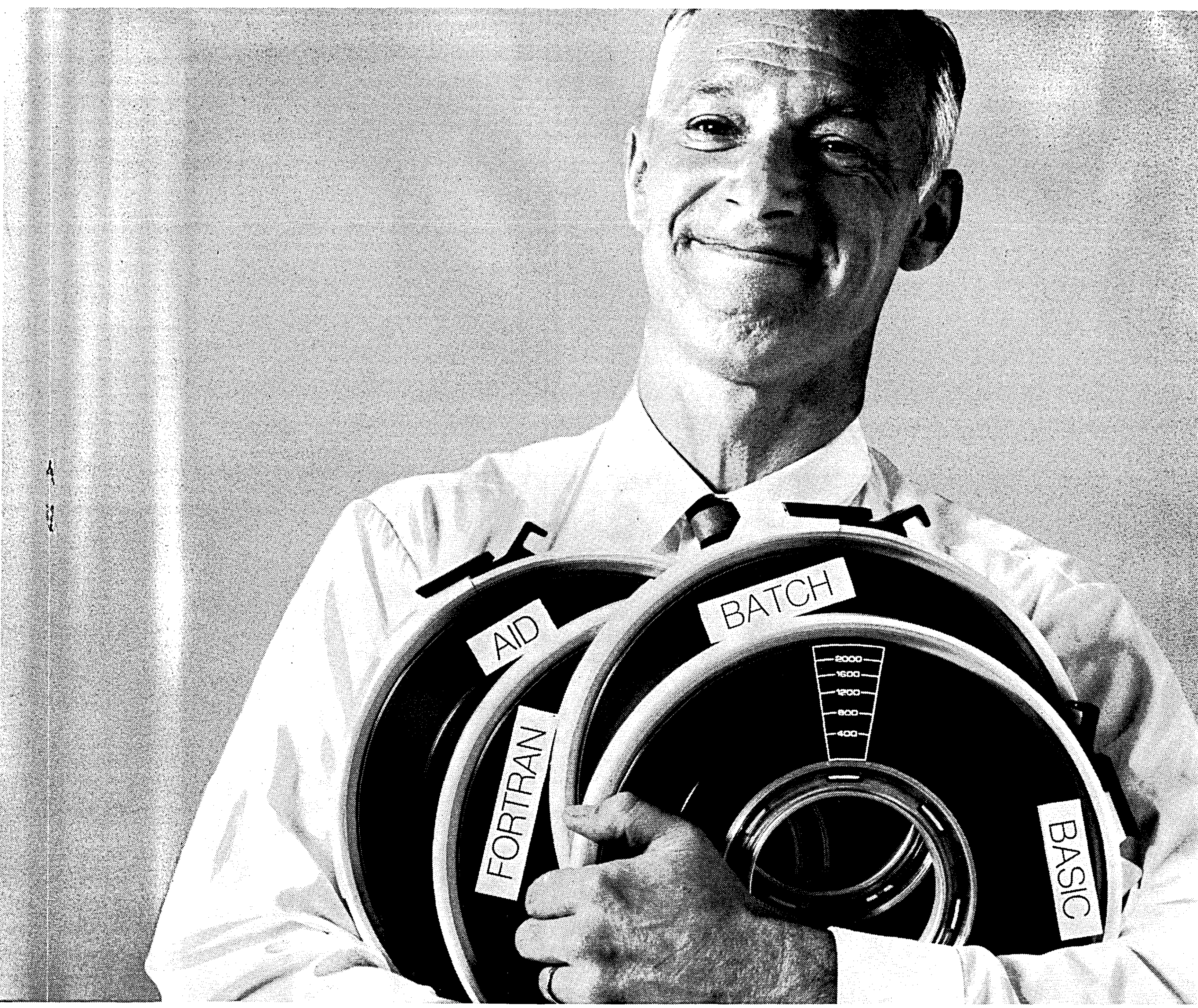
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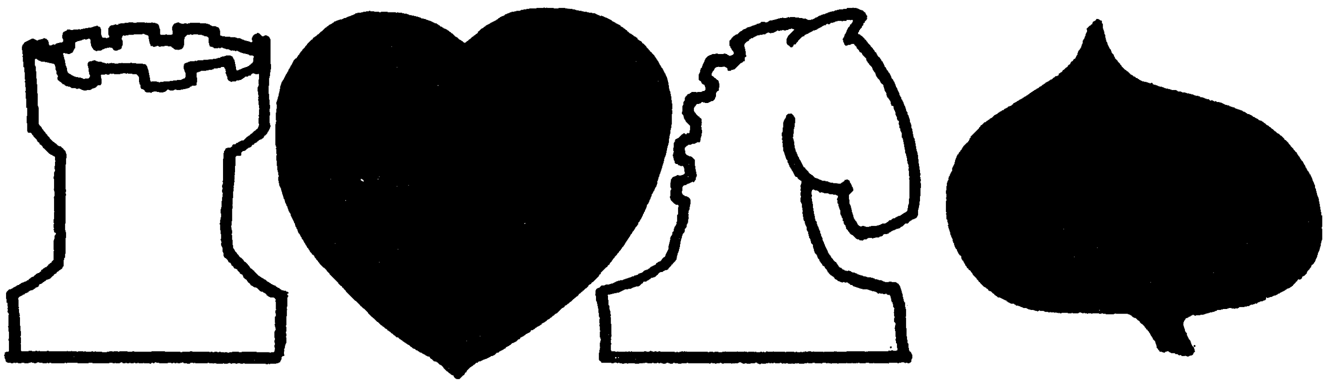

GAME PLAYING WITH COMPUTERS

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"Game programs provide excellent situations for learning computer programming. The beginning programmer can understand the problem to be programmed in a minimum amount of time; therefore, he can devote more time to learning the computer, the programming language, and the techniques of problem solving with a computer."

Two of the hardest working computers at the 1968 Spring Joint Computer Conference (SJCC) in Atlantic City, New Jersey, were the Scientific Control Corporation (SCC) 660 and the Varian Data 620i. These computers were being used to demonstrate computerized gaming — a popular pastime at computer conferences.

Blackjack

At the SCC exhibit, blackjack (also called 21) was being played. This exciting gambling game is always popular among computer people. In a casino at Las Vegas or elsewhere, everybody plays against the casino dealer. At the SJCC everybody played against the SCC 660 computer. The computer started the game by typing the following rules:

1. BLACKJACK PAYS DOUBLE
2. PAIRS MAY NOT BE SPLIT
3. DEALER HITS 16, STANDS ON 17
4. TIES ARE REPLAYED.

and the message
GOOD LUCK

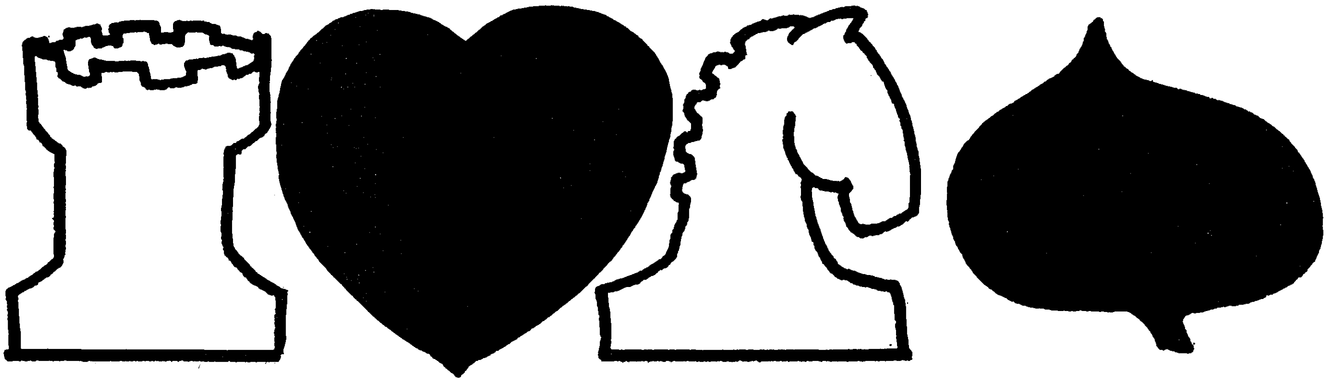
This was typed at any one of the four available teletypewriters. In a casino, a dealer would deal each player two cards, and himself one card face-up and one card face-down. This action is simulated on the teletypewriter in the form of two messages: one message specifies the player's two cards and another message indicates the dealer's face-up card. The object of the game is to draw cards that add up to 21, or as close to it as possible without going over. You *go over* when your cards total 22 or more.

Ten, Jack, Queen and King count 10. The Ace counts 1 or 11, as you choose. Other cards count by their face value.

After each player evaluates his hand, he either *stands* (by typing NO when the teletypewriter types HIT?) or informs the computer that he wants another card by typing YES when the teletypewriter types HIT? The player draws cards until he thinks the count of his hand is closer to 21 than the computer will get.

If the player's hand goes over 21, he goes *bust* and loses the game. If the player's hand is nearer 21 than the computer's, he wins; if it is less than the computer's, he loses. Ties are a *stand-off* and nobody wins. The player may draw as many cards as he likes, but the computer is programmed to draw on 16 or less — stand on 17 or over.

Figure 1 illustrates seven games that the author played with this system.



```
YOU HAVE Q OF SPADES, 9 OF HEARTS.
DEALER SHOWS Q OF CLUBS
HIT?  NO
DEALER HAS 8 OF DIAMONDS, Q OF CLUBS
DEALER'S SCORE IS 18. YOUR SCORE IS 19.
YOU WIN THIS ONE.             $1.00

YOU HAVE 9 OF DIAMONDS, 9 OF SPADES.
DEALER SHOWS 3 OF DIAMONDS
HIT?  NO
DEALER HAS 4 OF HEARTS, 3 OF DIAMONDS
4 OF CLUBS
2 OF DIAMONDS
5 OF HEARTS
DEALER'S SCORE IS 18. YOUR SCORE IS 18.
THIS ONE'S A TIE.

YOU HAVE A OF CLUBS, J OF CLUBS.
DEALER SHOWS 6 OF CLUBS
YOU HAVE A BLACKJACK          $3.00

YOU HAVE 2 OF SPADES, 5 OF CLUBS.
DEALER SHOWS Q OF SPADES
HIT?  YES 10 OF SPADES
HIT?  NO
DEALER HAS K OF HEARTS, Q OF SPADES
DEALER'S SCORE IS 20. YOUR SCORE IS 17.
DEALER TAKES THIS ONE.        $2.00

YOU HAVE J OF CLUBS, 4 OF DIAMONDS.
DEALER SHOWS 8 OF HEARTS
HIT?  YES 2 OF DIAMONDS
HIT?  YES 7 OF DIAMONDS
SORRY ABOUT THAT.             $1.00

YOU HAVE A OF HEARTS, 2 OF CLUBS.
DEALER SHOWS 10 OF DIAMONDS
HIT?  YES 7 OF HEARTS
HIT?  NO
DEALER HAS K OF DIAMONDS, 10 OF DIAMONDS
DEALER'S SCORE IS 20. YOUR SCORE IS 20.
THIS ONE'S A TIE.

YOU HAVE 3 OF HEARTS, 4 OF HEARTS.
DEALER SHOWS K OF SPADES
HIT?  YES 7 OF SPADES
HIT?  NO
DEALER HAS 10 OF CLUBS, K OF SPADES
DEALER'S SCORE IS 20. YOUR SCORE IS 14.
DEALER TAKES THIS ONE.        $0.00
```

Figure 1

Mr. Spencer is president of Abacus Computer Corporation and Senior Programming Analyst with the General Electric Company. He is the author of several articles and books including *The Computer Programmer's Dictionary and Handbook* (Blaisdell Publishing Co. — May 1968), and *Game Playing with Computers* (Spartan Books — July 1968). Mr. Spencer holds a mathematics degree from San Diego State College and belongs to the following professional societies: ACM, IEEE, MAA, AMA, NCTM and ASTD. He was previously associated with Univac and RCA.

Kriegsspiel IV^2

About 300 feet away from the SCC exhibit was another popular game attraction. At this location people were playing the game of Kriegsspiel IV^2 on a Varian Data 620i computer system. This fascinating game was developed by two members of Carnegie-Mellon University in Pittsburgh, Pennsylvania. Kriegsspiel IV^2 is a 4 by 4 board game that involved moving eight markers in a specified manner.[1] The Varian Data 620i computer was programmed to act as the opponent for the human player. The computer's program showed unpredictable behavior but it improved with experience. This machine was programmed to save the outcomes of several thousand past games and would make moves according to what it had *learned* were successful outcomes. This program steadily improved its ability to play the game of Kriegsspiel IV^2.

The reader should look for the appearance of this game at future conferences. Be prepared to lose, however, as you will be playing a very smart program. It forced this author to give up after the eighth move.

Game Playing at Computer Conferences

Playing games at computer conferences has become common. At the 1967 Fall Joint Computer Conference (FJCC) in Anaheim, California, participants played blackjack, nim, roulette, chess, tic-tac-toe and craps with computer systems. The 1967 SJC in Atlantic City also had a similar selection of game playing computer systems. At the 1965 FJCC in Las Vegas one could even play a slot machine which was simulated using Digital Equipment Corporation's cathode ray tube display unit.

During the 1963 FJCC in Las Vegas, Control Data LGP-21 computer was used to assist a blackjack-playing programmer to make decisions at a blackjack table in the Tropicana Hotel. After he won several hundred dollars, the casino operators informed the winning programmer that he could continue playing blackjack — but without his helpful computer aid.

Playing Games with Computers

Why are computers used to play games? Well, games are fun to play and are often good analogies to actual situations involving human beings and their environment. Gaming is being applied to business management and war strategy. Business executives are playing games with computers that simulate the operation of their business. Research laboratory personnel have used computers to conduct studies in the strategies of roulette, blackjack, and betting systems.

Another reason why human beings are using computers to play games is that the rules of how to play a game are usually relatively simple and can be understood by a person in a minimum amount of time. A person learning to write programs for digital computers can therefore begin with problems that are well defined and easily understood. Thus, game programs provide excellent situations for learning computer programming. The beginner programmer can understand the problem to be programmed in a minimum amount of time; therefore, he can devote more time to learning the computer, the programming language, and the techniques of problem solving with a computer. Many university professors use gaming examples in their computer science courses for this reason.

Game Classification

Games may be classified in a variety of ways. Dr. Eric Berne in *Games People Play* describes games as series of interacting events that people play in their everyday life. Dr. Berne's type of games fall in the area of transactional game analysis. A branch of mathematics known as game analysis deals with the mathematical theory of games. Games of strategy and logic are typical of games found in this area. An elementary school teacher considers dodge-ball a game while the college coach would be insulted if everyone did not recognize football as a game. The term *game* is here used very broadly to include a large collection of recreations: popular games such as *chess, checkers, tic-tac-toe, and GO;* casino games such as *roulette, craps, blackjack* and *keno;* mathematical recreations such as *prime numbers, magic squares, pentominoes,* and the *knight's tour;* and puzzles such as the *15 puzzle.*

Early Game-Playing Machines

Several machines have been specifically built to play games. In the early 19th century Charles Babbage, an English mathematician, wanted to build a tic-tac-toe machine to help finance the development of his *Analytical Engine.* In the late 18th century Baron Wolfgang von Kempelen astounded Europe with a *phoney automatic chess-playing machine.* It was later found that this machine contained a chess playing midget. In 1914, a Spanish inventor named L. Torres y Quevedo constructed an honest *chess playing machine.* In the 1930s E. V. Condon designed a special purpose computer for playing the game of *Nim.* Claude Shannon built a chess playing machine named *Caissac* and went on to define how general purpose computers could be used to play chess. Shannon also built a machine called NIMWIT which plays Nim and a machine that solves the ancient puzzle known as the Tower of Hanoi. Today one may find several special purpose game playing machines (such as tic-tac-toe machine at Disneyland; roulette, keno, craps, wheel-of-fortune and blackjack machines in Nevada casinos) however, it is more common to find game playing programs for general purpose computers.[2]

How Does a Computer Play Games?

A digital computer may be programmed to play games in several different ways. The computer may be pitted against a human player as would be done in a game of tic-tac-toe or chess. The computer may be directed to generate the solution to a specific game or puzzle, such as magic square. The computer can also be used as a scorekeeper between two players or teams; this is often done in war games and business games. The most popular form of play for the computer is for it to participate in the game as an active player. In this type of play the human player indicates each of his moves to the computer on an input device such as a teletypewriter or light pen display unit. The computer will then compute its move and report its move to the human being. The report is given on a teletypewriter, line printer, display, or some other output device. The computer always keeps score by recording both the computer's moves and the human's moves.

In games where no known solution exists, the computer often looks several moves ahead, examining all possible combinations of its own moves and those of the opponent, and selecting the move which is most advantageous to it according

---

[1]Rules for playing Kriegsspiel IV^2 are given in a small pamphlet written by Robert L. Anderson, Jr., Carnegie-Mellon University, Pittsburg, Pennsylvania.

[2]An exception to this statement is the many game playing machines which are constructed by high school students as entries in science fairs. Students have built machines to play checkers, nim, tic-tac-toe, hexapawn, and other games.

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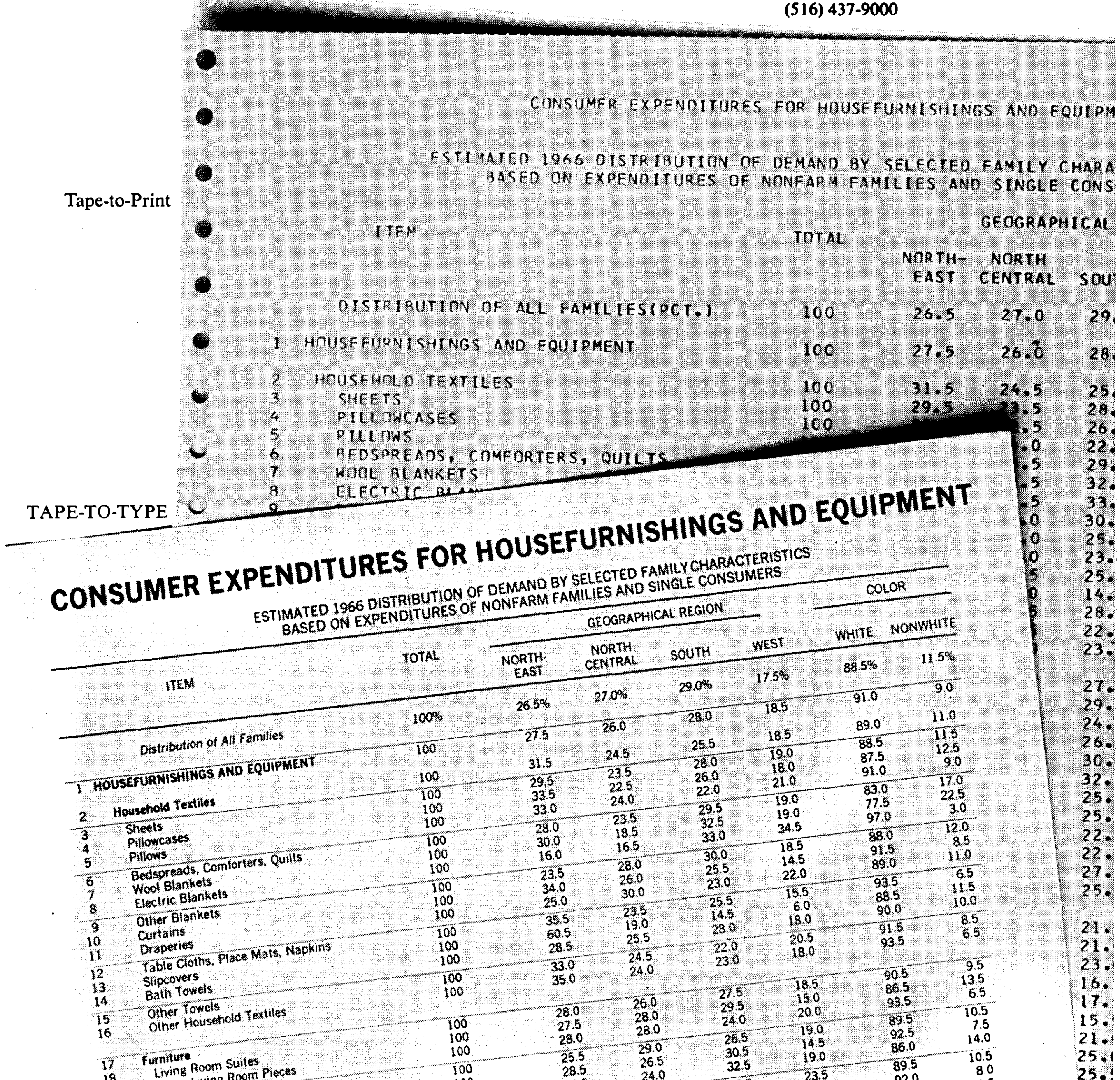

to some computable criterion for selecting a position. The above procedure is often used in chess, checkers, and the Japanese game of GO. This method somewhat simulates the action of a human player. However, there are many different, possible moves in games of chess, checkers and GO; and there are millions of possible situations resulting from just a few moves. This results in an extremely large number of possible variations in a game: 10^{120} in chess, 10^{40} in checkers and 10^{172} in GO. Because of the size of this number, a computer cannot analyze all possible sequences of moves in these games.

A Game for Reader Solution

Let us now look at the classical puzzle of the *knight's tour.* The reader may wish to write a computer program to play this game.

This problem involves the knight moving to every cell on the chessboard, but never moving to the same square twice. The knight is allowed to move to any square on the board which is two rows and one column or two columns and one row away from the square he is currently occupying. In other words, in Figure 2 the knight shown can make any one of the eight moves shown.

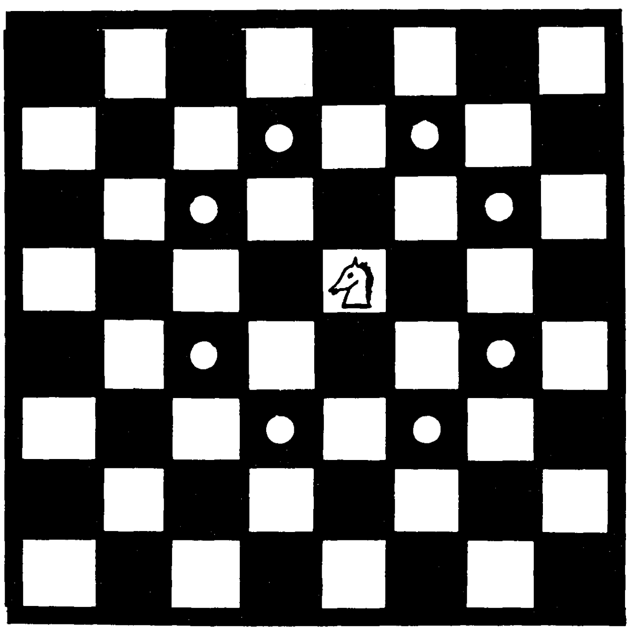

Figure 2

A chessboard consists of sixty-four squares and may be thought of as a matrix with eight columns and eight rows. Each element of the matrix is defined by specifying the row and column in which the element lies. For this problem, let us assume the matrix is named C and any element of the matrix may be specified by C(I,J), where I specifies the row and J specifies the column.

Thus the right topmost square of the chessboard is represented in the matrix as element C(1,8). This element is in the first row and eighth column.

This example will illustrate the knight's journey on the chessboard and show how each move is made. The knight starts in cell C(1,1), and then moves to C(2,3). This move and the moves that follow are represented in Figure 3. A move is represented in the diagram by a number appearing in the cell. This number indicates the order in which the cell was encountered; thus cell C(1,1) would contain the number 1, which was the starting location of the tour. The tour ends on the 63rd move in cell C(6,3).

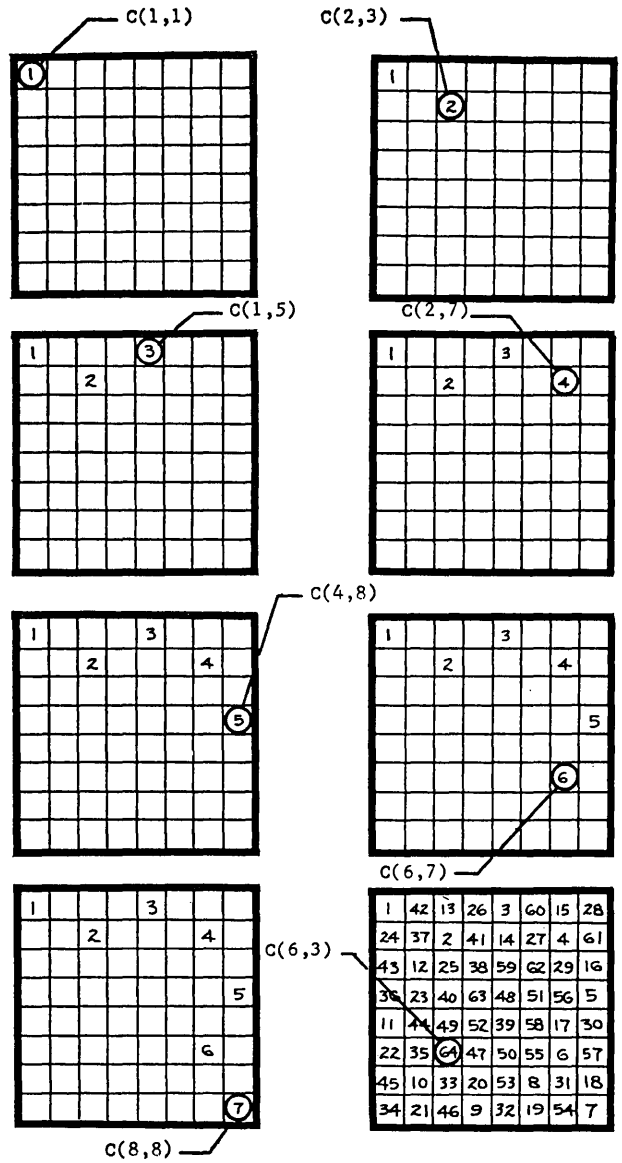

Figure 3

More on Computerized Gaming

For more detailed information on computerized gaming, see the following references.

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MACHINE TRANSLATION IN REVIEW

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"In order to attain the long-range research objectives of machine translation, it is important that research be continued on such short-range objectives as straightforward linguistic analysis of the lexicon and the grammar of various languages."

The primary aim of machine translation research is to produce the best possible translation, automated wherever feasible, from one language (the source language) into another (the target language) through the combined efforts of linguists, programmers, and research associates involved in related fields. A secondary aim, more an outgrowth of early research than an objective in itself, is to develop, as far as possible, a complete linguistic description of the grammars of certain languages. Accumulation of such data is invaluable for subsequent efforts to refine and develop machine translation output. Also, it is of great interest to linguists and teachers of the respective languages.

Historical Background

The idea of machine translation dates back to 1946, when Warren Weaver and A. D. Booth of the Massachusetts Institute of Technology began discussions on the technical feasibility of machine translation. A great deal of progress has been made since that time. In 1954, International Business Machines conducted a demonstration of machine translation in cooperation with the Georgetown University. An IBM 701 general purpose computer, using a total vocabulary of 250 words and six rules for determining the relationships that exist among sentence constituents, was programmed to translate Russian sentences into English. This highly publicized demonstration provided a marked impetus for interest growth and active research in the field. Machine translation research groups were organized not only in the United States, but also in countries throughout the world, *e.g.*, Great Britain, France, Italy, Germany, the Soviet Union, and Japan.

Main Tasks

These pioneer researchers realized that, if any real progress were to be made in machine translation, linguists and programmers would have to devise a system to store and retrieve vast quantities of natural data in the form of dictionary entries and text, and to create algorithms to perform analysis and synthesis. Also, they realized that high-speed hardware with vast memory capacity would have to be developed simultaneously with that system. The main tasks confronting the researchers, in ascending order of difficulty, are listed below:

- Compiling automatic dictionaries and developing procedures for efficient storage and retrieval of language data and translation rules or instructions (lexicon);
- Encoding the grammar of words and their constituent parts (morphology);
- Writing word order rules for sentence analysis (syntax or sentence structure determination or recognition); and
- Developing procedures for analyzing and codifying the meanings of words (semantics).

By 1960, about a dozen federally sponsored research groups in the United States were investigating problems connected with compiling automatic dictionaries, development storage and retrieval procedures, and morphology. Indeed, not until investigations were actually underway did the researchers realize just how little was known about the structure and usage of given languages or just how incomplete the descriptions of these languages were.

Machine Translation Conferences

In order to minimize duplication of tasks and to establish a basis for cooperative exchanges of information, a series of machine translation conferences was organized by Wayne State University. The first such conference was convened at the request and with the support of the Information Systems Branch, Office of Naval Research. Support for subsequent meetings was provided by the National Science Foundation, the United States Air Force and ONR.

The first machine translation conference, held in Princeton in 1960, concentrated on dictionary design and general questions of grammar. The second, which convened at Georgetown University in 1961, was devoted to problems of grammar coding. The third meeting, held in 1962 back at Princeton, was syntax-oriented; and the fourth, held in Las Vegas in 1965, dealt with semantics.

Reprinted from *Naval Research Reviews,* March 1968, published by Code 109, Office of Naval Research, Washington, D.C. 20360.

FIGURE 1 — MT PROCESSING OF A RUSSIAN SENTENCE

INPUT

УСТАНОВЛЕНИЕ ГИДРОЛОКАЦИОННЫХ СТАНЦИЙ ВОЕННИМ ФЛОТОМ ОБЛЕГЧИТ ОБНАРУЖЕНИЕ ВРАЖЕСКИХ ПОДВОДНЫХ ЛОДОК.

DICTIONARY LOOKUP
(grammar codes and English equivalents are retrieved)

e.g., УСТАНОВЛЕНИЕ - 1.00.401.343.02.000.0.0.0.0.00.0.0.0. - ESTABLISHMENT

Part of Speech | Homograph Code | Agreement Code | Person, Gender, Number | Case Government | Preposition Government | Motion Gov't | Infinitive Gov't | ЧТО, ЧТОБЫ Gov't | Complex Gov't | Pronoun/Proper Name | Animation | Non-Pred. Formula | Pred. Formula

SYNTACTIC BLOCKING
(analysis of sentence constituents in order to group related members)

nominal block 1: УСТАНОВЛЕНИЕ
nominal block 2: ГИДРОЛОКАЦИОННЫХ СТАНЦИЙ
nominal block 3: ВОЕННИМ ФЛОТОМ
predicate block 1: ОБЛЕГЧИТ
nominal block 4: ОБНАРУЖЕНИЕ
nominal block 5: ВРАЖЕСКИХ ПОДВОДНЫХ ЛОДОК.

HYPERPARSE
(automatic parsing of sentence - specific function(s) is assigned, to each of above blocks)

Predicate Candidates	Subject Candidates	Object Candidates	Adjunct Candidates
predicate block 1	*nominal block 1*	*nominal block 1*	*nominal block 2*
	nominal block 4	*nominal block 4*	*nominal block 3*
			nominal block 5

MATRIX REDUCTION YIELDS TWO POSSIBLE INTERPRETATIONS:

Subject	Predicate	Object	Adjunct
nominal block 1	*predicate block 1*	*nominal block 4*	*nominal block 2,3,5*
or nominal block 4	*predicate block 1*	*nominal block 1*	*nominal block 2,3,5*

OUTPUT

(THE) ESTABLISHMENT (OF) SONAR STATIONS (BY) (THE) (MILITARY) FLEET WILL FACILITATE (THE) DETECTION (OF) ENEMY SUBMARINES.

It was generally felt that these meetings benefitted all participants in terms of the climate of cooperation created, the informal exchange of views, and the precise definition of problems to be resolved. Various independent scholars and key representatives of research groups were able to examine together the problems, of either a linguistic or computational nature, that have confronted serious researchers. Also, conference participants were able to compare solutions, question one another on particular points, and, in general, pool the results of individual endeavors.

ONR-Sponsored Research at Wayne State University

ONR-sponsored research in computer-aided Russian→English machine translation at Wayne State University has led to the development of an experimental system which presently comprises three basic operations — dictionary lookup, syntactic blocking, and hyperparse (see figure 1). At the current stage of development, these three operations are coordinated through the interaction of both human and machine procedures.

Input to the system generally consists of a technical Russian language text which has been keypunched and read onto magnetic tape. One sentence at a time is analyzed. Each sentence item is looked up in a computer-stored dictionary (a compilation of words as they occur in a text comparable to the input text) and its encoded grammatical characteristics and English equivalent(s) are retrieved. The resultant output tape of looked-up text is used as input to the next operational phase — syntactic blocking or analysis. This procedure endeavors to recognize and to record the functional (grammatical) role played by each sentence constituent.

Syntactic Analysis

In syntactic analysis, sentence items (sometimes only one word) which serve the same function in the sentence, *e.g.*, subject, predicate, object, are put into blocks or groups. Each block has a kernel word (noun, verb, preposition) on which other sentence items may be said to depend. For example, blocks would be formed by a noun and its modifiers, a verb and an adverb, a preposition and its object noun, *etc.* An output tape of blocked sentences is then created and serves as input to the third operational stage, *i.e.*, where the blocked sentence is automatically parsed. This procedure entails determining the functional role (*e.g.*, subject, predicate, object) played by each of the blocks.

Interpretation

In the example shown in Figure 1, a grammatically ambiguous sentence offers two possible interpretations for the computer to discover. However, a single, logical interpretation would be deduced by a human translator, for the simple reason that he has more information stored in his brain than a computer has in its memory. To resolve this problem, a computer program has been written which would reduce grammatically ambiguous sentences to the fewest possible interpretations. This was done by means of a mechanically generated matrix which seeks to discover distinctions among the apparently ambiguous blocks. Those noun blocks which do not qualify as either subject or object candidates are grouped as so-called "adjuncts."

The system's presently obtainable output is represented by the non-parenthetic items in Figure 1. Information shown in parenthesis will be produced automatically when translation rules are revised in the near future to include provisions to rearrange word order and to insert articles and prewords. This latter task is still being done by a human post-editor. However, even in its present form, the telegram style output can be easily understood.

Experimentation in machine translation at Wayne State University is continuing with two primary objectives: first, to automate additional analytic procedures; and second, to refine previous routines according to insights gathered from each successive experiment. At the same time, translation rules are being formulated which, when written into the system, will improve the quality of the output.

Machine Translation Research Objectives

In order to attain the long-range research objectives of machine translation, it is important that research be continued on such short-range objectives as straightforward linguistic analysis of the lexicon and the grammar of various languages. Information to be gained from such research is necessary to successfully implement machine translation procedures and to overcome those problem areas or stumbling blocks that stand in the path of completely successful machine translation. These problem areas are primarily concerned with syntax (the structural interrelationships of sentence constituents) and semantics (the meaning of words and groups of words). There is reason to believe that sound theoretical bases have been established which will eventually resolve syntactic problems. However, a great deal remains to be done in semantics.

In any system of machine translation, there are many points of intersection in the areas of lexicon, morphology, syntax, and semantics. The boundaries are not clearcut but have had to be mapped and defined. The machine translation research process has been a heuristic one, where the knowledge and experience gained at a given stage of development has been applied to the refinement of preceding stages. The converse is also true. In this regard, the initial exploration of semantic problems, in many instances, has been based on syntactics.

Organizations Involved in Computer-Aided Translation

Although fully automatic, high-quality machine translation is still a remote objective, machine-aided translation (*i.e.,* translation produced through a symbiosis of man and mechanical devices) is indeed workable and productive. This is especially true in scientific areas for which microglossaries and microgrammers have been compiled.

To date, five organizations have been conducting effective computer-aided translation operations:

- Atomic Energy Commission at Oak Ridge, Tennessee;
- Foreign Technology Division, United States Air Force, Dayton, Ohio;
- National Physics Laboratory, Teddington, England;
- EURATOM at Brussels, Belgium and Ispra, Italy; and
- Central Research Institute for Patent Information, Moscow, USSR.

It is interesting to note that the last-named institute is translating the *Official Gazette,* the weekly publication of the United States Patent Bureau.

The operational machine-aided translation programs being conducted at the above organizations continue to produce a good deal of useful output. However, there is still a need for computer-aided linguistic investigations such as those being conducted at Wayne State University and at the Linguistic Research Center of the University of Texas. The results of these investigations are needed to refine further machine-translation-oriented linguistic analysis and to implement those refinements into operational programs. ■

EDITORIAL

(Continued from page 6)

stocking the mind, and what isn't. But there is also a very strong argument for cutting down the exposure to wrong information as much as possible. This can be done by choosing reading instead of radio (because you can choose what you read even as you are reading — and you are not a captive to the external sequence of controlled ideas); by choosing movies instead of a TV program (because you can choose what movie you want to see); by keeping advertisements off the parkways and highways of America, etc., — hurray for Ogden Nash's verse:

I think that I shall never see
A billboard lovely as a tree.

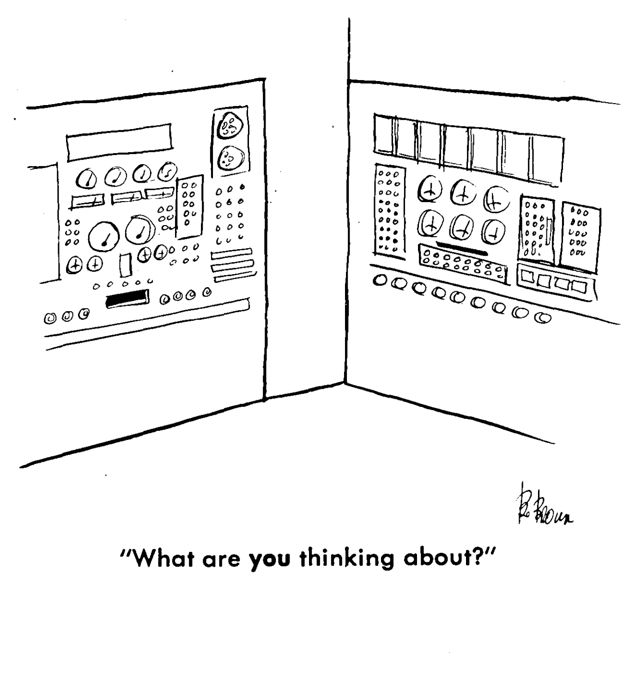
And so on.

I remember once riding in a bus in St. Louis, Mo., and listening to unending commercials being announced over a loud-speaking system to the passengers on the bus. I went up to the bus driver, said it interfered with my reading, and asked if he could please turn it off. He said he could not because the bus company had sold the captive audience of bus passengers for commercial advertising. I was angry, but could not do anything except stuff my fingers in my ears. A couple of years later I learned that a decision of the U.S. Supreme Court had declared this sort of thing illegal.

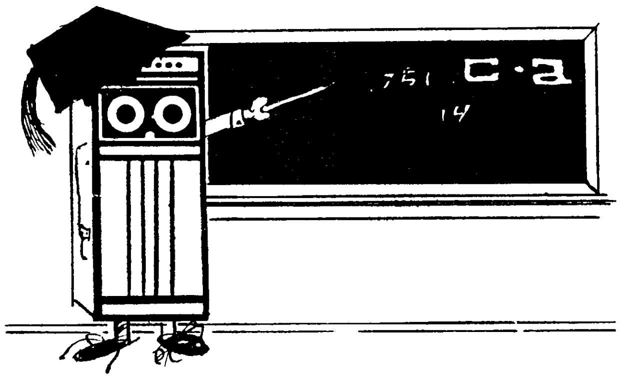
"Garbage in, garbage out" applies not only to computers but to minds. Let's cut down on "garbage in" to people's minds.

Edmund C. Berkeley
Editor

BACKGROUND PROGRAM



"What are you thinking about?"



Using a powerful, modern, small, general-purpose computer (a Digital Equipment Corp. PDP-9 which can perform 500,000 additions per second, etc.) which we have recently acquired -- and our experience since 1939 in many parts of the computer field, we have started to teach:

Course C12:

COMPUTING, PROGRAMMING, AND SYSTEMS FUNDAMENTALS FOR SUPERVISORY MANAGEMENT— WITH 'HANDS-ON-THE-COMPUTER' ORIENTATION AND EXPERIENCE

This course will be offered: September 11, 12, and 13 (Wed. through Fri.) and October 16, 17, and 18 (Wed. through Fri.), and from time to time thereafter. Computer time for course enrollees will be available, without additional charge, Wednesday through Sunday. The fee is $190; the enrollment is limited to 15.

WHO SHOULD TAKE COURSE C12?

In a recent article in Computers and Automation, Swen Larsen, Vice Pres., Computer Learning Corp., said:

> "In many companies, the top operating executive --the one who makes the key decisions -- came into his position of responsibility before the computer revolution. Of all the men in an organization, he is probably the one in the greatest need of knowledge of the computer. Two computer experts describe the manager's plight in this way:
>
> > 'The executive is likely to be baffled, or confused, or snowed. He has confidence in his firm's EDP manager, but he doesn't understand the jargon that he hears, nor does he comprehend what can be effected from the tools he controls.'"

Course C12 is directed squarely towards these people and this problem.

After the lectures beginning at 9 a.m. each day, the course will center around study groups of three or four persons who will have access together to the computer for three hours at a time; while one person runs his program, the others will work out or correct their programs. The instructor will, of course, be regularly available for guidance.

WHAT TOPICS ARE INCLUDED IN COURSE C12?

- Fundamentals of Computing, and Orientation in Computers and Programming, with "hands-on-the-computer" experience in: how to compute; how to program; how to edit a program; how to assemble a program; how to debug a program
- Some Powerful Concepts in Programming
- Introduction to Programming Languages
- Basic Principles of Systems in Computer Applications
- Applications and Nonapplications of Computers
- Some Natural History of Mistakes, and How to Avoid Them

WHO IS THE INSTRUCTOR?

The instructor for this course is Edmund C. Berkeley, editor and publisher of Computers and Automation since 1951, and president of Berkeley Enterprises, Inc., since 1954. He has been in the computer field since 1939. He took part in building and operating the first automatic computers, the Mark I and II, at Harvard University in 1944-45; he is now implementing the programming language LISP for the DEC PDP-7 and PDP-9 computers.

Mr. Berkeley is: a founder of the Association for Computing Machinery, and its secretary from 1947-53; the author of eleven books on computers and related subjects; a Fellow of the Society of Actuaries; and an invited lecturer on computers in the United States, Canada, England, Japan, the Soviet Union, and Australia.

We believe the experience of:

- sitting at a computer;
- having the entire machine at your command;
- being able to look into any register you choose, to see just what information is there;
- experimenting first with simple programs, then with more complicated programs; and
- having someone at your elbow to answer questions when you are perplexed;

is one of the most exciting, interesting, and instructive experiences of the computer age.

This experience is, we think, part of the essential background of supervisory management. With such experience, supervisors of data processing departments and divisions are better able to:

- make reality-based appraisals of computing and data processing;
- form sensible judgments that are relatively independent of what the computer professionals in their groups may tell them;
- avoid commitment to unworkable proposals and costly errors.

If you are interested, or have questions, or are considering enrolling, write, wire, or telephone:

computers and automation

COMPUTER-ASSISTED INSTRUCTION CENTER, 815 Washington St., Newtonville, Mass. 02160 (617) 332-5453

WORLDWIDE

REPORT FROM GREAT BRITAIN

Parliament — and ICL

In 44 closely-packed pages, Parliament's thoughts are available to anyone who wishes to follow blow by blow a classic example of how that august body, truly the mother of parliaments elsewhere, slowly and cautiously moves up towards the brink of any unpleasant decision — in this case the one to spend money on taking a share in and further money to support research and development in the single UK group building business and scientific computers — International Computers Limited (ICL).

The matter had to go before Parliament. It was the first industrial investment scheme to be made by ubiquitous Ministry of Technology under the hotly-contested Industrial Expansion Act. It allows the Government, through the latter Ministry, to do something which has long been cherished as an advanced political thought by a number of bright young Socialist thinkers — to directly participate in industry both monetarily and by the physical presence of a Government director or directors.

I cannot take the readers through all the convolutions of the debate, but there were some goodies for the computer-watching fraternity to mumble over as they sat at their typewriters. One was that from the dawn of time till just before the Government action to bring together ICT and English Electric, Government support to the "British" industry — defined as owned, directed from and researched into in the UK — was a measly $80m. Another was the claim by the Minister himself that, while the U.S. computer advance had been secured as a by-product of vast expenditure on war and space, "we are doing it in a much more cost-effective way. It is not a by-product of expenditure on other projects which might not justify themselves. We are going directly to the heart of the matter, which is money for computers . . . ."

American Companies in Britain

The issue of American companies operating in Britain was raised, and while not directly and deliberately dodged, nothing hard and fast on what would be done by the Ministry in those instances where a British product from the merged and Government-backed company was competing with a cheaper and more effective product from a British-based U.S. company was forthcoming. Admittedly, it is a delicate topic. On the one hand, through the Ministry, the Government will be handing out cash till past the end of the decade to its protégé. On the other hand, one of its organizations, the Computer Advisory Unit, will be handing out advice primarily to Government-controlled organisations — but also to many others — on what choice to make between competing tenders. Even if there are only two of these one must come from a U.S.-controlled company. See the problem? The Minister will have a large say in the route research and development will take over the next several years. Since he is spending so much taxpayers' money on it, how can one of his organisations turn around and hold its nose at a product which has resulted from all this activity?

Criteria for Selection

An attempt was made in the debate to find out the criteria for selection. It was stated on both sides of the House by official spokesmen that it "would be wrong to bring in the equivalent of a Buy American Act and put forward a precise formula under which a British machine will be bought as against a foreign one." But this is precisely what overseas companies trading in Britain want to know, and surely it would be elementary justice to tell the IBMs, Honeywells and Burroughses of this world what the weightings were going to be.

The Joint Parliamentary Secretary to the Ministry, Dr. Jeremy Bray (who must be unique in the Government since he not only knows a good deal about computer techniques but has also participated in the development of an extremely advanced optimisation system for on-line process control by computer) told the House that the Government policy still was to try to purchase computers made in Britain, whether by British firms or by British subsidiaries of foreign firms. He added a number of criteria which must weigh in any judgement: price, performance, delivery date, company performance on previous orders, type of equipment so far provided, and so on. Also in the balance would be ownership of the company, where the design was carried out, proportion of British components, and the value added of the hardware which represented work in Britain. Dr. Bray denied that there was more ill-feeling in public procurement of computers than procurement elsewhere. In a subsequent conversation with him I gathered that he thinks, as I do, that much of the "we wuz robbed" talk of the past few years has been public-relations inspired.

Be that as it may, I still believe that every foreign company which has set up or might set up a manufacturing and marketing operation in Britain should know exactly where it stands as regards testing the Government and semi-Government markets. That is asking a lot of Parliament and the UK company, but it is important since the action taken will inevitably shape events in Europe — mark that Philips has reached a tacit understanding that it will not compete in Britain with its new machines.

Ted Schoeters
Stanmore, Middlesex
England

CALENDAR OF COMING EVENTS

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

Sept. 9-13, 1968: Joint Fall Conference of the UNIVAC Users Association and the UNIVAC Scientific Exchange, The Shamrock Hilton Hotel, Houston, Tex.; contact Robert H. Beaton, Neisner Bros., Inc., 49 East Ave., Rochester, N.Y. 14604

Sept. 16-18, 1968: International Symposium on Analogue and Hybrid Computation applied to Nuclear Energy, Versailles Palais des Congrès, Versailles, France; contact Claude Caillet, Centre D'Études Nucléaires de Saclay, Boite Postale No 2, Gif-sur-Yvette (Seine-et-Oise), France

Sept. 19-21, 1968: Symposium on the Use of Computers in Clinical Medicine, School of Medicine, State University of New York, Buffalo, N.Y.; contact Dr. E. R. Gabrieli, Clinical Information Ctre., Edward J. Meyer Memorial Hospital, 462 Grider St., Buffalo, N.Y. 14215

Sept. 22-25, 1968: Fourth National Annual Meeting and Equipment Show of the Data Systems Div. of the Assoc. of American Railroads, Pick Congress Hotel, Chicago, Ill.; contact Frank Masters, Trade Assoc. Inc., 5151 Wisc. Ave., N.W., Washington, D.C. 20016

Sept. 23-25, 1968: Journées Internationales de l'Informatique et de l'Automatisme, Palace of Congress, Versailles, France; contact Commissariat Général, Dr. Jacques Paul Noel, 37, Avenue Paul Doumer, Paris 16ème, France

Oct. 3-4, 1968: Second Annual PL/I Forum, State University of New York at Buffalo Campus, Buffalo, N.Y.; contact R. F. Rosin, Computer Science Dept., SUNY, 4250 Ridge Lea Rd., Amherst, N.Y. 14226 **before Sept. 1, 1968**

Oct. 6-10, 1969: Second International Congress on Project Planning by Network Analysis, INTERNET 1969, International Congress Centre RAI, Amsterdam, the Netherlands; contact Local Secretariat, c/o Holland Organizing Centre, 16 Lange Voorhout, The Hague, the Netherlands

Oct. 7-8, 1968: Association for Computing Machinery (ACM) Workshop on Microprogramming, Bedford, Mass.; contact Thomas L. Connors, Mitre Corp., P.O. Box 208, Bedford, Mass. 01730

Oct. 14-16, 1968: System Science & Cybernetics Conference, Towne House, San Francisco, Calif.; contact Hugh Mays, Fairchild Semi-conductor R & D Labs., 4001 Junipero Serra Blvd., Palo Alto, Calif. 94304

Oct. 15-17, 1968: Switching & Automata Theory Symposium, Rensselaer Polytechnic Inst., Schenectady, N.Y.; contact S. B. Akers, Jr., Elec. Lab., General Electric Co., Syracuse, N.Y. 12301

Oct. 18, 1968: Annual ACM Symposium on "The Application of Computers to the Problems of Urban Society", New York Hilton Hotel, New York, N. Y.; contact Justin M. Spring, Computer Methods Corp., 866 Third Ave., New York, N. Y. 10022

Oct. 20-23, 1968: International Systems Meeting, Systems and Procedures Assoc., Chase-Park Plaza Hotel, St. Louis, Mo.; contact Richard L. Irwin, Systems and Procedures Assoc., 24587 Bagley Rd., Cleveland, O. 44138

October 20-24, 1968: American Society for Information Science (formerly American Documentation Institute), 31st Annual Meeting, Sheraton-Columbus Motor Hotel, Columbus, Ohio; contact Gerald O. Plateau, ASIS Convention Chairman, c/o Sheraton-Columbus Motor Hotel, Columbus, Ohio

Oct. 28-30: Seventh Computer Workshop for Civil Engineers, Purdue Univ. School of Civil Engineering, Lafayette, Ind.; contact Prof. A. D. M. Lewis, Purdue Univ., Lafayette, Ind. 47907

Oct. 28-31, 1968: Users of Automatic Information Display Equipment (UAIDE) Annual Meeting, Del Webb Towne-house, San Francisco, Calif.; contact Ellen Williams, NASA/Marshall Space Flight Center, Huntsville, Ala. 35812

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

Nov. 17-21, 1968: Engineering in Medicine & Biology Conference, Shamrock Hilton Hotel, Houston, Texas; contact not yet available.

Dec. 2-3, 1968: Second Conference on Applications of Simulation (SHARE/ACM/IEEE/SCI), Hotel Roosevelt, New York, N.Y.; contact Ralph Layer, Association for Computing Machinery, 211 East 43 St., New York, N.Y. 10017

Dec. 2-4, 1968: Applications of Simulation Conference, Roosevelt Hotel, New York, N.Y.; contact Arnold Ockene, IBM, 112 E. Post Rd., White Plains, N.Y. 10601

Dec. 9-11, 1968: Fall Joint Computer Conference, Civic Auditorium (Program sessions), Brookshall (industrial and education exhibits), San Francisco Civic Center, San Francisco, Calif.; contact Dr. William H. Davidow, General Chairman, 395 Page Mill Rd., Palo Alto, Calif. 94306

Dec. 16-18, 1968: Adaptive Processes Symposium, Univ. of California at L.A., Los Angeles, Calif.; contact J. M. Mendel, Douglas Aircraft Co. Inc., 3000 Ocean Pk. Blvd., Santa Monica, Calif.

Jan. 28-31, 1969: International Symposium on Information Theory, Nevele Country Club, Ellenville, N.Y.; contact David Slepian, Dept. of Transportation, Washington, D.C.

March 24-27, 1969: IEEE International Convention & Exhibition, Coliseum and N.Y. Hilton Hotel, New York, N.Y.; contact IEEE Headquarters, 345 East 47th St., New York, N.Y. 10017

April 15-18, 1969: The Institution of Electrical Engineers and the Institution of Electronic and Radio Engineers Computer Aided Design Conference, Southampton University, So 9, 5 NH., Hampshire, England; contact Conference Dept., IEE, Savoy Place, London, W.C.2

May 14-16, 1969: Spring Joint Computer Conference, War Memorial Auditorium, Boston, Mass.; contact American Federation for Information Processing (AFIPS), 345 E. 47th St., New York, N.Y. 10017

May 18-21, 1969: Power Industry Computer Application Conference, Brown Palace Hotel, Denver, Colorado; contact W. D. Trudgen, General Electric Co., 2255 W. Desert Cove Rd., P.O. Box 2918, Phoenix, Ariz. 85002

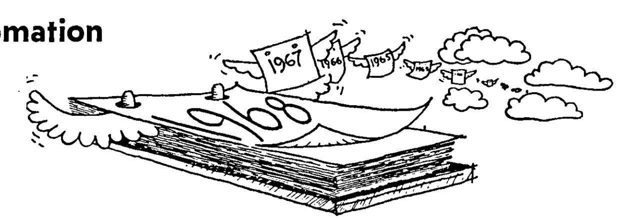
June 16-21, 1969: Fourth Congress of the International Federation of Automatic Control (IFAC), Warsaw, Poland; contact Organizing Comm. of the 4th IFAC Congress, P.O. Box 903, Czackiego 3/5, Warsaw 1, Poland.

Aug. 6-8, 1969: Joint Automatic Control Conference, Univ. of Colorado, Boulder, Colorado; contact unknown at this time.

Aug. 11-15, 1969: Australian Computer Society, Fourth Australian Computer Conference, Adelaide Univ., Adelaide, South Australia; contact Dr. G. W. Hill, Prog. Comm. Chrmn., A.C.C.69, C/-C.S.I.R.O., Computing Science Bldg., Univ. of Adelaide, Adelaide, S. Australia 5000.

Oct. 27-31, 1969: Business Equipment Manufacturers Assoc. (BEMA) Annual Business Equipment Exposition and Management Conference, New York Coliseum, Columbus Circle, New York, N.Y. 10023; contact Laurance C. Messick, Business Equipment Manufacturers Assoc., 235 East 42nd St., New York, N.Y. 10017

Nov. 18-20, 1969: Fall Joint Computer Conference, Convention Hall, Las Vegas, Nev.; contact American Federation for Information Processing (AFIPS), 345 E. 47th St., New York, N.Y. 10017



Computers in the Factory (Part 2)

Reprinted from Vol. 2, No. 7 — October, 1953

David W. Brown
Ultrasonic Corp.
Cambridge, Mass.

Simple digital machine controls may be economically desirable when one programmed computer may prepare input data for many machine tools. Some inconvenience may result if the data must be prepared and used at widely separated locations, but this problem becomes small if the machine tool can be operated a long time with each set of programmed data. On the other hand, in certain classes of job-shop work, such as tool-making, it is exceptional to make more than one or two parts to the same specification. Whenever parts are made on such a basis, it is apparent that a large amount of specification data must be prepared, and economy dictates that the cost of data preparation must be kept as low as possible. In such a case, a considerable amount of computer apparatus within the control itself is justified. A digital machine control suited to very small lots, then, tends to require only a minimum of input data, supplying whatever additional information it needs by means of its own built-in computing equipment.

The M.I.T. Servomechanisms Laboratory, working under the sponsorship of the Air Materiel Command of the U.S. Air Force, has developed a control system of this type for a vertical spindle milling machine. By means of this development, M.I.T. sought to study and to demonstrate the application of digital control techniques to certain problems of die-sinking and forging-finishing which are common in the aircraft industry.

The M.I.T. device controls all three slides of the milling machine. For each straightline motion of the milling cutter, the distance to be traveled is broken into x, y and z components. Input data for each motion consists of three component distances, punched in tape in binary form, plus a coded number representing the time allowed to complete the motion. Having sensed this data, the control apparatus performs first order interpolation. By means of a frequency dividing network, a series of command pulses are sent out representing x, y and z motions. Each pulse represents a movement of one half-thousandth of an inch. These commands are such that if executed without error, they would cause the x, y and z machine slides to move in coordination so as to reproduce the required tool motion at the required rate, never deviating from a straight line by more than half a ten thousandth of an inch. It is evident that the output of the interpolator in the M.I.T. device is information in a form very similar to that of the inputs in the Daco, Bell and Cunningham controls.

In the M.I.T. control, digital summing registers are also used to derive continuously the difference between the number of command pulses received from the interpolator and the number of similar pulses received from devices measuring actual motion of the machine. The computed differences are converted to analog voltages which serve as the error signal inputs to the machine drive servos. It is significant that this method of control postpones conversion to analog data-handling as long as possible. The percentage errors characteristic of analog components are applied only to the servo error, which is a very small fraction of an inch, rather than to the total travel of the machine, which is as much as sixty inches. A high order of precision is thus made possible.

A digital machine control capable of third order interpolation has been built by the Lewis Flight Propulsion Laboratory of the N.A.C.A. This control, which operates a milling machine, was devised to meet the Laboratory's continuing need for a wide variety of precisely made experimental turbine blades. For each blade cross-section, the position of the center of the milling cutter is specified in polar coordinates at about fifty points around the blade. The function of the control unit is to drive the milling cutter in a path which connects these points in a smooth curve. (If first order interpolation were used, as in the M.I.T. system, the points would be connected by straight lines, and the resultant blade shape would be a polygon.) In order to achieve a smooth curve, a high order of interpolation is necessary. Interpolation is accomplished by using three precision Kelvin-type ball-disc integrators to generate an interpolation polynomial, the constants of which may be expressed in terms of the fourth differences of the specified polar radii. The interpolating process is said to contribute an accumulated error of about a tenth of a percent for a full interpolation cycle. The output shaft of the interpolator provides an analog command signal for a servomechanism which drives the machine tool.

What do controls like these cost? No prices have been set, but those who have gained experience with experimental units are willing to make estimates. Made today in very small quantities, a single-motion positioning control, the simplest of digital input devices, might sell for about $5,000. A more elaborate unit, like a two-motion continuous interpolating control, might run around $25,000. These prices, furthermore, do not take into account the cost of developing a prototype unit of each type, a cost which should amount to at least three times the cost of the first duplicate unit.

The inclusion of a computer control at least doubles the price of a machine tool. There is no reason to doubt that experience will eventually reveal short-cuts and production techniques through which the price of computer controls

Part 1 of this article appeared in the July 1968 issue.

can be reduced. Certainly this has been the case with other electrical products. In the meantime, however, manufacturers of computer controls must search for applications where the abilities of the computer are worth enough to make the computer pay for itself quickly at today's prices.

Surprisingly, a number of such applications have already been found. As the list of existing control units would suggest, the most successful applications seem to involve the accurate machining of small numbers of intricate parts. Work completed at M.I.T. for example, suggests that computer controls could radically reduce the cost of milling certain steel and aluminum forgings included in current military aircraft. One manufacturer of precision cams estimates that computer control will reduce his cam engineering costs by as much as 30%, and production costs by as much as 50%. A large electronics manufacturer has built his own card-operated punch press for about $20,000 and expects to write his investment off in less than five years.

These experiences, plus increasing interest of all industries in automatic production, have caused both machinery and electronics manufacturers to devote more and more attention to computer controls. Although the machine tool industry is inclined to be highly secretive about new product developments, there are some hints of the extensive activity now taking place. At least two machine tool builders have constructed prototype computer controls in their own laboratories, and others have done some work on components. At least four other machine tool builders have contracted with outside suppliers or educational institutions for design study work in this field, and a number of potential users of computer controls have contemplated similar steps. In addition, many manufacturers of computers have undertaken design and developmental work in the machine tool field. Among these are Arma Corp., Beckman Instrument Company, General Electric Company, Hillyer Instrument Company, Hughes Aircraft Corporation, Sperry Corporation, and Ultrasonic Cooperation.

The knowledge which will result from this activity is sure to accelerate the introduction of computers to the metalworking shop. As the capabilities and limitations of computer controls become more widely known, manufacturers will become aware of the savings that can be made by use of such equipment in their own shops. In similar fashion, computer builders will learn to spot those applications which will be most profitable to the user. As soon as a sufficiently broad application is found for computer control, the economies of high production will make themselves felt, and the cost of the computers will fall to levels comparable with those of conventional control equipment. Low cost in itself will encourage further sales, and computers will tend to become standard shop equipment.

Fully automatic factories are, of course, the objective of every builder of computer controls. That goal is still very far away, but the road to it is now mapped.

C.a

PROBLEM CORNER

PROBLEM 688: DIFFERENT DIFFERENCES

"I wish we didn't have to be so economical with storage," said Charlie, shaking his head. "Then I could leave room for everything even though a lot of locations would end up empty."

Dan looked up from the sheets he was working on. "This is a tight program and we can't be extravagant. I have to lay out these triangular matrices in a line so that there won't be any blanks. What part of the program are you working on?"

"You know where these values come in as ten-bit numbers? Well, each one has to be subtracted from the number with these bits written in reverse order and a count of these differences made. I have to set up a register for each difference and add one every time that difference occurs."

"Well, we're not so strapped for storage." Dan tried to sound a little hopeful. "If you think only a few will go to waste why not make provision for everything?"

"No." Charlie replied glumly. "There are over a thousand possible differences. Fortunately we don't have to worry about signs; we can just use the numerical value. But I don't think more than a small percentage of these differences can actually occur."

What is the total number of differences that can occur?

Solution to Problem 687: Coffee and Pi

The instructions read: $X = Y + 1$, $Y = X + 1$. This leads to $Z = 2 \dfrac{2 \cdot 2 \cdot 4 \cdot 4 \cdot 6}{1 \cdot 3 \cdot 3 \cdot 5 \cdot 5} \ldots$ which approaches π.

Our thanks to Oddbjørn Gunnes, Oslo, Norway, and Ady Tzidon, Lod Airport, Israel, who also spotted an omission in our answer to Problem 684: A Conversion Trick (See page 42 in last month's issue.)

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

ACROSS THE EDITOR'S DESK

Computing and Data Processing Newsletter

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APPLICATIONS

ARIZONA "PROSPECTOR" USES IBM COMPUTER TO SEARCH GLOBE FOR PRECIOUS METALS

A modern-day prospector, mining consultant Richard F. Hewlett of Tucson, Ariz., is using a pair of IBM computers to search for copper, lead, silver and gold around the world. His firm is probably the first consultant service of its kind to have its own computers — desk-size IBM 1130 systems. His work ranges from ore reserve estimation to property evaluation, mine design and production scheduling to process control.

Mr. Hewlett and his associates are asked by both U.S. and foreign mining companies to help determine whether a potential mine will be profitable or whether an existing mine is worth expansion. His preparation of IBM computer analyses may result in the explosion of tons of dynamite on a mountain in Peru, in bringing to life a mining ghost town in New Mexico or in expanding a gold mine in South Africa.

"What we do, in effect, is recreate the land formation and potential mine — in our computers — in three dimensions," said Mr. Hewlett. "We develop a mathematical model from all available data gathered from historical records, test drillings, instrument analyses and aerial surveys at the exploration site. With the data we can help determine if an area will be worth mining in relation to the enormous actual costs that would be involved."

Financial analysis programs guide the computer as it weighs the many factors involved in a successful mining venture. Once the geophysical data have been reduced to numerical form, the computer also can manipulate the information to provide automatically plotted charts and graphs for on-site personnel.

COMPUTERS CREATE ELECTRONIC OCEAN AT HONEYWELL LAB

A bounding main on computer tape may lead to the development of a revolutionary type of ship that can maneuver with almost as much versatility as a helicopter. Such a ship would not be limited to only forward and backward movement, but also would be able to move sideways, turn in circles in its own diameter and hover in a fixed position. In addition, it could travel on an exact track through rough waters.

The imaginary sea that might be used for studying this new vessel concept is a paper ocean on which marine engineers sail paper ships — ranging from 800 to 40,000 tons. This computerized ocean — which has waves, currents, water forces and winds — is one of the main developments of the new dynamic simulation facility at Honeywell's Marine Systems Center (MSC), West Covina, Calif. It will be the test bed for unique engineering design problems.

"The so-called 'paper sea' is a model test basin created with electronics, but its experimental possibilities are much greater than the test tank in which physical models are towed," said Arnold Klimke, director of engineering at MSC. "We can obtain and work with data that hasn't existed before, hence our simulations will be unique."

The facility consists of analog computer systems with recorders and plotters and a Honeywell DDP-124 general purpose digital computer. The computers are used to develop new designs for such things as special purpose ships, barges and semi-submersible drilling platforms, as well as missiles, torpedoes, anti-submarine warfare (ASW) training systems and fire control systems for the U.S. Navy.

WAR ON CREDIT CARD FRAUD ASSISTED BY COMPUTER

At American Express Credit Card Division headquarters in New York, a computer is combating fraudulent and abusive use of credit cards by automatically answering telephone inquiries from airlines, restaurants, hotels, shops, and other businesses. An IBM System/360 Model 40 computer 'remembers' details on over two million credit card accounts — including account numbers of lost, stolen and cancelled cards — and can supply information on a specific account in seconds.

Under this new system, when credit authorization is required or desirable, the firm contacts the computer in New York by means of a Touch-Tone Card Dialer telephone. An employee first inserts special dialing cards which signal the computer and identify his place of business. Then, using the push buttons on the phone, he transmits the credit card account number and the amount of the transaction. The computer either gives verbal credit

— At Kenny's Steak Pub in midtown Manhattan, manager John Allan uses a Card Dialer telephone to contact an IBM computer at American Express headquarters

approval immediately or, in doubtful cases, transfers the call to a "credit authorizer," at the same time displaying the account record for him on a display screen.

The new system protects the cardmember, the business establishment and the Company. In addition to being a major weapon against fraud, the new system gives American Express much better control over delinquent accounts. Businesses which do not have the Card Dialer phones installed can relay their queries to the computer through an American Express telephone operator.

PORTLAND ENGINEERS SEE INTO 21ST CENTURY WITH HELP OF IBM COMPUTER

Portland's (Oregon) department of public works is using an IBM computer to make plans for the 21st century — from the ground up. The department's bureau of design, aided by an IBM 1130 computer, is simulating the growth of Portland's sewer system, block by block, through the year 2000.

The IBM 1130 was primed with a variety of facts before the year-by-year, section-by-section simulation began. Sewer flow measurements were gathered, along with line sizes, roughness of the pipe's interior and grade of each section. Then population and industrial growth — estimated for the various sections of the city — were added in, based on statistics from metropolitan, county, state and national agencies.

With this information as a basis, the city can predict, for example, what impact a proposed factory at a particular location would have on the sewer system or determine in advance the sewer requirements for a builder planning a major development. The simulation is more than two-thirds completed.

Ray Cruden, chief of the bureau of design said that Oregon's largest city is already benefiting from the study. "Many times we're asked to recommend to a planning organization which way sewage should be routed," Mr. Cruden explained. "With the computer we can investigate several alternate plans and determine a course of action that is not only best now, but best for the years to come."

The computer also is aiding on another front — water pollution. Faced with a 1972 state deadline for cleaning up the Willamette River, which runs through downtown Portland, the city has used the 1130 to design systems that will assure proper treatment of sewage before it is piped into the river — and is already ahead of schedule on pollution control.

ALASKAN SURVEYORS USE COMPUTER TO EXPLORE FOR OIL

The F. M. Lindsey Company of Anchorage, Alaska, is using an IBM 1130 computer to help explore and survey an area from Point Barrow, the northernmost outpost of civilization in the United States, down the Alaska Peninsula and across the Aleutian chain. Dense forests, swamps and the unpredictable tides of Cook Inlet or the Gulf of Alaska make conventional methods of surveying virtually impossible.

The computer charts the exact navigation routes Lindsey's airplanes, helicopters and boats must follow to produce surveys assigned by petroleum, mining and construction companies. . It also is being used in such projects as positioning a complex offshore drilling platform from which 32 different wells may be drilled in the often ice-choked Cook Inlet, or for "navigating" the laying of 35 miles of pipeline from an offshore installation to one onshore.

Helicopters often are used to locate drilling sites in remote areas inaccessible by jeep or days away on foot. The firm also uses helicopters to survey ice-bound water areas. Flying to precise

— A helicopter pilot follows computer-prepared flight chart in the search for new oil producing areas high above Alaska's Kenai Peninsula

locations plotted by the computer, the helicopter can hover above the ice and lower instruments through it to survey the sea bottom.

In a seismic survey to explore the bottom composition of Cook Inlet, the computer pre-plots an exact course for a boat over specific portions of the sea bed. Seismic instruments measure and probe the bottom to depths of 10,000 feet in the search for potential oil pools as the boat proceeds along its course. Readings from these and other instruments enable geophysicists to determine locations for possible offshore drilling platforms.

"These techniques compress what normally would require days into a few hours and speed the development of Alaska's new areas," Mr. Lindsey said.

ORGANIZATION NEWS

FIRST PATENT FOR SOFTWARE SORTING SYSTEM GRANTED TO APPLIED DATA RESEARCH

A patent for a sorting system has been granted by the United States Patent Office to Applied Data Research, Inc., Princeton, N.J. It is the first time that the Patent Office has granted patent protection to a computer system embodied in a computer program or software.

For many years patents have been granted for hardware forms of computer systems. However, legislation, which had been introduced in Congress to prevent the patenting of computer programs, had led to doubts that patent protection would be available for the software forms of such computer systems. Recently, this legislation was withdrawn by the Patent Office and the issuance of this patent is the first landmark event that has taken place since the legislation was withdrawn.

The Patent, No. 3,380,029, was filed with the Patent Office in April 1965 and was granted recently. The inventor of the sorting system is Martin A. Goetz, an ADR vice president. The sorting system, described by Mr. Goetz in a paper delivered to the Spring Joint Computer Conference of 1964, uses a read-forward oscillating merge principle for the sorting of information on a computer and could be used with various computers.

Commenting on the significance of this patent event, Richard C. Jones, ADR president and a longtime spokesman for software patent protection, said that the "Patent Office's action indicates that software systems and programs are entitled to patent protection in much the same way as computer hardware. A computer system is patentable whether in the form of software or hardware and whether made by a software company or a hardware company. The issuance of a software system patent is another milestone in the coming to maturity of the software industry."

CONTROL DATA AND SWEDISH FIRM SIGN SCANDINAVIAN TRADE PACT

Control Data Corporation, Minneapolis, Minn. and ASEA of Vasteras, Sweden, have signed a trade agreement concerning a line of Control Data Computers and Peripheral Equipment.

The agreement gives the Swedish firm exclusive rights to market Control Data 1700 series computer systems and associated peripheral equipment, such as tape transports, cathode-ray tube devices and high-speed printers, in Scandinavia.

Under terms of the new contract, ASEA may also sell Control Data series 1700 computer systems and associated peripheral equipment in the world market on a non-exclusive basis.

ASEA is a world-renowned group of companies with a product program covering equipment for generation, transmission and industrial applications of electric power. Control Data is maker of a complete line of computers and peripheral equipment for use in business, science, education and industry.

COURANT INSTITUTE AT NEW YORK UNIV. TIES 3 INSTITUTIONS TO ITS CDC 6600

New York University's Courant Institute of Mathematical Sciences is operating telephone links with three institutions in Texas, Illinois and New York that give those institutions direct access to the Institute's Control Data Corporation 6600 computer. The institutions now tied into the system by Data-Phone are the Southwest Center for Advanced Studies in Dallas, Texas; the National Accelerator Laboratory, Weston, Ill.; and Renselaer Polytechnic Institute in Troy, N.Y. By fall the system is expected to be capable of handling 16 remote users.

To interpret and handle the remote transmissions, Courant researchers developed advanced multiplexer equipment and computer programs that make the system compatible with any computer or card reader-printer equipment. Work is handled on a remote batch basis.

The Institute is a major computing center for the U.S. Atomic Energy Commission and as such serves more than 100 institutions doing A.E.C.-authorized basic research. Most of these send researchers directly to the Institute for computing work, but the remote links now give distant reserachers full access to the computing facility from their home institutions.

ITEK, SCIONICS AGREE TO MERGE

Itek Corporation of Lexington, Mass. and The Scionics Corporation of Los Angeles, Calif., have agreed in principle to the merger of Scionics into Itek. The announcement was made by John R. Thorne, President of Scionics and Robert B. Wolf, President of Itek's Business Products Division (IBP).

Scionics manufactures and distributes microfilm aperture card equipment, and operates service centers for production of microfilm aperture cards and copy cards.

Prior to the merger, the Scionics' Instrument division will be transferred to a new corporation which will operate under the name "Scionics, Inc.," in areas not related to the microfilm aperture card field. After the merger, the microfilm aperture card and copy card business will be continued by the Business Products Division of Itek.

NCR ACQUIRES ARGENTINE BUSINESS MACHINE COMPANY

The National Cash Register Co. (Dayton, Ohio) is expanding its manufacturing and marketing operations in South America by acquiring the majority interest in an Argentine business machines company.

The company, Ultra Argentina Sociedad Anonima Industrial y Commercial, is located in Buenos Aires. NCR has purchased the 90% interest in the company formerly held by Swiss and Argentine stockholders. The remaining 10% will continue to be held by Raul Carlos Ferraro, an Argentine who has been an officer of the firm and who will remain a board member.

George Haynes, NCR vice president and group executive, International Operations, said the acquisition was effected "in the spirit of the Latin American Free Trade Association". He pointed out that NCR now will have manufacturing facilities in three important LAFTA countries (Brazil and Mexico in addition to Argentina) and will benefit as freer trade arrangements in South America evolve. The three factories will complement each other's production.

WORLEY & RINGE, INC. PROVIDE PHYSICIAN-ORIENTED COMPUTER APPLICATIONS

Thomas B. K. Ringe, Jr., has announced the formation of Worley & Ringe, Inc., Philadelphia, Pa. The new corporation, known as WRI, is devoted exclusively to medical computer systems design and application programming.

WRI provides medical research computer systems that instantly transmit all desired research data. Traditional time lags in medical, hospital, and drug research have been eliminated by using "on line" cathode-ray tube (CRT) video display systems, newly developed by General Electric, RCA, IBM, Sanders Associates, Inc., and others. The new WRI research systems offer both instant data display and the ability to make any necessary changes immediately

Founder and President of the new firm is William E. Worley, M.D., formerly assistant Director of Medical Research for Merck Sharp & Dohme Research Laboratories, West Point, Pa., where he actively engaged in medical computer applications. Dr. Worley, considered a medical computer expert by colleages, is an authority on systems design and application programming of medical research data.

GRAPHTEK CORPORATION — NEW SOFTWARE FIRM

Graphtek Corporation, a new software firm, has been formed recently with its headquarters in Phoenix, Arizona. The founders are Dr. Marvin T. Ling (formerly with General Electric's Advanced Systems and Technology Operation in charge of development of Graphic Display Systems for Man-Machine Communication) and Mr. Walter F. Cook (previously Manager, GE 600 Time Sharing of General Electric's Large Systems Department in Phoenix).

The company will specialize in the development of computer graphics software for individual customer applications. Graphtek provides the full range of software support from system studies, conceptual design through implementation, documentation and maintenance.

Specifically, Graphtek Corporation offers services in such areas as development of generalized basic graphic display systems, computer aided design, systems simulation, remote and/or interactive APT for numerical control, design automation, dynamic management information system, and many others where improved methods of design or problem solving may be accomplished by Man-Machine interactions using CRT display with light pen type of devices.

Newsletter

EDUCATION NEWS

NCR SEMINARS ON AUTOMATED RECORD HANDLING FOR CATHOLIC SCHOOLS

Seminars designed to help the nation's Catholic schools automate the handling of records are being conducted in eight archdiocesan cities by the National Cash Register Company. The day-long NCR sessions are in cooperation with the National Catholic Educational Association, which recently received a $60,800 Ford Foundation grant for the introduction of long-range planning techniques into the church's elementary and secondary schools.

The objective of the program is to provide Catholic schools with working tools which will aid them in their financial planning activities. An initial group of 100 selected persons is being trained. These, in turn, will introduce the techniques to other schools. Trainees are being introduced to the mechanization and computerization possibilities of school planning by J. E. Nettles, special representative of the Educational Systems Division of NCR.

REGIONAL COMPUTING CENTER ESTABLISHED AT CARNEGIE-MELLON INSTITUTE

Area students from the grade school level through graduate school will have access to one of the country's most complete computation centers as a result of the establishment of a Regional Computing Center at Carnegie-Mellon University, Pittsburg, Pa. The Center has been funded by a two-year grant of about $525,000 from the National Science Foundation. In addition, the participating institutions and Carnegie-Mellon will provide support amounting to another $357,000 over the two year period. The Center officially began activities on July 1, 1968.

The Regional Computing Center has its own administrative staff headed by Thomas P. Cunningham, who has been manager of user relations at Carnegie-Mellon's Computation Center. The purpose of the new Center is to provide an opportunity for "hands-on" experience in using the computer for faculty members and students at ten area colleges and universities and seven secondary schools and school districts in Western Pennsylvania and West Virginia. Under the terms of the grant, the seventeen participating organizations will each have at least one remote device connected to the CMU Computation Center's UNIVAC 1108 computer. Most of the devices will be remote teletypes connected to the 1108 by telephone lines.

While it is expected that many of the students will have to be taught computer languages and programming techniques, the goal of the project is to have them use the computer for classroom problems in mathematics, the natural sciences, and the social sciences, while gaining a working knowledge and realization of the role of the computer in modern society. College students at the undergraduate and graduate level also will be able to use the 1108 as part of research projects.

NEW PRODUCTS

Digital

LEEDS & NORTHRUP LN5000 DIGITAL COMPUTER SYSTEM FOR PROCESS CONTROL

The most recent addition in the field of third-generation process-computer systems is the new LN5000 Digital Computer System recently introduced by the Leeds & Northrup Company, North Wales, Pa. Applications for the LN5000 system are in direct digital control of processes, process monitoring and alarm logging, automatic start-up and shut-down of production units, and industrial data processing.

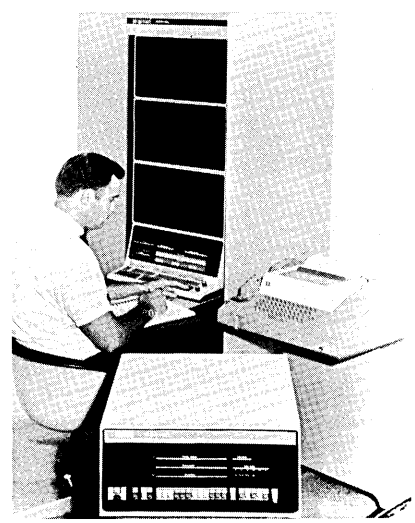
This real-time, on-line computer system, offers multi-programming capability which allows the computer to operate on process control (foreground) programs while, at the same time, it is operating on general-purpose programs in the lower-priority background.

The LN5000 has a comprehensive library of process-oriented software in addition to general-purpose software. Special purpose programs include a language for steam-power plants, software for electric-power transmission and distribution, and a Control Diagram Language (CODIL) for process applications which allows the customer's own process engineers to assemble a complete control program directly from a block diagram of the process.

With the LN5000 hardware, less than one microsecond is required for full memory cycle in the mainframe. Input/output equipment scans analog inputs at a rate of up to 1000 points per second, accepts digital inputs at a rate of 2,000,000 points per second. Accuracy is 0.1% of full scale at the 3 sigma variance limits.
(For more information, designate #41 on the Reader Service Card.)

DIGITAL EQUIPMENT ANNOUNCES TWO NEW LOW-COST COMPUTERS, PDP-8/L AND PDP-9/L

Two new low-cost computers, introduced by Digital Equipment Corporation, Maynard, Mass., are aimed at a $200-million computer market in a half-dozen selected industries, including the OEM market and end users in education, research, instrumentation and numerical control. The PDP-8/L, an $8,500, 12-bit computer and the PDP-9/L, a $19,900 18-bit system are smaller versions of the PDP-8/I and PDP-9.



— Both the PDP-8/L (foreground) and the PDP-9/L computers are equipped with ASR Teletype devices

The systems have basic core memories of 4K words, expandable in the 8/L to 8K and in the 9/L to 32K. The PDP-8/L has a 1.6 usec cycle time; it accepts software identical to that of the 8/I including

FORTRAN and DEC's recently announced conversational language, FOCAL.

The basic 9/L has a 1.5 usec cycle time and a new Compact Software System consisting of assembler, debugging routines, Editor, Math Package and Utility Programs. Expanded to 8K and larger, the 9/L will accept all PDP-9 software and most of its hardware.

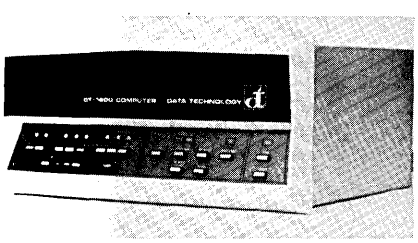
First deliveries for both systems are scheduled for October. (For more information, designate #42 on the Reader Service Card.)

DT-1600 — LOW COST GENERAL PURPOSE COMPUTER ANNOUNCED BY DATA TECHNOLOGY

Data Technology Corporation, Mountain View, Calif., has entered the small, general purpose digital computer field with its first machine, the DT-1600. The computer has all IC digital circuitry, 17,000 MTBF (Mean Time Between Failure), 8 bits word size and 4K memory (expandable to 16K). Memory cycle time was designed at 8 usec to eliminate critical pulse timing problems, especially when communicating with peripheral devices. (The DT-1600 interfaces with a wide range of peripheral devices.)

The machine's modular construction allows user replacement of any card (including the memory stack) without special circuit tuning. Virtually all circuitry contained is on seven plug-in PC cards.

The set of 73 instructions (the majority of the frequently used are only 8 bits long) are optimized to make input/output and test-and-branch operations flexible, efficient, and easy-to-use.



The DT-1600 measures 8-3/4 x 17 x 22", weighs 28 pounds, and costs $6,600 (fob Mountain View), including complete software. It is suited for real-time control functions such as data acquisition, process control, machine tool control, automatic test and inspection, and medical data monitoring/processing.
(For more information, designate #43 on the Reader Service Card.)

Special Purpose Systems

EXHAUST GAS DATA ACQUISITION AND REDUCTION SYSTEMS

A new computer system, developed by General Motors Corporation at its GM Technical Center, Warren, Mich., is being manufactured by Applied Dynamics of Ann Arbor. The units are called Exhaust Gas Data Acquisition and Reduction Systems. These systems provide automotive engineers working on air pollution control with fast and accurate information concerning the effect of changes in engine design, carburetor adjustment and other factors which affect the production of noxious gases from automobiles.

Standardized tests of air pollutants now are required of all automobile manufacturers by several states and the federal government. The new machine, Applied Dynamics reports, accomplishes nearly instantaneously what previously required as much as 10 man-hours of labor. In addition, errors in calculation have been eliminated. The machine prints all results as the test progresses, providing immediate information to the engineer and designer.

The systems, now in use in twelve locations, have proved economical and reliable, and are contributing to the reduction of air pollution by automobiles.
(For more information, designate #45 on the Reader Service Card.)

FOTOTRONIC-CRT TYPESETTER

Harris-Intertype Corporation, Cleveland, Ohio, has released its cathode ray tube phototypesetting system for commercial marketing. The computer-driven system, named "Fototronic-CRT" typesetter, composes pages of type by photographing characters generated on the face of a high-resolution cathode ray tube. In disclosing details of the machine, the company said it was designed primarily to meet printing and publishing requirements, and secondarily as an improved printout device for computers.

The Harris-Intertype system is basically an "area composition" device. Magazine, book or directory pages can be composed at the rate of two to ten per minute, depending on size and complexity of the page.

The speed with which individual type characters can be generated is determined by the size of type being set. Typical 7-point directory type, of graphic arts quality, can be set at the rate of 1,100 characters per second. Smaller type can be set considerably faster, larger type proportionately slower.

The machine is designed to be used with computers made by any major manufacturer. It produces type on either film or photo paper, in sizes from 4-point to 24-point, or larger if required. Maximum image width for various models ranges from 8½ inches to 16 inches. A built-in digital memory system provides access to as many as 40 different faces of type, or approximately 4,000 characters. These faces can be electronically manipulated to produce condensed, expanded or slanted faces.

Harris-Intertype expects principal users of the Fototronic-CRT system to be computer-oriented, high-volume producers of full-page composition.
(For more information, designate #44 on the Reader Service Card.)

Memories

MDM-X DIGITAL COMPUTER MEMORY

Infotechnics, Inc., Van Nuys, Calif., has announced a new series of inexpensive, random access computer memories. This series, known as MDM-X, uses rigid magnetic discs as a storage medium. The device provides an on-line storage capacity of up to 25 million bits with a maximum access time of 25 milliseconds per head.

A dominant feature of the machine is the ability to use two magnetic heads per disc surface, or a maximum of four independently moving heads per disc. From this point of view, the effective maximum access time can be reduced by a factor of two.

The magnetic disc is contained in a protective cassette which also serves as an interchangeable loading cartridge. The cassettes are flat, and can be conveniently stacked while off-line.

All machines in the MDM-X Memory Series are provided in the form of a desk-top cabinet and include the following: 1) one disc handling mechanism, 2) random access head positioners, 3) all necessary power supplies and 4) the electronics to service the motion of the positioners and the flow of information. The MDM-X also can be furnished without the cabinet in order to be mounted on a standard 19-inch rack.
(For more information, designate #46 on the Reader Service Card.)

SS/30 SMALL STORE MEMORY AVAILABLE FROM VARIAN DATA MACHINES

Varian Data Machines' (Irvine, Calif.) new SS/30 small store, low cost memory is a 4-wire coincident current core memory. It is only 8-5/8 inches wide, 3-1/4 inches high, and 13 inches deep. The SS/30 has 2.4 microseconds full cycle time, storage capacity of 512 or 1024 words with word lengths of 8 and 16 bits. Word lengths of 4 and 12 bits also are available as an option.

The system provides operation modes of full cycle (clear/write and read/restore) as well as read-modify-write (or split cycle), and half cycle of read only and write only. Other features are buffered single rail address inputs and 600 nanosecond access time.
(For more information, designate #47 on the Reader Service Card.)

MEDIUM-SCALE INTEGRATED CIRCUIT LOGIC FEATURED IN NEW MAGNAFILE DRUM MEMORY

Medium Scale Integrated (MSI) circuit logic has been utilized by Magnafile, Inc. (Phoenix, Ariz.) in the design of their newest drum memory system; Model 8403, the second announced member of the 8400 head-per-track family, has been specifically designed to meet the data storage requirements for small computer systems. The basic memory configuration is equally adaptable to I/O or Direct Memory Access applications.

Model 8403 provides a 1.1 million bit data base with 64 tracks and an average access time of 8.5 or 17 milliseconds. The new memory has a nickel cobalt recording medium, individual flying heads, and a modular set of completely self-clocked, peak detecting, device-oriented electronics.
(For more information, designate #49 on the Reader Service Card.)

THIRTEEN TRACK FLYING HEAD FOR DISC MEMORIES FROM APPLIED MAGNETICS

A new thirteen track flying magnetic head for disc memories, available from Applied Magnetic Corporation, Goleta, Calif., provides reliable performance at packing densities up to 1300 bits per inch. Track width is .015" spaced on .125" centers. Inductance is 40 microhenries per winding leg and gap length is 200 microinches. External dimensions are: length 1.6" x width .460" x height .350" maximum. Each head is dynamically tested for flight characteristics and operating parameters in specially designed testing stations.
(For more information, designate #48 on the Reader Service Card.)

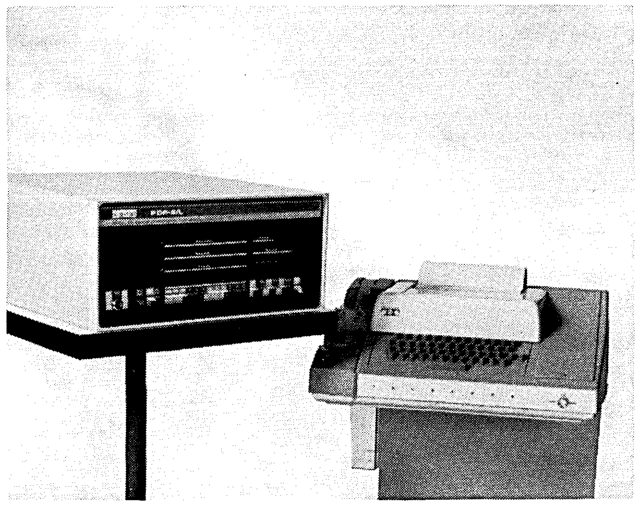
Software

CPA (COMPUTER PROCESSING FOR ACCOUNTANTS) / Computer Resources Corp., Wilton, Conn. / CPA is a COBOL system designed to do cost accounting, general ledger posting, and statement preparation. The system also provides automatic state and federal tax calculations, automatic year-end closing, monthly statements on 8½" x 11" forms, budget analysis, and prior year comparisons. The system is currently operating on IBM System/360 and the Honeywell 200 and can be adapted to most machines with a COBOL compiler.
(For more information, designate #50 on the Reader Service Card.)

GENERAL PURPOSE CONTOURING PROGRAM (GPCP) / California Computer Products, Inc., Anaheim, Calif. / GPCP is a proprietary software product for automatic plotting of the functions of two variables in the form of contour diagrams or maps. It is designed for contouring use in geophysics, geology, meteorology, engineering, biology and medicine. The program is available for a one-time lease charge of $10,000.
(For more information, designate #51 on the Reader Service Card.)

MOD 4 OPERATING SYSTEM / Honeywell Electronic Data Processing, Wellesley Hills, Mass. / Mod 4 is an operating system which can control up to 20 concurrent data processing jobs on an advanced Honeywell Model 4200. The system insures excellent turnaround time through the multi-task processing of each job, such as input reading, job execution, and output writing. Each task is executed independently without being interrupted by other tasks. Memory areas and peripheral devices are scheduled and called into use as they are needed, according to specified priorities. Certain elements of the system also will be available on the Honeywell Model 1250 and 2200 central processors.
(For more information, designate #52 on the Reader Service Card.)

PROMPT (Program Monitoring and Planning Techniques) / Aries Corporation, McLean, Va. / PROMPT, a new computer-based management control package, provides detailed computerized reports, oriented to multiple levels of management. Described as a "fine-tuned" PERT, the basic PROMPT package is written in COBOL and includes a specifically-tailored PROMPT program deck, three instruction manuals, an educational and usage indoctrination course, and technical assistance in setting up and running the program on the user's computer. The package is adapt-



The world's lowest cost, full scale, general purpose computer. $8,500 complete.

PDP-8/L
Complete. With teletype. With software 4096 12-bit words. 1.6 usec cycle time. All integrated circuit. On-line, real-time. Expandable.

PDP-8/L is the latest achievement in the history of a company that introduced the first under-$100,000 computer, the first under-$50,000 computer, the first under-$20,000 computer, the first under-$10,000 computer.

PDP-8/L is based on the family of PDP-8 machines, thousands of which have been sold and delivered — to scientists in laboratories, instrument builders, manufacturers of process control equipment, industrial users who have automated their machinery. The PDP-8 family is, without question, the most successful set of small computers ever built. Bar none.

To those of you who have never used computers before, because of price, write to us. A large part of our background is in introducing people to their first computers. We can be extraordinarily helpful.

To those of you thinking of incorporating a computer in another system, or another instrument, write to us. Quantity discounts are available. And our experience includes selling more computers as built-ins than any other company in the world.

digital
COMPUTERS · MODULES

DIGITAL EQUIPMENT CORPORATION, Maynard, Massachusetts 01754. Telephone: (617) 897-5111 • Cambridge, Mass. • New Haven • Washington, D.C. • Parsippany, Palisades Park, N.J. • Princeton, N.J. • Rochester, N.Y. • Long Island, N.Y. • Philadelphia • Pittsburgh • Cleveland • Dayton • Huntsville • Cocoa, Fla. • Chicago • Denver • Ann Arbor • Salt Lake City • Houston • Albuquerque • Los Angeles • Palo Alto • Seattle. INTERNATIONAL, Carleton Place and Toronto, Ont. • Montreal, Quebec • Edmonton, Alberta, Canada • Reading and Manchester, England • Paris, France • Munich and Cologne, Germany • Oslo, Norway • Stockholm, Sweden • Sydney and West Perth, Australia •

Designate No. 10 on Reader Service Card

able to any computer operation. (For more information, designate #53 on the Reader Service Card.)

RCA DISC OPERATING SYSTEM (DOS) / RCA, New York, N.Y. / RCA's DOS for Spectra 70 customers, has six levels of multiprogramming. DOS is a complete software control system with a full complement of languages — COBOL, FORTRAN 4, Report Program Generator and Assembler. It provides all necessary systems functions. The system requires about half the memory allocation of other disc operating systems of comparable sophistication, working with as little as a 32,000-byte; memory in a basic Spectra 70/35 processor. (For more information, designate #54 on the Reader Service Card.)

SIGMA 5 TIME SHARING SOFTWARE / Scientific Data Systems, Santa Monica, Calif. / The new Sigma 5 Batch Time-Sharing software permits interactive time sharing for up to eight simultaneous users; at the same time the system runs batch problems written in FORTRAN, COBOL, or assembly language. The new Sigma 5 time sharing system is a lower priced version of the time sharing system available with the Sigma 7. SDS now offers four time sharing computer systems. (For more information, designate #55 on the Reader Service Card.)

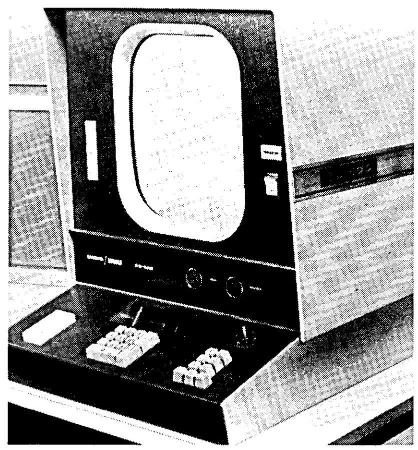
SIM 1401 / Datamation Services, Inc., Lynbrook, N.Y. / Programs originally written for an IBM 1401 or 1460 computer may be run on an IBM System/360 model 40 and up using this new software development. SIM 1401 can process more than one job at a time. The program mix may include 360 as well as other 1401 programs. It operates with the following supervisors: OS (Operating System), TDS (Disk Operating System), and TOS (Tape Operating System), etc. (For more information, designate #56 on the Reader Service Card.)

UNI-TRY / United Computing Corp., Redondo Beach, Calif. / System designers and programmers may easily generate sample output reports and listings from proposed programs before they are written. This new program, UNI-TRY, can be used as an aid in proposal preparation, format design, and management presentation. UNI-TRY operates on any popular computer having on-line or off-line card reader and printer capabilities. It sells for $2.00, including users documentation. (For more information, designate #57 on the Reader Service Card.)

Information Retrieval

S/D-500 DATA STORAGE AND RETRIEVAL SYSTEM

The S/D-500 Data Storage and Retrieval System was developed in a joint venture by Sanders Associates, Inc. of Nashua, N.H., and Diebold, Inc. of Canton, Ohio. This high speed microimage storage and retrieval system provides immediate push-button access to any one of 5 million pages of stored information.



The S/D-500 System consists of a microimage repository that can store intermixed microimages of all sizes and formats, a remote television-style display terminal connected by closed-circuit television to the repository, and a 10-button keyboard control.

The repository, a specially designed Diebold Power File, includes 20 rotating shelves, each of which contains seven modules. Within each module are seven bins holding 50 microimage retainers in each bin. The retainers can accommodate all forms and sizes of microfiche including COSATI, aperature cards, and 35 mm formats.

The display system controls include system status indicators on left of screen, an adding machine type keyboard (center) for page selection; a "joystick" camera-control for close-up viewing of specific points on the selected page, and control buttons for zooming, focusing, and for manual selection of another page on a given microfiche. Up to 10 display terminals can be used with the S/D-500 System and they can be located as far as 6,000 feet from the central repository. (For more information, designate #59 on the Reader Service Card.)

COMMON AIRLINES RESERVATIONS SYSTEM FROM CONTROL DATA

A versatile solution to the complex problems of airline schedules has been introduced by Control Data Corp., Minneapolis, Minn., in a flight information retrieval system called SAFIR. The SAFIR system has been proposed to the Air Traffic Conference which has determined the necessity for a Common Airlines Reservation System to be used by all carriers and travel agents.

SAFIR, designed for use by travel agents and airlines, provides instantaneous and automatic access to airline flight schedules and fare information by the use of remote terminals which are linked to a Control Data central computer via common carrier lines. The remote terminals are Control Data display units, consisting of a cathode ray tube (CRT) with its keyboard and a ticket printer.

SAFIR figures complicated airline passenger routings under a wide variety of conditions. The passenger only has to specify origination and destination cities. The agent or reservations clerk then touches a few keys on the display unit, and the computer figures the route, schedules and fares and displays the answer on the screen. The correct tickets then are issued to the passenger via the "on line" ticket printer. An outstanding feature of the SAFIR program is its ability to build and remember an itinerary from multiple schedule items. Accurate fares, based on type of service, are automatically constructed and displayed.

The SAFIR system also can prepare agents' sales reports from stored information. Car and hotel bookings and theater tickets also can be integrated into the computer system.
(For more information, designate #58 on the Reader Service Card.)

Peripheral Equipment

COGNITRONICS INTRODUCES REMOTE OPTICAL CHARACTER RECOGNITION SYSTEM

Cognitronics Corp., Mount Kisco, N.Y., has developed a remote optical character recognition system to solve the data processing problem of accurate and efficient conversion of information to computer language. Remote Optical Character Recognition (ROCR) uses a small desk-top scanner, placed to suit the customer's convenience.

The Cognitronics desk-top optical scanner occupies less space than an office copying machine. Documents are inserted manually,

and the copy which is scanned line by line is fed by ordinary telephone lines to a central recognition unit capable of converting the data to punch paper, magnetic tape or punch cards. Since this scanner is located on the user's premises, original documents never have to leave the client. A single unit, as pictured above, can scan with 100% accuracy and convert to computer language the equivalent amount of work done by 12 key punch operators.

ROCR visually signals unrecognizable characters, and permits their instant manual insertion. Cognitronics' method of on-line correction permits unidentifiable characters from one scanner to be held at the converter until corrected, while processing from other readers continues.

"The entire system is under computer control, and operates in a time-sharing mode," explained Mr. David Shepard, president of Cognitronics. "This enables all operations such as facsimile transmission, recognition, error correction, validity checks, data formation, as well as output creation, to flow efficiently and without costly time delays."
(For more information, designate #66 on the Reader Service Card.)

POTTER DD4311 DISK DRIVE IS IBM COMPATIBLE

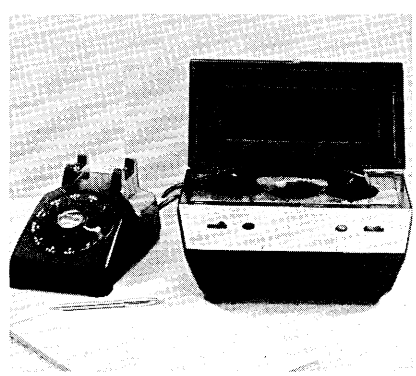
The new Potter DD4311 Disk Drive, developed and marketed by Potter Instrument Company, Inc., Plainview, N.Y., is plug-to-plug compatible with the more costly IBM 2311 and matches all performance characteristics and functions although it costs substantially less than all comparable-make disk drives. The DD4311 also offers quick interchangeability of removable disk packs.

A Potter disk drive is served by a comb-like access mechanism that contains a separate read/write magnetic head for the 10 disk recording surfaces in each IBM or equivalent disk pack. The multiple-head access mechanism and cylinder or track mode of data organization make the DD4311 suitable for either random or sequential processing methods. Each of the 200 track cylinders on the disks' surfaces can store up to 36,250 data bytes, or 72,500 packed decimal digits.

Repositioning time averages 75 milliseconds, and data transfer rate is 156,000 bytes per second. (For more information, designate #65 on the Reader Service Card.)

TELEPHONE/COMPUTER COUPLER FROM VERNITRON CORP. GIVES ACCESS OVER ANY TELEPHONE

The Vernitron TC-1 Telephone/Computer Coupler now makes it possible to use any telephone for sending printed inputs to time-sharing computers and receiving readable printouts. In addition, the flexible coupler, (developed by Vernitron Corp., Farmingdale, N.Y.) permits the device to be used with all data terminals such as Teletype terminal types KSR 33, ASR 33, Models 35, 37 and 38....and IBM and Friden typewriter terminals.



The Vernitron TC-1 Telephone Coupler provides for a data transmission rate up to 300 BAUD. Operating frequencies are 1070 and $1270 H_z$ for send, and 2025 and $2225 H_z$ for receive. The Coupler comes complete with a plug-in jack for interconnection with terminals.

Connection of the terminal to a computer is accomplished in three steps. The coupler cable is plugged into a 110VAC outlet, the phone is dropped into the chamber, and the typewriter terminal is operated to transmit input. There are no problems with equipment delivery, office arrangements or technical details. (For more information, designate #64 on the Reader Service Card.)

CONVERSATIONAL DATA TERMINAL FROM DATEL CORPORATION DOUBLES AS OFFICE TYPEWRITER

A new conversational data terminal, the THIRTY-21C, introduced by Datel Corp., South San Francisco, Calif., brings the convenience of remote text editing applications into any office or business environment. When not used as a conversational data terminal in time sharing computer usage, the THIRTY-21C doubles as an executive electric typewriter that provides quality hard copy and complete typeface selection.

The THIRTY-21C terminal design includes: I/O rates to 15 characters per second; Selectric and BCD code standard; parity checking on incoming data and parity generation on outgoing data; full duplex interrupt capability; an automatic terminal check which allows the computer to check operation of an unattended terminal; and all-silicon integrated circuits and semiconductors.

The new Datel terminal is a compact, lightweight standard typewriter package weighing just 50 pounds and measuring 21 inches wide, 21 inches deep and eight inches high. It requires no special desk well. An optional carrying case is available.
(For more information, designate #62 on the Reader Service Card.)

BECKMAN 3700 SERIES DATA ACQUISITION RECORDERS

Beckman 3700 Series Data Acquisition Recorders have been introduced by the Electronic Instruments Division of Beckman Instruments, Inc., Fullerton, Calif. The systems are assembled from modular building blocks, providing custom systems at off-the-shelf prices. All units are designed with integrated-circuit modules for digital and control functions. Field-effect transistors are used to switch the incoming analog signals at scanning rates that vary from 1 to 5,000 samples per second.

The combination of FET switching and IC control permits the systems to be operated as either sequential scanners or as random-access devices. Sequential scanning is controlled by internal counting circuits; random-access operation is by external address signals.

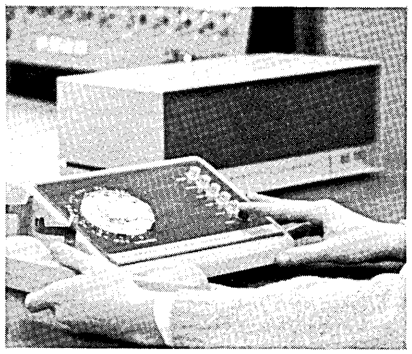
Each system is composed of three basic modules. One is the Model 3700 ANSCAN Subsystem, which contains all analog switching amplification and ADC circuitry. The output of this module is normally provided to a Model 3701 Universal Output Coupler that has been programmed at the factory to interface with the specific recording device that is to be used. The 3701 also accepts up to nine digital data sources that can be recorded along with the information from the Model 3700. The third modular element is the recording device itself — printer, paper tape punch, incremental or continuous magnetic tape recorder, or computer memory.
(For more information, designate #63 on the Reader Service Card.)

NEW DATA SETS TRANSMIT AND RECEIVE FROM WIDE VARIETY OF BUSINESS MACHINES

General Telephone & Electronics Corporation has announced the development of two new data sets that will transmit and receive data from a wide variety of business machines. The new units, introduced by Automatic Electric Co. (a GT&E subsidiary), Northlake, Ill., are designated AE 103A and AE 103F data sets.

The AE 103A data set was developed for use over the commercial telephone network, and the AE 103F data set for private-line or "dedicated" communications systems that are established for individual customers. They can be utilized in such applications as payroll accounting, hospital admission, airline reservations, securities transactions, and others.

A special data telephone was introduced with the AE 103A data set (see picture), which operates over the commercial telephone network. The telephone provides voice communications between operators of the data terminals at each end of the circuit, and also enables them to supervise the operation of the data sets. In addition to a



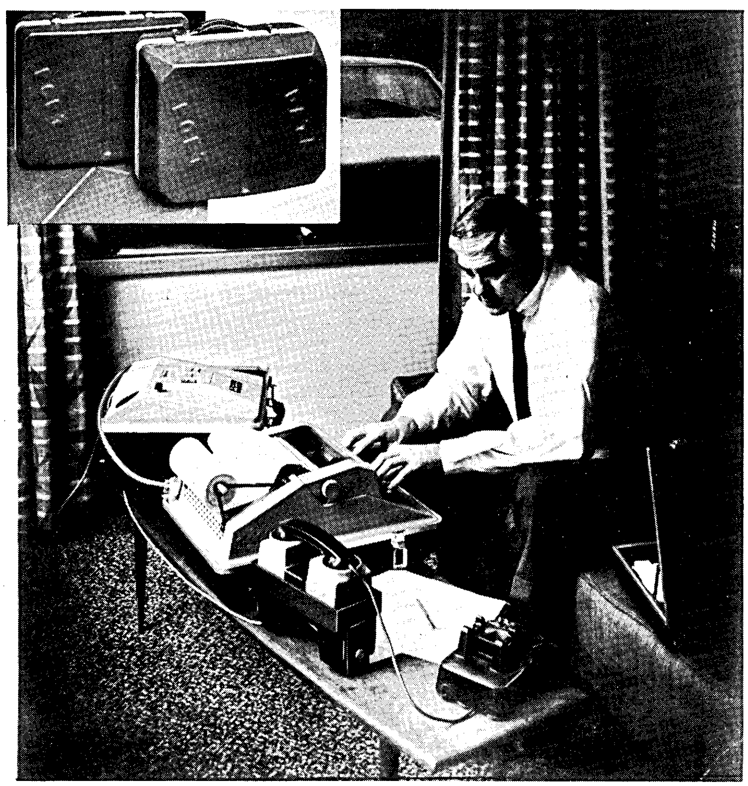
conventional rotary dial, the data telephone includes six pushbuttons which control the voice and data transmission functions and various test operations.

The AE 103F data set for private-line communications systems does not require the associated data telephone. On such a system, the data sets can be adjusted permanently for transmission or reception, or the business machines utilized in the system can change the direction of transmission.
(For more information, designate #60 on the Reader Service Card.)

DATAPORT[T] TELEPRINTER DATA TERMINAL TRAVELS ANYWHERE — SETS UP IN MINUTES

The new DATAPORT VDT-2 Portable Teleprinter Data Terminal, developed by Vernitron Corp., Farmingdale, N.Y., now makes it possible for the travelling man to communicate with a computer network system from an ordinary telephone. Consisting of a teleprinter, electronic control module. and telephone coupler, the terminal prints out on paper rolls or fanfold paper in both the send and receive modes. The terminal can be set up in minutes, and provides data transmission and reception characteristics for readable printouts over a wide range of telephone conditions.

Portability of the DATAPORT VDT-2 Teleprinter Data Terminal is obtained through the use of two luggage-type cases (see picture insert). The one case, containing the teleprinter, weighs 36 pounds. The second case, combining the electronic control module and telephone coupler, weighs 32 pounds. Shown



from top to bottom in the picture, the VDT-1 consists of the electronic control module, the teleprinter, and the telephone coupler. Automatic answering and hang-up enable the user to receive printouts while the unit is unattended.
(For more information, designate #61 on the Reader Service Card.)

RESEARCH FRONTIER

FLEXIBLE MULTILAYERED PRINTED CIRCUIT DEVELOPED BY TYCO'S ELECTRALAB DIVISION

The successful development of a flexible multilayered printed circuit has been announced by the Electralab Division of Tyco Laboratories, Inc., Encinitas, Calif. Burt Isaacson, president of the Electralab Division said the major significance of the new development for printed circuitry is that it now becomes possible to combine the space saving characteristics of the flexible circuit with the density of the multilayered circuit.

Several of the 16 layers of circuitry contained in the first flexible multilayered printed circuit developed by Electralab can be seen in the prototype shown below. The prototype shows three 12" diameter discs integrally interconnected with flexible circuitry. Each disc contains a different number of layers which combine to total 16.

The flexible multilayer also greatly increases equipment reliability and decreases equipment maintenance through elimination of all handwiring. More than 500 soldered connections were eliminated on this prototype. Substantial reduction in total cost per connection is thus possible through ease of manufacture, elimination of random error, reduced assembly and testing time, as well as lower maintenance.

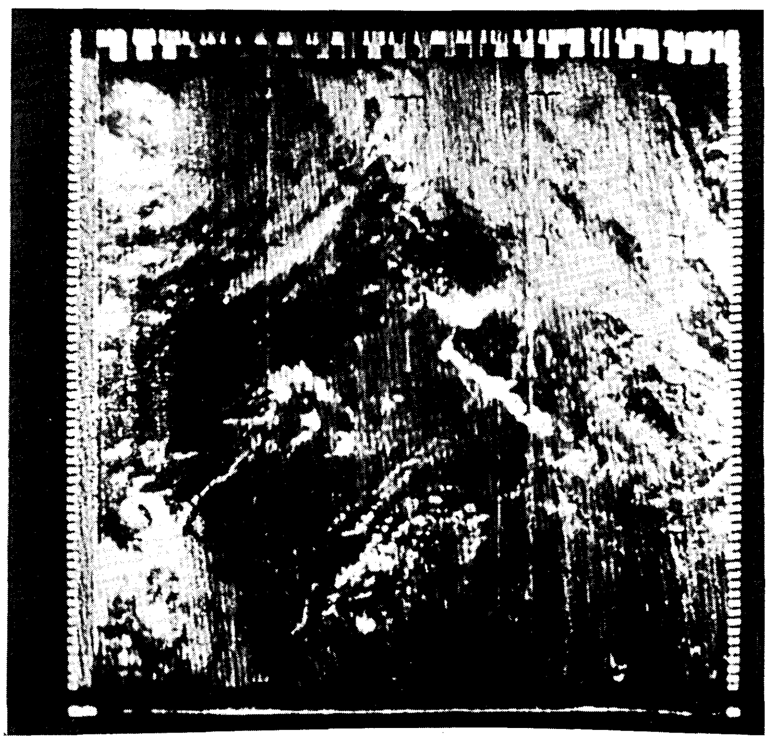
Electralab currently is producing prototypes of a flexible multilayer for a military weapons system developed at Picatinny Arsenal, Dover, N.J. Dr. Arthur J. Rosenberg, president of Tyco, said, "We also expect that eventually the application will have a significant impact on industrial instrumentation and commercial computers."

MISCELLANY

WESTINGHOUSE TECHNICIAN TUNES IN WEATHER SATELLITES AT HOME

The cloud cover over an area 1200 miles square in southeastern United States is shown in this photograph made by Rex L. Smith, senior technician at the Westinghouse electronic tube division. Using second-hand electronic equipment he put together himself, Rex tunes in on the government's Nimbus weather satellites. The project is a hobby he conducts in his spare time from one corner of his basement.

Rex tunes in the satellite's beeping picture signals, decodes them, records them on tape and watches them build up, line by line, on the storage tube. Then, with a simple Polaroid snapshot, he records the pictures permanently. His photographs, coming from a Nimbus weather satellite passing overhead some 625 miles in space, show areas of the United States about 1200 miles square. Providing the



cloud cover is not too heavy, there is enough faint background of the earth to roughly identify the geographical location.

Key elements of his apparatus are an $18 surplus military FM radio receiver, a homemade transistorized amplifier to make the receiver more sensitive to the satellite's weak signals, an ordinary home tape recorder, and a Westinghouse electronic storage tube that resembles a television picture tube but holds its glowing pictures for a half-hour at a time. Putting it together was a six-month, do-it-yourself project.

One unusual feature of Rex's experiments is that he receives his weather signals on a home-built high-frequency antenna which leans against a wall of his workshop. "I'd probably do better," he observes, "if I'd get that antenna out of the basement and up on a pole in the backyard."

NEW CONTRACTS

TO	FROM	FOR	AMOUNT
Greyhound Computer Corp., Chicago, Ill.	"a major 'advanced technology' company"	A lease contract for twenty IBM System/360 computers — Models 30, 40 and 50	$10.9 million
Computer Sciences Corp., Los Angeles, Calif.	National Library of Medicine, Bethesda, Md.	Analysis, programming and support services for a major expansion and upgrading of the automated information retrieval system of the National Library of Medicine	$2 million
Epsco, Inc., Westwood, Mass.	U.S. Army Missile Command	Mobile Target Tracking Systems and for modifications and field test equipment	$1.2 million
Service Technology Corp., (a subsidiary of LTV Aerospace Corp.)	U.S. Army Electronics Command, Fort Monmouth, N.J.	Providing maintenance support documentation services to the Avionics/Navigation Aids Branch and the Combat Surveillance, Night Vision and Photographics Branch of the U.S. Army Electronics Command	$1 million
Rixon Electronics, Silver Spring, Md.	U.S. Army	Two contracts for digital data communications equipment to be used to facilitate world-wide data transmission over telephone circuits at speeds up to 4800 bits per sec	$980,000
Farrington Manufacturing Co., New York, N.Y.	Credit Systems Inc. (CSI), St. Louis, Mo.	Over 15,000 Variable Amount Imprinters	over $750,000
Milgo Electronic Corporation, Miami, Fla.	U.S. Army Combat Developments Command Experimentation Command	Designing, developing, and installing a major expansion of the Data Acquisition and Recording System at the Hunter Liggett Military Reservation, Fort Ord, Calif.	$750,000
Data Products Corp., Culver City, Calif.	Electro-Mechanical Research Inc., Computer Division	Model 4500 and 4300 LINE/PRINTERS which will be used in conjunction with EMR's 6100 Series computers	over $503,000
Data Disc, Inc., Palo Alto, Calif.	Hewlett-Packard	F-series disc memories for Hewlett-Packard's general-purpose instrumentation computers and time-sharing systems	$600,000
Tally Corporation, Seattle, Wash.	IBM Corporation	Paper tape readers built to IBM specifications for use as part of a peripheral equipment option to IBM System/360 Models 25 through 50	about $500,000
Honeywell S.p.A., Milan, Italy	Societa' Italiana Resine (S.I.R.)	Building and installation of an instrumentation and computer-control system for a new plant being built in Sardinia to produce ethylene	over $500,000
Computer Sciences Corp., Los Angeles, Calif.	U.S. Army Materiel Command	New tasks in the development of a computer-based management information system known as PEMARS (Procurement of Equipment and Missiles, Army Management Accounting and Reporting System)	over $500,000
Informatics Inc., Sherman Oaks, Calif.	Litton Industries, Data Systems Division	Designing test programs for TACFIRE, a computer-based artillery fire direction system under development for the U.S. Army	$415,000
Epsco, Inc., Westwood, Mass.	U.S. Navy, Naval Air Systems Command	A contract amendment for spare parts for synchro data converters	$349,000
International Telephone and Telegraph's Data System Div.	State of New York, Department of Audit and Control, Albany, N.Y.	Analysis and design of a new information system to speed handling of the State's financial transactions in the 70's	$286,000
Ampex Corporation, Redwood City, Calif.	U.S. Department of Defense, Advance Research Project Agency	One-microsecond core memories for the Project Genie research program at the University of California, Berkeley	$210,000
Data Products Corporation, Culver City, Calif.	U.S. Naval Electronics Laboratory Center, San Diego, Calif.	Development and manufacture of a high-speed Teleprinter and Teleprinter test module	$159,000
Information Control Corp., El Segundo, Calif.	North American Rockwell Corp., Columbus Division	Manufacture of LP-300 Series Solid State Light Pens	$41,000
Computer Sciences Canada Ltd., Ottawa, Ont.	Canadian Government	Design of a computer-based logistics system to serve all of Canada's land, sea and air forces; formally known as DEVelopment of Integrated Logistics program, the project is commonly known as the Devil Program	—
Control Data Corp., Minneapolis, Minn.	U.S. Air Force	Designation as prime contractor for the design, development, installation and operation of a comprehensive command and control system for Pacific Air Forces Operations; known as SEEK DATA II, the program is concerned with analysis and control of information relating to all air planning operations in Southeast Asia	—
Wyle Systems Division, Wyle Laboratories, El Segundo, Calif.	Bureau of Public Roads, U.S. Department of Transportation, Washington, D.C.	An accident simulation measurement system that will telemeter data from an automobile as it is crash-driven into various types of barriers	—
Keystone Computer Associates, Inc., Willow Grove, Pa.	Bell Telephone Laboratories	Engagement in Bell's DIR/ECT project (the computer automation of the telephone directory throughout the Bell System); Keystone will perform both systems design and programming for the computers	—

NEW INSTALLATIONS

OF	AT	FOR
Burroughs B5500 system	General Post Office of Great Britain Gresham St., London, England	Assisting nearly 3,000 scientists and engineers working on diverse projects in four London locations (system valued at $1.25 million)
Control Data 6400 system	State University of New York (SUNY) at Buffalo	Research and administrative tasks; it will serve as the core of a nine-campus network serving students, administrators and faculty at each campus on a time-sharing basis using remote terminals
	Lehigh University, Bethlehem, Pa.	Enlarging the University's Computing Center to accommodate the ever-increasing educational needs; the center is active in educational, research and administrative work
Control Data 6600 system	Control Data Corp., Data Center Houston, Texas	Computers users in the Southwest, to be made available on an hourly charge basis
Honeywell Model 1200 system	Orenda Limited, Malton, Ontario	Automated control over production and costs; the computer keeps track of 60,000 operations that go into manufacturing of engine parts
	City of Toledo, Toledo, Ohio	Keeping a record of the license plates of stolen cars or those thought to have been used in a crime as well as other police department applications, and will be operated on the service bureau concept in the performance of jobs for other city departments
IBM 1130 system	Coseco Inc., Kalamazoo, Mich.	Engineering design and stress analysis for proposed new buildings; also stress analysis studies on existing buildings
	Hinsdale Public Schools, Hinsdale, Ill.	Use in a two-semester computer mathematics course offered in the Hinsdale High Schools to juniors and seniors; FORTRAN is taught and students receive 'hands-on' experience
IBM System/360	Putnam Management Company, Inc., Boston, Mass.	Shareholder services, portfolio comparisons and evaluations, and bookkeeping
IBM System/360 Model 20	Young Men's Christian Association of Metropolitan Chicago, Chicago, Ill.	Centralizing administrative tasks formerly handled by 40 local YMCAs; these include cost analyses, accounting, purchasing, records of members, etc.
IBM System/360 Model 50	Honolulu Police Department, Honolulu, Hawaii	Information retrieval about wanted persons and stolen automobiles; files for traffic accidents, manpower deployment, fingerprints, criminal identification etc.; also many city and county departments will be utilizing the computer center
PDP-10/40 computer system	Sikorsky Aircraft Corp., Stamford, Conn.	Use in the simulation of the dynamic properties of helicopters to assist in design and development work
PDP-10/50 computer system	University of Western Ontario, Canada	Time-shared operations; plan to interface the PDP-10/50 with their existing IBM 7040 system which will do batch processing
RCA Spectra 70/35 system	Computer Utilization, Inc., Austin, Texas	Use at its data center in a variety of applications ranging from manufacturing process control to analysis of econometrics
RCA Spectra 70/45 system	The National Weather Records Center, and the U.S. Air Force's Data Processing Division, Federal Bldg., Asheville, N.C. (2 computers)	Joint management by the military and civilian agency to be used in the collection and processing of worldwide weather observations and in the preparation of environmental defense studies
	Gulf Oil Corp., Houston, Texas (2 computers)	Billing Travel Card customers west of the Mississippi and in Ohio and Michigan
SDS 940 computer	Tymshare, Inc., Los Angeles and San Francisco, Calif., and New York, N.Y. (3 systems)	Installation in time-sharing computer centers (systems valued at $3,700,000)
UNIVAC 1107 system	U.S. Department of Agriculture, Minneapolis Processed Commodity Office, St. Paul, Minn.	Fast, economic evaluation of bids for processed commodities; the Minneapolis office is responsible on a national basis for the purchase and handling of more than 60 processed commodities
UNIVAC 1108 system	Bell Telephone Company of Canada, Montreal and Toronto, Canada (2 systems)	Processing personnel and payroll functions, controlling and maintaining records for assets valued in excess of $3 billion and preparing disbursements totalling more than $750 million annually (systems valued at about $10 million)
UNIVAC 1108 II multiprocessor computer system	Jet Propulsion Laboratory, Pasadena, Calif.	Wide variety of scientific calculations involved in the Lab's research projects (system valued in excess of $5.5 million)
UNIVAC 9200 system	Alabama Board of Corrections, Kilby Prison, Montgomery, Ala.	Maintaining complete statistics on prisoners and for general accounting purposes
	Arapahoe County School District Six, Littleton, Colo.	Payroll processing, inventory control, grade reporting and preparation of instruction cards
UNIVAC 9300 system	Sanitation District #2 of Los Angeles County, Los Angeles, Calif.	Payroll processing, job costing, maintaining an equipment inventory and keeping engineering records
	County Government Offices, El Paso County, Colorado Springs, Colo.	General accounting, tax assessments and billing
UNIVAC 9400 system	Beck & Gregg Hardware Company, Atlanta, Ga.	Inventory control, billing, accounts receivable and payable, picking tickets and a variety of management reports

MONTHLY COMPUTER CENSUS

The following is a summary made by "Computers and Automation" of reports and estimates of the number of general purpose electronic digital Computers manufactured and installed, or to be manufactured and on order. These figures are mailed to individual computer manufacturers from time to time for their information and review, and for any updating or comments they may care to provide.

Our census has begun to include computers manufactured by organizations outside the United States. We invite all manufacturers located anywhere to submit information for this census. We also invite our readers 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
- (S) - sale only
- X - no longer in production
- C - figure is combined in a total (see column to the right)
- E - figures estimated by "Computers and Automation"
- ? - information not received at press time

AS OF JULY 15, 1968

NAME OF MANUFACTURER	NAME OF COMPUTER	AVERAGE OR RANGE OF MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	MFR'S TOTAL INSTALLATIONS	NUMBER OF UNFILLED ORDERS	MFR'S TOTAL UNFILLED ORDERS
I. United States Manufacturers							
Autonetics (R)	RECOMP II	$2495	11/58	30		X	
Anaheim, Calif.	RECOMP III	$1495	6/61	6	36	X	0
Bailey Meter Co.	Bailey 756	$60,000-$400,000 (S)	2/65	14		5	
Wickliffe, Ohio	Bailey 855	$100,000 (S)	4/68	0	14	10	15
Bunker-Ramo Corp. (R)	BR-130	$2000	10/61	160		X	
Canoga Park, Calif.	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	0
Burroughs (R)	205	$4600	1/54	38		X	
Detroit, Mich.	220	$14,000	10/58	31		X	
	B200 Series, B100	$5400	11/61	800		31	
	B300 Series	$9000	7/65	370		150	
	B2500	$5000	2/67	35		95	
	B3500	$14,000	5/67	24		74	
	B5500	$22,000	3/63	74		12	
	B6500	$33,000	2/68	0		17	
	B7500	$44,000	4/69	0		6	
	B8500	$200,000	8/67	0	1370 E	5	390 E
Control Data Corp. (R)	G-15	$1600	7/55	295		X	
Minneapolis, Minn.	G-20	$15,500	4/61	20		X	
	LGP-21	$725	12/62	165		X	
	LGP-30	$1300	9/56	322		X	
	RPC-4000	$1875	1/61	75		X	
	636/136/046 Series	?	-	29		C	
	160*/8090 Series	$2100-$12,000	5/60	610		X	
	924/924A	$11,000	8/61	29		X	
	1604/A/B	$45,000	1/60	59		X	
	1700	$3500	5/66	100		C	
	3100/3200/3300	$10,000-$16,250	5/64	261		C	
	3400/3600/3800	$18,000-$48,750	6/63	79		C	
	6400/6500/6600	$52,000-$117,000	8/64	63		C	
	6800	$130,000	6/67	0	(as of	C	
	7600	$150,000	12/68	0	2107 12/30/67)	C	360 E
Digital Electronics Inc. (R)	DIGIAC 3080	$19,500 (S)	12/64	11		1	
Plainview, N.Y.	DIGIAC 3080C	$25,000 (S)	10/67	1	12	1	2
Digital Equipment Corp. (R)	PDP-1	$3400	11/60	59		X	
Maynard, Mass.	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	1300		C	
	PDP-8/S	$300	9/66	700		C	
	PDP-9	$1000	12/66	85		C	
	PDP-10	$7500	12/67	6		C	
	LINC-8	?	9/66	105	2611 E	C	450 E
Electronic Assoc., Inc. (R)	640	$1200	4/67	42		18	
Long Branch, N.J.	8400	$12,000	7/65	21	63	4	22
EMR Computer Div. (R)	ASI 210	$3850	4/62	C		X	
Minneapolis, Minn.	ASI 2100	$4200	12/63	C		X	
	ADVANCE 6020	$4400	4/65	C		C	
	ADVANCE 6040	$5600	7/65	C		C	
	ADVANCE 6050	$9000	2/66	C		C	
	ADVANCE 6070	$15,000	10/66	C		C	
	ADVANCE 6130	$1550	8/67	19	85	C	18
General Electric (N)	115	$1370-$5000	4/66	620 E		600 E	
Phoenix, Ariz.	130	$4350-$15,000	-	0		C	
	205	$2500-$10,000	6/64	C		X	
	210	$16,000-$22,000	7/60	C		X	
	215	$2500-$10,000	9/63	C		X	
	225	$2500-$16,000	4/61	200 E		X	
	235	$6000-$18,000	4/64	130 E		C	
	255	$15,000-$19,000	10/67	C		C	
	265	$17,000-$20,000	10/65	C		C	
	405	$5120-$10,000	2/68	C		C	
	415	$4800-$13,500	5/64	380 E		70 E	
	420	$17,000-$20,000	6/67	C		C	
	425	$6000-$20,000	6/64	130 E		C	
	430	$15,500-$19,000	-	0		C	
	435	$8000-$25,000	9/65	C		C	
	440	$22,200-$27,000	-	0		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	1800 E	C	900 E
Hewlett-Packard (R)	2116A	$600	11/66	102		C	
Palo Alto, Calif.	2115A	$412	11/67	103	205	C	50 E

NAME OF MANUFACTURER	NAME OF COMPUTER	AVERAGE OR RANGE OF MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTAL-LATIONS	MFR'S TOTAL INSTAL-LATIONS	NUMBER OF UNFILLED ORDERS	MFR'S TOTAL UNFILLED ORDERS
Honeywell (R)	DDP-24	$2500	5/63	93		X	
Computer Control Div.	DDP-116	$900	4/65	200		30	
Framingham, Mass.	DDP-124	$2050	3/66	64		30	
	DDP-224	$3300	3/65	52		8	
	DDP-516	$700	9/66	155		150	
	H632	$2700	-	0	564	?	218
Honeywell (R)	H-110	$2500	8/68	0		C	
EDP Division	H-120	$3900	1/66	650		240	
Wellesley Hills, Mass.	H-125	$3900	12/67	20		75	
	H-200	$8400	3/64	1130		87	
	H-400	$8500	12/61	120		X	
	H-800	$28,000	12/60	89		X	
	H-1200	$9500	2/66	175		130	
	H-1250	$9500	7/68	0		20	
	H-1400	$14,000	1/64	12		X	
	H-1800	$42,000	1/64	21		X	
	H-2200	$12,000	1/66	78		71	
	H-4200	$20,500	6/67	0		20	
	H-8200	$35,000	4/68	0	2200 E	5	650 E
IBM (N)	305	$3600	12/57	C		X	
White Plains, N.Y.	360/20	$3000	12/65	7200 E		5000 E	
	360/25	$5330	1/68	C		1000 E	
	360/30	$9340	5/65	6600 E		3000 E	
	360/40	$19,550	4/65	3200 E		1500 E	
	360/44	$15,000	7/66	C		C	
	360/50	$32,960	8/65	C		C	
	360/65	$69,850	11/65	C		C	
	360/67	$138,000	10/66	C		C	
	360/75	$81,400	2/66	C		C	
	360/85	$115,095	-	0		C	
	360/90 Series	-	10/67	C		C	
	650	$4800	11/54	C		X	
	1130	$1545	2/66	3400 E		4500 E	
	1401	$6480	9/60	7000 E		X	
	1401-G	$2300	5/64	1600 E		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	39,600 E	C	16,000 E
Interdata (R)	Model 2	$200-$300	-	0		3	
Oceanport, N.J.	Model 3	$300-$500	3/67	52		110	
	Model 4	$400-$800	-	0	52	5	105
National Cash Register Co.(R)	NCR-304	$14,000	1/60	24		X	
Dayton, Ohio	NCR-310	$2500	5/61	10		X	
	NCR-315	$8500	5/62	650		150	
	NCR-315-RMC	$12,000	9/65	80		50	
	NCR-390	$1850	5/61	660		6	
	NCR-500	$1500	10/65	1860		580	
	NCR-Century-100	$2645	-	-		C	
	NCR-Century-200	$7500	-	-	3284	C	1050 E
Pacific Data Systems Inc.(R) Santa Ana, Calif.	PDS 1020	$550-$900	2/64	145	145	10	10
Philco (R)	1000	$7010	6/63	16		X	
Willow Grove, Pa.	2000-210, 211	$40,000	10/58	16		X	
	2000-212	$52,000	1/63	12	44	X	0
Potter Instrument Co., Inc. Plainview, N.Y.	PC-9600	$12,000 (S)	-	-	-	-	-
Radio Corp. of America (R)	RCA 301	$7000	2/61	635		C	
Cherry Hill, N.J.	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	190		120	
	Spectra 70/25	$6500	9/65	102		57	
	Spectra 70/35	$10,400	1/67	60		135	
	Spectra 70/45	$22,000	11/65	110		85	
	Spectra 70/46	$34,400	-	0		C	
	Spectra 70/55	$34,300	11/66	7	1270 E	14	420 E
Raytheon (R)	250	$1200	12/60	175		X	
Santa Ana, Calif.	440	$3500	3/64	20		X	
	520	$3200	10/65	27		0	
	703	(S)	10/67	43	265	37	37
Scientific Control Corp. (R)	650	$500	5/66	29		1	
Dallas, Tex.	655	$1800	10/66	25		44	
	660	$2000	10/65	5		9	
	670	$2600	5/66	1		0	
	6700	$30,000	10/67	0	60	1	55
Scientific Data Syst., Inc. (N)	SDS-92	$1500	4/65	120 E		10 E	
Santa Monica, Calif.	SDS-910	$2000	8/62	225 E		25 E	
	SDS-920	$2900	9/62	200 E		20	
	SDS-925	$3000	12/64	C		C	
	SDS-930	$3400	6/64	235 E		30	

NAME OF MANUFACTURER	NAME OF COMPUTER	AVERAGE OR RANGE OF MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTAL-LATIONS	MFR'S TOTAL INSTAL-LATIONS	NUMBER OF UNFILLED ORDERS	MFR'S TOTAL UNFILLED ORDERS
Scientific Data Syst., Inc.	SDS-940	$10,000	4/66	C		C	
(cont'd)	SDS-9300	$7000	11/64	C		C	
	Sigma 2	$1000	12/66	80 E		160	
	Sigma 5	$6000	8/67	C		50	
	Sigma 7	$12,000	12/66	C	1000 E	C	330 E
Standard Computer Corp. (N)	IC 4000	$9000	7/68	0		2 E	
Los Angeles, Calif.	IC 6000	$10,000-$22,000	5/67	7	7	12 E	14 E
Systems Engineering Labs (R)	SEL 810	$1000	9/65	24		X	
Ft. Lauderdale, Fla.	SEL 810A	$900	8/66	70		45	
	SEL 810B	?	-	1		9	
	SEL 840	$1400	11/65	4		X	
	SEL 840A	$1400	8/66	35		28	
	SEL 840 MP	?	1/68	5	139	7	89
UNIVAC, Div. of Sperry Rand (R)	I & II	$25,000	3/51 & 11/57	23		X	
New York, N.Y.	III	$20,000	8/62	77		X	
	File Computers	$15,000	8/56	13		X	
	Solid-State 80 I, II, 90, I, II & Step	$8000	8/58	210		X	
	418	$11,000	6/63	135		20	
	490 Series	$35,000	12/61	190		35	
	1004	$1900	2/63	3100		20	
	1005	$2400	4/66	1090		90	
	1050	$8000	9/63	280		10	
	1100 Series (except 1107 & 1108)	$35,000	12/50	9		X	
	1107	$55,000	10/62	33		X	
	1108	$65,000	9/65	105		75	
	9200	$1500	6/67	170		850	
	9300	$3400	7/67	85		550	
	9400	$7000	5/69	0		60	
	LARC	$135,000	5/60	2	5522 E	X	1710 E
Varian Data Machines (R)	620	$900	11/65	75		0	
Newport Beach, Calif.	620i	$500	6/67	180	255	420	420
		I. U.S. Manufacturers, TOTAL —			63,000 E		23,300 E
II. Non-United States Manufacturers							
A/S Regnecentralen (R)	GIER	$2300-$7500	12/60	36		2	
Copenhagen, Denmark	RC 4000	$3000-$20,000	6/67	1	37	1	3
Elbit Computers Ltd. (R) Haifa, Israel	Elbit-100	$4900 (S)	10/67	19	19	37	37
English Electric Computers	LEO I	-	-/53	3		X	
Ltd. (R)	LEO II	-	6/57	11		X	
London, England	LEO III	$9600-$24,000	4/62	39		X	
	LEO 360	$9600-$28,800	2/65	8		X	
	LEO 326	$14,400-$36,000	5/65	11		X	
	DEUCE	-	4/55	32		X	
	KDF 6	-	12/63	17		X	
	KDF 8-10	-	9/61	12		X	
	KDF 9	$9600-$36,000	4/63	28		X	
	KDN 2	-	4/63	8		X	
	KDF 7	$1920-$12,000	5/66	8		X	
	SYSTEM 4-30	$3600-$14,400	10/67	3		C	
	SYSTEM 4-40	$7200-$24,000	5/69	-		C	
	SYSTEM 4-50	$8400-$28,800	5/67	9		C	
	SYSTEM 4-70	$9600-$36,000	1/68	2		C	
	SYSTEM 4-75	$9600-$40,800	9/68	-		C	
	ELLIOTT 903	$640-$1570	1/66	52		C	
	ELLIOTT 4120	$1600-$4400	10/65	82		C	
	ELLIOTT 4130	$2200-$9000	6/66	23	348	C	110
GEC-AEI Automation Ltd. (R)	Series 90-2/10/20/25/						
New Parks, Leicester, England	30/40/300	-	3/63-1/68	12		C	
	S-2	-	1/68	1		0	
	S-5	-		0		C	
	S-7	-		0		C	
	GEC-TRW130	-	12/64	2		X	
	GEC-TRW330	-	3/63	9	25	X	8 E
International Computers and	1901 to 1909	$4000-$27,000	12/64-12/66	755		359	
Tabulators Ltd. (R)	1200/1/2	-	-/55	54		0	
London, England	1300/1/2	$3500	-/62	199		9	
	1500	$5200	7/62	106		4	
	1100/1	-	-/60	21		0	
	2400	-	12/61	4		0	
	Atlas 1 & 2	$70,000	-/62	6		0	
	Orion 1 & 2	$40,000	1/63	15		0	
	Sirius	-	-/61	21		0	
	Mercury	-	-/57	17		0	
	Pegasus 1 & 2	-	-/56	25	1223	0	372
Japanese mfrs.	Various models	-	-	C	2074	C	500 E
The Marconi Co., Ltd.	Myriad I	£36,000-£66,000	3/66	26		19	
Chelmsford, Essex, England	Myriad II	£22,000-£42,500	10/67	3	29	9	28
N.V. Philips' Computer Industrie Apeldoorn, Netherlands	P1000	?	6/68	0	0	5 E	5 E
Saab Aktiebolag (R)	DATASAAB D21	$5000-$14,000	12/62	31		3	
Linkoping, Sweden	DATASAAB D22	$8000-$60,000	5/68	1	32	10	13
Siemens Aktiengesellschaft	2002	54,000 (Deutsche	6/59	42		-	
Munich, Germany	3003	52,000 Marks)	12/63	34		-	
	4004/15	19,000 "	10/65	60		23	
	4004/25	32,000 "	1/66	29		5	
	4004/35	46,000 "	2/67	57		57	
	4004/45	75,000 "	7/66	45		40	
	4004/55	103,000 "	12/66	3		3	
	301	2000 "	-	-		9	
	302	4000 "	9/67	8		10	
	303	10,000 "	4/65	65		8	
	304	12,000 "	-	1		25	
	305	14,000 "	11/67	17	361	22	202
USSR	Various models	-	-	C	2500 E	C	700 E
		II. Non-U.S. Manufacturers, TOTAL —			6600 E		2000 E
		Combined, TOTAL —			69,600 E		25,300 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.

May 14, 1968

3,383,521 / Allan Greenberg, Binghamton, N. Y. / International Business Machines Corporation, Armonk, N. Y., a corporation of New York / Shift register storage device.

3,383,660 / Henry L. Herold, Palo Alto, Calif., and David W. Masters, Phoenix, Ariz. / General Electric Company, a corporation of New York / Data processing system.

May 21, 1968

3,384,766 / John J. Kardash, South Acton, Mass. / Sylvania Electric Products Inc., a corporation of Delaware / Bistable logic circuit.

3,384,879 / Kurt Stahl, Hohensachsen, and Ruth Vogel, Jurgen Langer, and Hans Kielgas, Mannheim, Germany / Brown, Boveri & Cie, Aktiengesellschaft, Mannheim-Kafertal, Germany, a German corporation / Diode-matrix device for data storing and translating purposes.

3,384,880 / Simon Duinker, Hamburg, Bahrenfeld, and Gerhard Haas, Hamburg, Germany / North American Philips Company Inc., New York, N. Y., a corporation of Delaware / Disc memory storage comprising magnetic heads arranged obliquely to the track.

May 28, 1968

3,386,083 / Allen R. Geller, Leo J. Hasbrouck, and Gordon L. Smith, Poughkeepsie, N. Y. / International Business Machines Corporation, Armonk, N. Y., a corporation of New York / Interruptions in a large scale data processing system.

3,386,084 / Robert A. Nelson, Poughkeepsie, N. Y. / International Business Machines Corporation, Armonk, N. Y., a corporation of New York / Remote addressing in a data processing system.

3,386,089 / William H. Meiklejohn, Scotia, N. Y. / General Electric Company, a corporation of New York / Apparatus for converting information to binary digital form.

June 4, 1968

3,387,269 / George W. Hernan, Haddonfield, N.J., Peter W. Beresin, Philadelphia, Pa., and Eugene Gertler, Cinnaminson, N.J. / Ultrasonic Systems Corp., a corporation of Delaware / Information display system.

3,387,274 / William W. Davis, Minneapolis, Minn. / Sperry Rand Corporation, New York, N.Y., a corporation of Delaware / Memory apparatus and method.

3,387,275 / Dennis J. Gooding, Acton, Mass., and Andrew Wartella, Clarence, N.Y. / United States of America as represented by the Secretary of the Air Force / Digital detection and storage system.

3,387,276 / Richard Charles Reichow, St. Paul, Minn. / Sperry Rand Corporation, New York, N.Y., a corporation of Delaware / Off-line memory test.

3,387,277 / Edwin Singer, Stamford, and Ambros Geissler, Wilton, Conn. / Telecontrol Corporation, a corporation of Ohio / System and apparatus for addressing a cyclical memory by the stored contents thereof.

3,387,281 / Theodore R. Peters, Flanders, N.J. / Bell Telephone Laboratories, Inc., New York, N.Y., a corporation of New York / Information storage arrangement employing circulating memories.

3,387,287 / Richard C. Webb, Broomfield, Colo. / Colorado Instruments, Inc., Broomfield, Colo., a corporation of Colorado / Digital data storage circuit for data recording and transmission systems.

3,387,289 / Karlheinz Walter, Munich, Germany / Siemens Aktiengesellschaft, Munich, Germany, a corporation of Germany / Magnetic thin film readout system.

3,387,290 / Richard L. Snyder, Fullerton, Calif. / Hughes Aircraft Company, Culver City, Calif., a corporation of Delaware / Multiphase shift register memory.

June 11, 1968

3,388,239 / Glen R. Duncan and William H. Wertz, Canoga Park, Calif. / Litton Systems, Inc., Beverly Hills, Calif. / Adder.

3,388,268 / Francis J. Murphree, Sunnyside, Fla. / United States of America as represented by the Secretary of the Navy / Memory device.

3,388,382 / Edwin S. Lee III, West Covina, Calif. / Burroughs Corporation, Detroit, Mich., a corporation of Michigan / Memory system.

3,388,383 / Prem Shivdasani, Newton, and David D. De Voy, Dedham, Mass. / Honeywell Inc., Minneapolis, Minn., a corporation of Delaware / Information handling apparatus.

3,388,384 / Howard Z. Bogert, Cupertino, Alan E. Pound, Sunnyvale, and George E. Avery, Saratoga, Calif. / General Micro-Electronics Inc., Santa Clara, Calif., a corporation of Delaware / Zero suppression circuit.

3,388,385 / Joseph A. Lukes, Palo Alto, Calif. / Hewlett-Packard Company, Palo Alto, Calif., a corporation of California / Nondestructive round-off display circuit.

BOOK REVIEWS AND NOTICES

Neil Macdonald
Assistant Editor
Computers and Automation

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

Reviews

Minsky, Marvin / Computation: Finite and Infinite Machines / Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632 / 1967, hardbound, 317 pp., $?

This book "provides the professionals — computer programmers, mathematicians, electrical engineers — with an introduction to the central concepts underlying the "Theory of Machines," i.e., the theoretical background on which the study of what can and cannot be done with computers is based. This book provides an insight into the fundamental theoretical concepts of computation, and describes some mathematical ideas involved in the analyses of discrete systems.

Among the sixteen chapters are "Finite-State Machines," "Turing Machines," and "The Computable Real Numbers." Bibliography. Index.

The author is a distinguished professor at M.I.T. and has used this book, or its predecessors in the form of notes, for teaching students there. The book is highly academic, and spends most of its energy on the discussion of infinite machines. There are nevertheless many very interesting remarks, observations, theorems, arguments, etc. There is no doubt that the book is authoritative.

Martin, James / Design of Real-Time Computer Systems / Prentice Hall, Inc., Englewood Cliffs, N.J. / 1967, hardbound, 629 pp., $?

This book is intended for analysts and programmers employed in the detailed aspects of systems implementation, and for those whose interest is less technical — such as general management, many students, and, in some cases, computer salesmen. The book emphasizes real-time commercial systems with their special problems and dangers. Part I is INTRODUCTION. Part II is TECHNIQUES. Part III is APPLICATIONS. Part IV is HARDWARE. Part V is DESIGN CALCULATIONS. Part VI is IMPLEMENTATION. Some of the forty chapters are: "Basic Techniques"; "The Man-Machine Interface"; "Basic Functions of an On-Line System"; "Airline Reservations"; "The Estimating Process"; "Accuracy and Security"; and "Cutting Over the System." There is a glossary, and an index.

The author is a graduate of Oxford University and holds an M.A. in Physics; he is a staff member of the Systems Research Inst. of IBM Corporation.

Forsythe, George, and Moler, Cleve B. / Computer Solution of Linear Algebraic Systems / Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632 / 1967, hardbound, 148 pp., $?

This "monograph" introduces the reader to "basic analytic and computational tools from matrix algebra, presents good programs for solving linear equation systems, and investigates the fundamental concepts of error involved." The author assumes that, before reading the book, the reader has had a mathematics course in linear algebra and is familiar with programming matrices, canonical forms, ergenvalues and cigenvectors, and automatic digital computing in ALGOL 60, FORTRAN, or PL/I.

The 25 chapters include "Vector and Matrix Norms," "Condition of a Linear System," "Computing the Determinant," and "Positive Definite Matrices; Band Matrices," "The Crout and Doolittle Variants," "Gaussian Elimination and LU Decomposition," etc. The book includes a bibliography and an index. George Forsythe is a Professor of Computer Science at Stanford Univ., and a former president of the Association for Computing Machinery. Cleve Moler is an Assistant Professor of Mathematics at the University of Michigan.

Martin, Francis F. / Computer Modeling and Simulation / John Wiley & Sons, Inc., 605 Third Ave., New York, N.Y. 10016 / 1968, hardbound, 331 pp., $12.95

This book provides "an introduction for the student and a useful reference for the professional." It reviews the methods, techniques, and tools applicable to computer modeling and simulation. The 10 chapters include "Applications"; Statistical Techniques"; "Stochastic Features"; and "Model Implementation." The four parts are Introduction; Applications; Methods Techniques and Tools; and Model Construction. The book is mathematical in part but not by any means entirely. Glossary. Bibliography. Four more appendices. Index. The author is a senior staff engineer for Hughes Ground Systems.

CLASSIFIED

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.