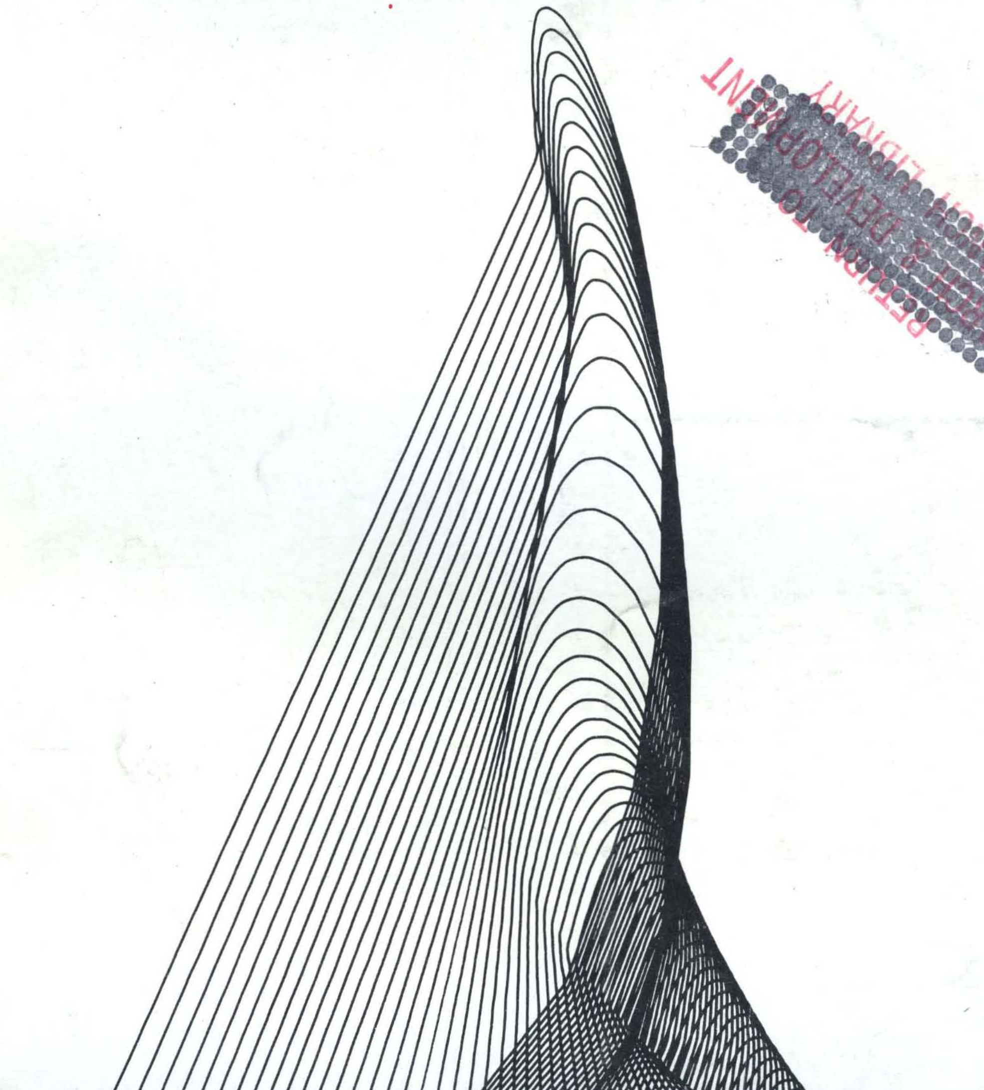
August, 1964

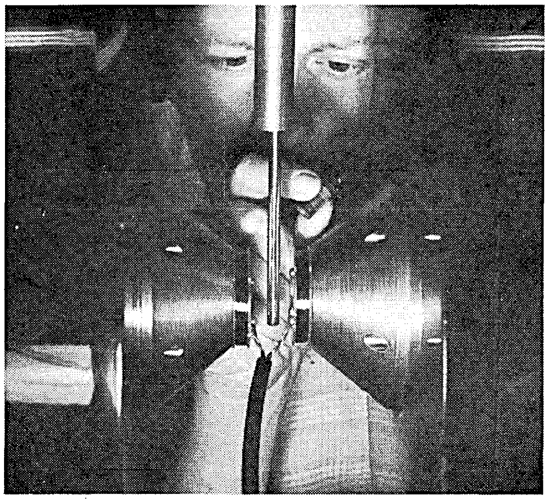
computers and automation



Computer Art Contest
First Prize

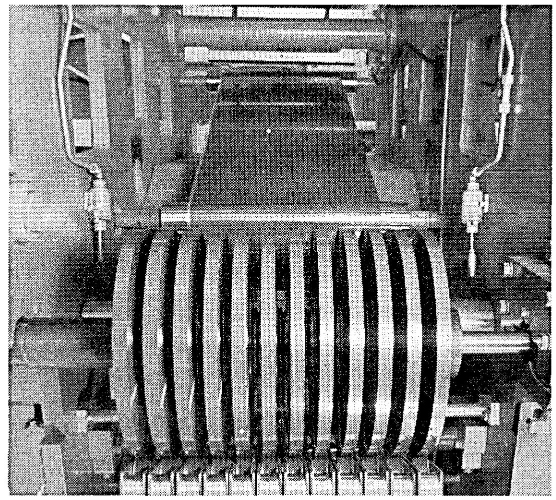
4 WAYS TO IMPROVE COMPUTER TAPE

(And how Memorex did it!)



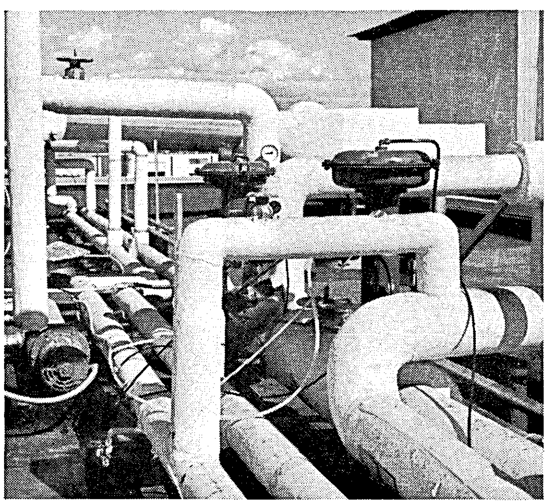
Exercise greater quality control.

The Memorex-designed Vibrating-Sample Magnetometer (VSM) tests basic characteristics of oxide raw material and precise concentration of oxide particles in the tape coating. Extra tests of this kind guarantee the improved performance and reel-to-reel uniformity of Memorex computer tape.



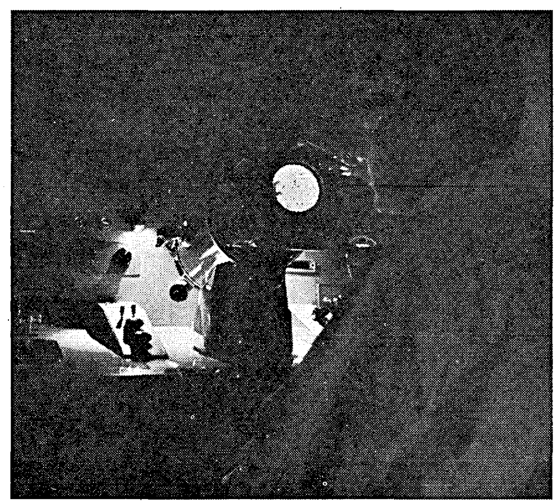
Employ advanced production techniques.

Specially constructed equipment — used to slit Memorex computer tape from jumbo rolls — produces tape with clean, straight edges free from ripples and ridges. A new slitting technique is but one of seventeen manufacturing improvements made to insure superior performance of Memorex tape.



Use a superior production facility.

A conspicuous aspect of the Memorex plant is the complex system of air filtration, humidification, dehumidification, heating and cooling. The unusual high-purity system, equal to that used in pharmaceutical processing, provides a contaminant-free environment — prerequisite to production of improved error-free tape.



Apply research in depth.

Research in oxide, coating materials, and tape-making processes has equipped Memorex with a fund of new technology. Combined with manufacturing competence, this fundamental knowledge is manifest in Memorex computer tape by freedom from dropouts, longer life, and improved uniformity and reliability of performance.

Memorex tape is premium tape. No need to pre-check it. You can place Memorex computer tape directly in service — reel after reel.

Memorex certification means what it says: Memorex computer tape <u>is</u> error-free. Extra care, extra steps and scrupulous attention to every detail make it that way. We know the importance to you of having a tape you can depend on.

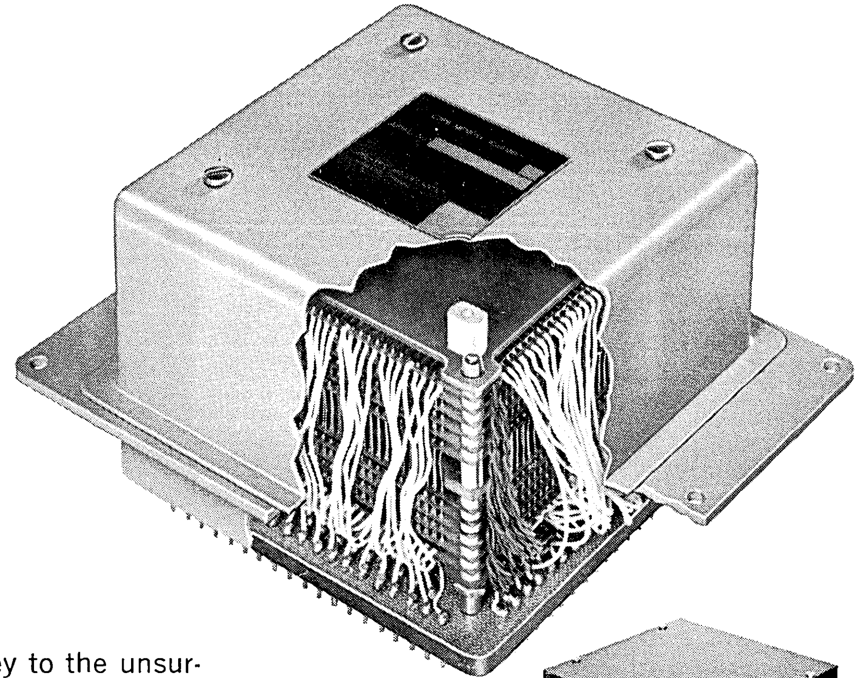
Are you on our mailing list to receive the Memorex Monograph Series of informative technical literature? Write 1176 Shulman Avenue, Santa Clara, California.

MEMOREX

PRECISION MAGNETIC TAPE

Circle No. 6 on Readers Service Card

It isn't the heat ...it's the uniformity



That word "uniformity" is the key to the unsurpassed performance of Fabri-Tek temperature-controlled core memory stacks.

A unique system developed by Fabri-Tek insures evenly distributed heat throughout every plane. The optimum temperature is maintained within narrow limits through the entire stack. The result is complete elimination of output drift, outstanding stability even in rapidly changing ambients.

The photographs on this page show part of the range of Fabri-Tek temperature-controlled stacks. Those illustrated run from a 4096 x 12 stack to an 8192 x 32 stack. Temperature (and performance) is uniformly stabilized in any size.

Normal production stacks are rugged, too, withstanding high level shock and vibration.

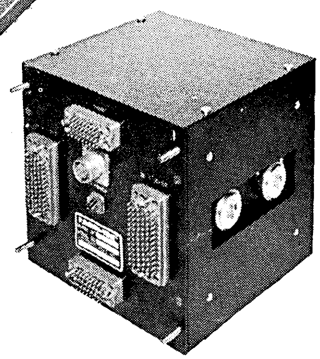
Planes used in the temperature-controlled stacks are, of course, of traditional Fabri-Tek quality. Electrical characteristics are exactly matched to customer system requirements. An active product assurance group constantly monitors all factors affecting product quality.

What's your memory problem? All of the above solutions to temperature control of memory stacks were solved by Fabri-Tek—using a common method in various configurations. We have more than 450 people whose sole business is developing and producing highest quality magnetic memory components and systems. May we help you?

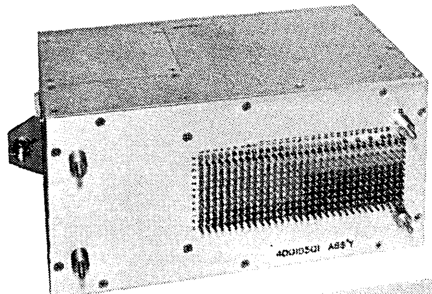
Fabri-Tek, Incorporated, Amery, Wisconsin
Telephone: COngress 8-7155 • TWX: Amery 8931

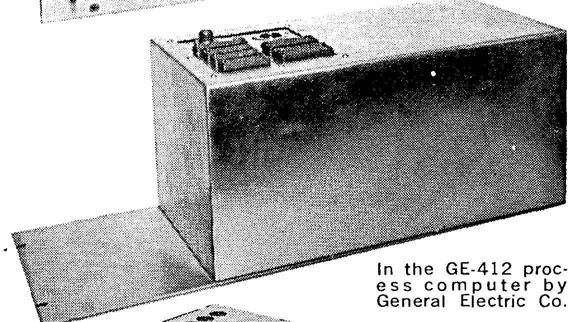
Used in Polaris program by Hughes Aircraft Co. and Control Data Corporation

In the 8400 Series computer by Collins Radio

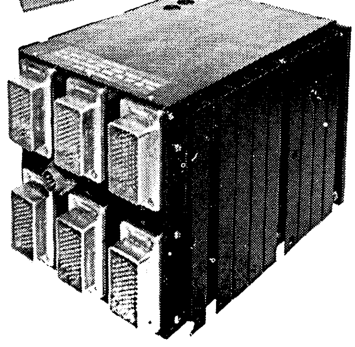


In AN/UYK-1 computers by Thompson Ramo Wooldridge





In the GE-412 process computer by General Electric Co.

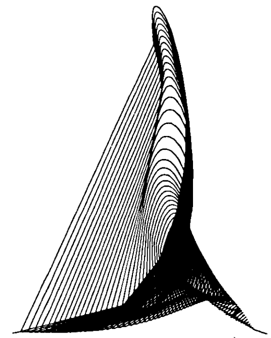


In the RCA 4100 series computers by Radio Corporation of America.

FABRI-TEK

Circle No. 7 on Readers Service Card

The winner of our Annual Computer Art Contest is again the U.S. Army Ballistic Research Laboratories, Aberdeen, Maryland, using an Electronic Associates' Dataplotter. The front cover drawing shows trajectories of a ricocheting projectile (range vs. altitude).



computers and automation

AUGUST, 1964 Vol. XIII, No. 8

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

In This Issue

In Every Issue

COMPUTERS AND AUTOMATION IS PUBLISHED MONTHLY AT 815 WASHINGTON ST., NEWTONVILLE 60, MASS., BY BERKELEY ENTERPRISES, INC. PRINTED IN U.S.A. SUBSCRIPTION RATES: UNITED STATES, $15.00 FOR 1 YEAR, $29.00 FOR 2 YEARS, INCLUDING THE JUNE DIRECTORY ISSUE; CANADA, ADD 50c A YEAR FOR POSTAGE; FOREIGN, ADD $1.50 A YEAR FOR POSTAGE. ADDRESS ALL EDITORIAL AND SUBSCRIPTION MAIL TO BERKELEY ENTERPRISES, INC., 815 WASHINGTON ST., NEWTONVILLE, MASS., 02160. SECOND CLASS POSTAGE PAID AT BOSTON, MASS.

When reliability counts, count on MYLAR®!

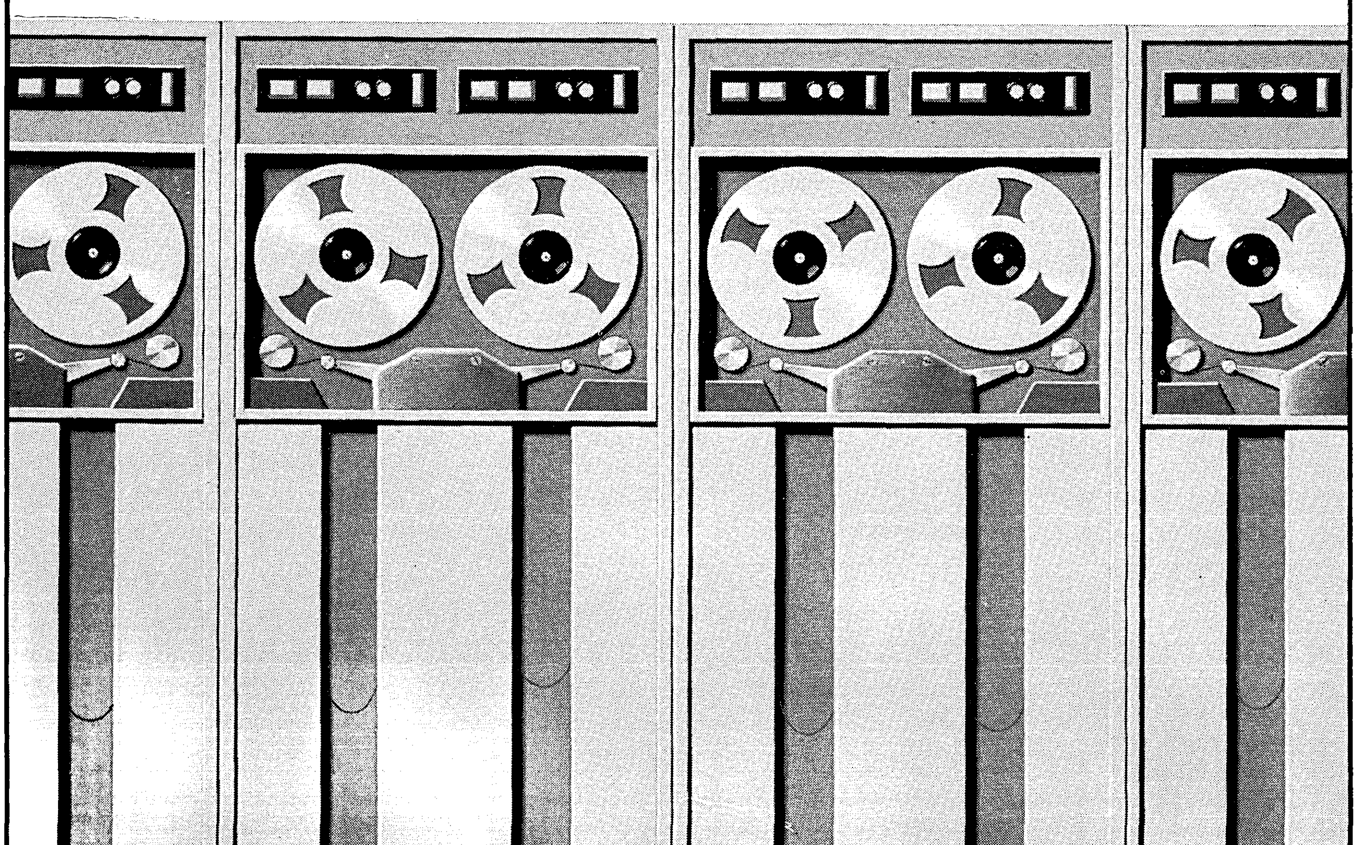
When you are recording or processing data, you want to be able to depend on your tape without worrying about it. If your tape is on a base of "Mylar"*—you can! "Mylar" is strong (a tensile strength of 20,000 psi). "Mylar" is stable (unaffected by temperature or humidity changes). "Mylar" is durable (no plasticizer to dry out or become brittle with age). "Mylar" is proven in use (a ten-year record of successful performance). When reliability counts, count on "Mylar".

*Du Pont's registered trademark for its polyester film.

DU PONT
REG. U. S. PAT. OFF.

only DU PONT makes
MYLAR®
POLYESTER FILM

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*



People Who Do Not Work

I had a discussion the other evening with a friend of mine about receiving income and not working. I said to him:

"Do you think that children under 16 should work in order to support themselves?" He said, No, their families should support them.

"Do you think that a person who is seriously ill with crippling rheumatism should earn his own living?" He said, No, his savings or his insurance or his family should support him.

"Do you think that people who are 65 and over, who are becoming feeble, should earn their own living?" He said, No, their pension plans or social security should support them.

"Do you think that intellectually able young men and women, who intend to become doctors, physicists, lawyers, etc., and who need to study full time in graduate schools, medical schools, etc., should support themselves by work while they are studying?" He said, No, they get scholarships and grants; and many of them marry, and their wives support them until they get their degrees.

"Here is a man who has spent 15 years of his life becoming a good typesetter on a newspaper linotype—and along comes an invention whereby linotype setting for all news service dispatches can be done once and for all by a punched tape produced by impulses over long distance telephone—and the newspaper cuts the number of its typesetters from 8 to 3, and this man is fired, and his skill is no longer marketable. Do you think that he should have an income until he is trained for other work?" Well, my friend hemmed and hawed, and finally he said, Yes.

"Here is a young man, age 26, with IQ about 85, he can't read well, he was never able to learn very much, he used to run an elevator but an automated elevator displaced him—and no employer will give him a job now, because there are plenty of better men available. Do you think that this man should have a minimum decent income he could live on—or do you think that he should live in poverty, on the borderline of starvation, punished for no reason he can control?"

We agreed there were a great many kinds of people in society who for one reason or another could not earn their own living. Yet how could we insist that they live in poverty in a society as wealthy as ours?

Just how extensive is work and non-work in the United States?

Table 1, below, shows some figures for the United States in 1960, based on information in "The Statistical Abstract of the United States" for 1961.

In other words, about 38 percent of the people of the United States by their work support all the people of the United States.

And we have hardly seen anything yet. The industrial system of the United States—with its computers and its automation—is extraordinarily productive, and in a few more years will be fantastically productive. It is like a fairy tale. It is as if we were making a magical machine which each year will more and more automatically provide all the food, clothing, shelter, and other goods needed for millions of people—but each year a smaller fraction of all these people will be needed to operate the machine: one in three nowadays, one in five in the next few years, possibly one in twenty or fifty in the future. What will the other potential workers do? Nothing? Is there nothing for them but boredom, and relief on a poverty level?

We have invented an industrial system which can produce wealth and abundance for everybody—and then we choke the system by providing that the only sharers in the abundance it produces are (a) people who have appropriate training and actually find and perform jobs, and (b) people who are owners.

The time has come to take a good hard look at the "people who do not work" and to change the patchwork quilt of their patterns of receiving income into something much more rational, and consistent with the industrial power to produce abundance. Might it not make sense to provide a decent minimum standard of living for everybody because he is a human being? And then in order to keep incentive for working, provide a considerable jump in income for anyone doing useful work? For example, many years ago in the United States it was decided to provide a standard of public education for every young person because he was a human being, and then provide higher education on the basis of merit and other factors.

And just incidentally, the increase in demand for goods by adding millions of effective consumers to the market for business's products would be likely to produce fantastic prosperity easily able to pay for the change. It ought to be good business!

Edmund C. Berkeley
EDITOR

TABLE 1

Distribution of Work in the United States

	Number (in millions of people)		Percent	
	Working	Not Working	Working	Not Working
14 years of age and over:				
In the labor force:				
Working:	69		38%	
Unemployed:		4		2%
Not in the labor force:				
Keeping house:		35		20%
In school:		8		4%
Other:		10		6%
13 years of age and under:		53		29%
In institutions:		2		1%
TOTAL:	69	112	38%	62%

FORUM ON THE SOCIAL IMPLICATIONS OF COMPUTERS AND AUTOMATION

COMPUTERS, AUTOMATION, AND SOCIETY —THE RESPONSIBILITIES OF PEOPLE

R. W. Retterer
Senior Vice President, Marketing
Univac Division of Sperry Rand Corporation
New York 19, N. Y.

Automation has been called the salvation—and the curse of society; the redeemer—and the oppressor of the individual; the pinnacle—and the pitfall of mankind. Automation and computers, alone, are, it seems to me, none of these. Man has conceived them, has constructed them, has converted these powerful tools to his own needs, and will, in the final analysis, control—or fail to control—the ultimate effect of computers and automation on society.

The benefits of automation are not achieved automatically; nor are the problems created by automation solved automatically. It is the diligent application by human beings of their own talents that will gain the benefits and resolve the problems.

Contrary to certain defeatist outcries—that automation is mechanizing human beings, eliminating responsibilities, and destroying the individual, I believe we possess, as a country and as individuals, perhaps the greatest responsibility in the history of mankind.

The biggest danger lies, it seems to me, in not recognizing—and not accepting—this responsibility; in not understanding that the benefits, although they are made possible by an elite group of engineers and technicians, are achieved not by them but by society at large, by people in all walks of life, who have the responsibilities of understanding and guiding the changes.

In devising uses for our electronic assistants, in choosing them and adapting them, in integrating computing systems, and in introducing them in a way that creates minimum hardship, we as persons must exercise the greatest ingenuity, imagination, foresight, and intelligence.

In an interview conducted shortly before his death, Norbert Wiener, answering the question "Are computers being used intelligently today?", replied "in 10 per cent of the cases, yes."

Asked to explain this appallingly low figure, he went on:

> ". . . it takes intelligence to know what to give to the machine. And in many cases the machine is used to buy intelligence that isn't there.
>
> "The computer is only as valuable as the man using it. It can allow him to cover more ground in the same time. But he's got to have the ideas. And in the early stage of testing the ideas, you shouldn't be dependent on using computers."

Wiener summarized his own approach to the problem: ". . . we can no longer value a man by the jobs he does. We've got to value him as a man."

This is why a vocational education geared to one commercial skill—a potentially obsolete skill—is dangerous. Any education or institution which attempts to pressure a human being Procrustes-like into one of society's vacant beds rather than adjust to the individual's needs and abilities is a narrowing, mechanizing, and crippling force.

The question, it seems to me, is not how to adapt *society* to *automation,* but how to adapt *automation* to *society.* The problem is not to teach human beings to speak computer language, but to teach computers how to speak our language.

In those minority instances of successful computer installations (in the McKinsey survey the one-third of companies which had recovered the start-up as well as the current operating costs of computing systems) it was the *ideas,* the innovations, of the *men* involved, that were in each case the reason for success.

In the McKinsey study, the 9 successful companies (out of 27 surveyed) were utilizing the computer for a wide variety of applications besides the routine office and accounting functions. The other 18 systems were restricted almost exclusively to routine record-keeping activities. Moreover, neither the success of the 9 nor the failure of the 18 could be attributed in any way to the inherent merits or defects of equipment. The outcome was wholly determined by the initiative—or indolence—of the persons making decisions.

Moreover, while a great deal of the success of a computer installation depends on top executive leadership, especially at the beginning, the truly integrated data processing system demands familiarity with the equipment, and awareness, on the part of all employees concerned, of its possibilities.

In the "total systems" concept, operating on a management-by-exception principle, information from every department—inventory, sales, etc., is processed regularly by a central computer. Deviations from an expected pattern are indicated so that immediate corrective action may be taken. The efficiency of such a system—often run on a real-time basis—depends not only on top management's ability to deal with the information and make the right decisions, but relies on the possession by each department head of a thorough knowledge of his immediate area *and* a sufficient understanding of the computer-integrated operation to relate the particular to the general and to organize departmental data in a new and meaningful way. Again, it is management men—not engineers and technologists—who are the essential inaugurators and creative members of the age of computers and automation.

In advertising, for example, factors which determine media selection were for years considered too indefinable or volatile for translation into specific computer language. Yet they have been successfully quantified by six progressive advertising agencies, and their media decisions are being made on more valid principles, on the basis of greater evidence, and with definite assurance instead of indefinite hunches.

In manufacturing, the decision is usually more obvious. Automation means increased efficiency and, in many cases, the key to survival (against domestic or foreign competition). It is economically sound and profitable to automate, to invest thousands of dollars in equipment to eliminate superfluous labor and paperwork, *only* if this will insure higher productivity and expansion, in a dynamic economy, and for a market healthy enough to respond. The desire to create jobs (at good wages) is not a disinterested and altruistic one, but a sound and important economic factor.

This parallel growth is dramatically reflected in business forecasts for the next four years. The McGraw-Hill Annual Survey for 1964-67 predicts that industry will increase its 1963 total of \$7 billion expenditure for automated machinery and equipment to \$8 billion annually over the next four years—a 14% increase. Employment in industry, the survey indicates, is expected to increase by 8% from the end of 1963 through 1967.

Interestingly enough, electrical manufacturers, who among the manufacturing industries spent the highest proportion of 1963 investment (one third) on automation and will raise this to 38% between 1964 and 1967, also expect the largest increase in employment, 11%.

While the transitional period has had its share of problems, I am convinced that the correlation between automation and increased employment will become even more striking in the months and years ahead. There are at the moment 4 to 5 million persons unemployed—yet there are job openings for 4 million skilled workers. The statistic speaks for itself. But who is going to speak for and educate these people?

Gradually we are awakening to the enormity of the change—but too gradually. Slowly we are realizing a collective and individual responsibility—but too slowly. The challenge is not only to adjust to change, or even to be abreast of change, but to anticipate and be ahead of it.

Automation and computers—our most powerful tools—are not by themselves divining rods or philosopher's stones. Man is the alchemist, who can turn a gray electronic box into an instrument of profit, prosperity, leisure, and perhaps—if he is an individual—his own happiness.

DECISIONS THAT LIMIT RESOURCES

U. Thant

Secretary General of the United Nations, United Nations, N. Y.

(From a recent publication "World Wide Trade for Peace")

"It is no longer resources that limit decisions. It is decisions that limit resources. This is the fundamental revolutionary change—perhaps the most revolutionary that mankind has ever known. . . . Those old and dreadful tyrannies of shortage are being overcome. . . ."

JOB DISPLACEMENT

"It's the only logical alternative — after all — you did terribly on the Management Decision Making Simulator."

WHO WILL TAKE THE "ULTRA-COMPUTER BUILDER" TITLE?

The face of IBM Chairman Thomas Watson, Jr. flushed slightly when a stockholder put the question directly at the recent Annual Meeting: "Does the Control Data 6600 system stand alone as the world's most powerful computer?" After a pause, Chairman Watson replied, "I think it fair to say that viewed from certain aspects — such as the kinds of equipment about to be installed or already working for a customer — the 6600 is, at the moment, the fastest computer."

Watson clearly wished the answer was otherwise ... and he is hoping the answer will change by 1967. As the leading manufacturer of computers, IBM realizes the publicity and prestige associated with being the designer and builder of the "world's fastest computer". They invested millions of dollars of their own funds in Project STRETCH during the late '50's in an attempt to gain continuing possession of the title "maker of the world's fastest computer". However STRETCH fell far short of original performance specifications, and production was terminated on the computer after only a handful of installations.

IBM's current entry in the "most powerful computer-to-be" competition is the model 90 of the System/360. This computer offers a 64-bit word length with 64K words of internal core memory (512K characters). Speeds range up in the three million additions/sec., one million floating point multiplications/sec. area... about twice as fast as the model 70. Cost of the model 90 with a half million words of 8usec. bulk core storage is about $4.5 million. In a typical configuration with the model 50 as a satellite processor, costs are in the area of $7 million. Delivery date on the model 90 is currently quoted as the summer, 1967. The only bulk storage devices currently being quoted on the model 90 are those already announced for the System/360 line... the 2361 bulk core storage unit, the 2321 data cell, and an assortment of magnetic disks and drums.

Control Data is not unmindful of the competition from the model 90. They have already lowered the lease cost on the 6600 by 40%, and have designed a new computer, the 6800, reputed to be four to five times faster than the 6600. CDC is currently proposing this machine to several AEC installations and is hoping to acquire a contract to build the first unit by this fall.

One of the problems CDC faces with their ultra-large computer program is that it appears to be singularly dependent on their engineering genius, V-P Seymour Cray. Cray is doing the pioneering design work on both the hardware and software for the 6000 family and many people feel that only he understands the full complexities of the system well enough to complete the job. At least one prominent prospect for a 6600 has expressed to us his reluctance to order a $4-6 million computer that is dependent on one man for the completion of key parts of the system. Should anything happen to Cray, they feel, Control Data is unlikely to be able to deliver on schedule and/or to specifications.

Other computer builders are also competing for contracts for development of ultra-large computer systems. Burroughs has been proposing a 9000 computer to several large installations. We understand that this unit is an extension of the firm's B5000 computer into the $50,000 per month range with an eight-to-ten times increase in processing power. Its entire memory is thin film. Philco has been proposing an extension of their 2000 line, believed to be called the 1700, and leasing in the $80,000 per month range. Both machines are believed to operate in the two to three million operations per second range, with a heavy emphasis on multiprocessing capability (executing several instructions simultaneously).

The market for ultra-fast computers has in the past been limited to scientific research institutes doing calculations for nuclear research or weather forecasting, and to the military for command and control systems. The demands of both problem areas require greatly increased fast-access storage capacity as well as greater computing power. The first demand will probably be met in the next eighteen months by the developments of photo-optical memories, ultra-fast magnetic drums, and continuous plane ferrite or thin-film memories. The second demand is not likely to be met by computers with an internal organization similar to those in the field today. For these complex problem areas possess a common mathematical characteristic, the calculation of a matrix of numerical values... values which can be determined by mutually independent calculations within the computer. A computer with a highly parallel computing structure, where these values can be determined by simultaneous and independent computing operations, could solve such problems much more quickly than possible today.

Westinghouse's SOLOMON (Simultaneous Operation Linked Ordinal Modular Network) computer provides such a network of mutually independent memories and computing elements. However, it is unlikely that Westinghouse will venture into the computer manufacturing area with this computer. Mindful of the experiences of IBM on STRETCH, and UNIVAC on LARC, Westinghouse realizes that the development of a super-scale computer is a very costly and speculative operation. However, the AEC group at Livermore, Calif. is holding technical briefings this summer with selected computer builders to invite bids for the development of a SOLOMON-type computer. The initial contract for this computer development may be awarded this fall. The selected contractor will probably be able to lay claim to "the maker of the most powerful computer-to-be" title from that point on.

ARTISTIC DESIGN BY COMPUTER

L. Mezei
Associate Manager, Systems Programming Department
Confederation Life Association
Toronto, Canada

(Based on a paper presented at the meeting of the
Computing and Data Processing Society of Canada, Ottawa, May 11-12, 1964)

Computers have been made use of in many novel ways: writing serious music and popular tunes; composing poetry; and even writing mediocre drama for production on television. One unusual field, however, where little work has been done so far is the field of artistic design by the use of a computer. In these days of abstract art supposedly even a chimpanazee can produce paintings which are acceptable to art juries—why not the computer? Besides the challenge of breaking new ground, one might be able to learn something significant about pattern and design, about order and disorder, about general laws of aesthetics.

A brief review of some of the work which has already been done in this field is shown in Chart 1.

Reasons for Research

What are the reasons for seeking to design pleasing patterns by computer program? First, perhaps is intellectual curiosity, the lure of the unknown. Throughout the ages man has used his tools for artistic purposes. The computer is merely another tool in his hands. After all, it will not really be the computer making the design, but the programmer using the computer as a tool—much like the painter's brush. Second, the question of what is aesthetic and what is not can be explored, as well as the nature of pleasing patterns. What is order, and what is chaos? Can one develop a scale from complete chaos to complete order, much as probability goes from complete uncertainty to certainty?

Resources for Computer Art

In computer-produced art, we can use mathematical equations in various combinations, and in addition introduce randomness at will. Generating pseudo-random numbers by program is relatively easy; since these are pseudo-random numbers, one can repeat the same experiment using the same pseudo-random numbers as often as desired; this has some advantages, particularly while testing a proposed program. The amount of randomness which is applied to a particular design can be controlled. It would be interesting to see what happens when, given a pattern, various modifications and distortions are applied to it. Of course, by varying these elements we would hope that eventually some designs of substantial artistic merit would be produced. We could give a test (like Turing's test) by placing a number of computer-produced designs among a number of man-made ones (as long as they are executed in the same medium, such as black and white abstracts) and then ask a group of people to try to distinguish which ones were made using the computer and which ones were made without it.

We could make movies by changing the pattern continuously and photographing the result periodically. In fact, one of the papers presented to the Spring Joint Computer Conference 1964 was "A Computer Technique for Producing Animated Movies." This paper by K. C. Knowlton of Bell Telephone Laboratories describes a highly developed language for producing movies directly from the computer. We could design textile fabrics, wall papers, tile, linoleum patterns, and what not.

What is Artistic Merit?

The crucial problem remains—what has artistic merit in a design and what does not? This problem is perhaps the main reason why so few attempts have been made at computer design, compared to computer music. Music has a limited number of elements, namely 12 discrete tones, and some well defined laws of harmony, etc.; poetry has rhyme and meter; but there are not many rules and laws of design. Exploring this problem and experimenting with proposed theories might be of value.

Birkhoff's Aesthetic Measure

One very interesting approach which could be explored on the computer is described in a book "Aesthetic Measure," by Dr. G. D. Birkhoff, a former professor of mathematics at Harvard University, was published in 1933. Birkhoff sought to assign an aethetic measure or value to any work of art—be it two-dimensional shapes, Grecian urns, music, poetry, etc. If such a measure could be found, aesthetic design by computer would be much easier. We could calculate the aesthetic measure for many related designs and select automatically the one with the highest aesthetic measure, by varying parameters. Birkhoff's formula is a rather simple one: the aesthetic measure is a function of the order in the design and of the complexity of the design. The various elements of order and of complexity which enter depend on the particular medium being considered. Birkhoff adopted the simple rule that the aesthetic measure is the order divided by the complexity; this is the expression of a well known definition of art by the 18th Century Dutch philosopher Hemsterhuis: "Beautiful is that which gives us the greatest number of ideas in the shortest space of time." In other words, it is the density of order relations in the aesthetic object.

This proposed formula is clearly too simple. Although useful in limited cases, it leads to rather artificial manipulations, such as negative corrections for faults, to make it work. To modify the formula, we could find elements of order, such as repetition, similarity, contrast, equality, symmetry, balance, sequence, center of interest, etc., and assign scores to these elements, and combine them with weighting functions. We could then test out various formulas, using the computer, and grade various shapes according to the formulas. Then a number of art experts would be asked to judge them independently, and we would find which formula—if any—came nearest to their judgement.

Chart 1

Artistic Design by Computer—Some Events and References

1958—Program written by Dr. A. P. Rich of the Applied Physics Laboratory, Johns Hopkins University, to print out weaving designs for a loom. He has also experimented with random-walk patterns with various repetitions and symmetries:

1963—Computer-aided design systems, being developed at Mass. Inst. of Technology, reported in the proceedings of the 1963 Spring Joint Computer Conference.

1963—"Computers and Automation," January, 1963, front cover showed a design produced at Mass. Inst. of Technology, by feeding images from a TV camera to a computer controlling representation of the data on an oscilloscope.

1963—"Computers and Automation," August, 1963, front cover showed a plot of the radial and tangential distortions of a camera lens, produced by a computer program developed at the Ballistic Research Laboratories, Aberdeen, Maryland, and graphed on an Electronic Associates Inc. Dataplotter.

1963—Experiments in design using a computer conducted by a A. M. Noll, Bell Telephone Laboratories: microfilm printing used in conjunction with a digital computer.

1963—Maps obtained from large-scale digital computers, displayed on a cathode-ray tube of General Dynamics Electronics.

1963—Benson-Lehner's electric plotter associated with a computer produced finished art, such as company trademarks and cartoons to various scales.

1964—"The Many Phases of Digital Plotting," a booklet distributed by California Computer Products, included examples of pictures which, once coded, can be obtained to any desired scale.

1964—Article in Jan., 1964, "Computers and Data Processing" by N. J. Ream discussed certain problems of visual display systems.

1964—An advertisement for Stromberg Carlson S-C 4020 explains the advantages of visual display powers to transform numbers into picture on graphic form,

1964—"Adding Motion to Computer Output," article by N. E. Franley, in "Data Processing for Science Engineering," March-April, 1964: visualizing of computer output.

Polygons

For example, for polygons, the elements of order are vertical symmetry, stability, rotational symmetry, and the existence of a horizontal-vertical network. The complexity is measured by the number of distinct lines containing at least one side of the polygon. Birkhoff rated some ninety polygons; the square received the highest score, 1.5; some complex polygonal figures had a negative score.

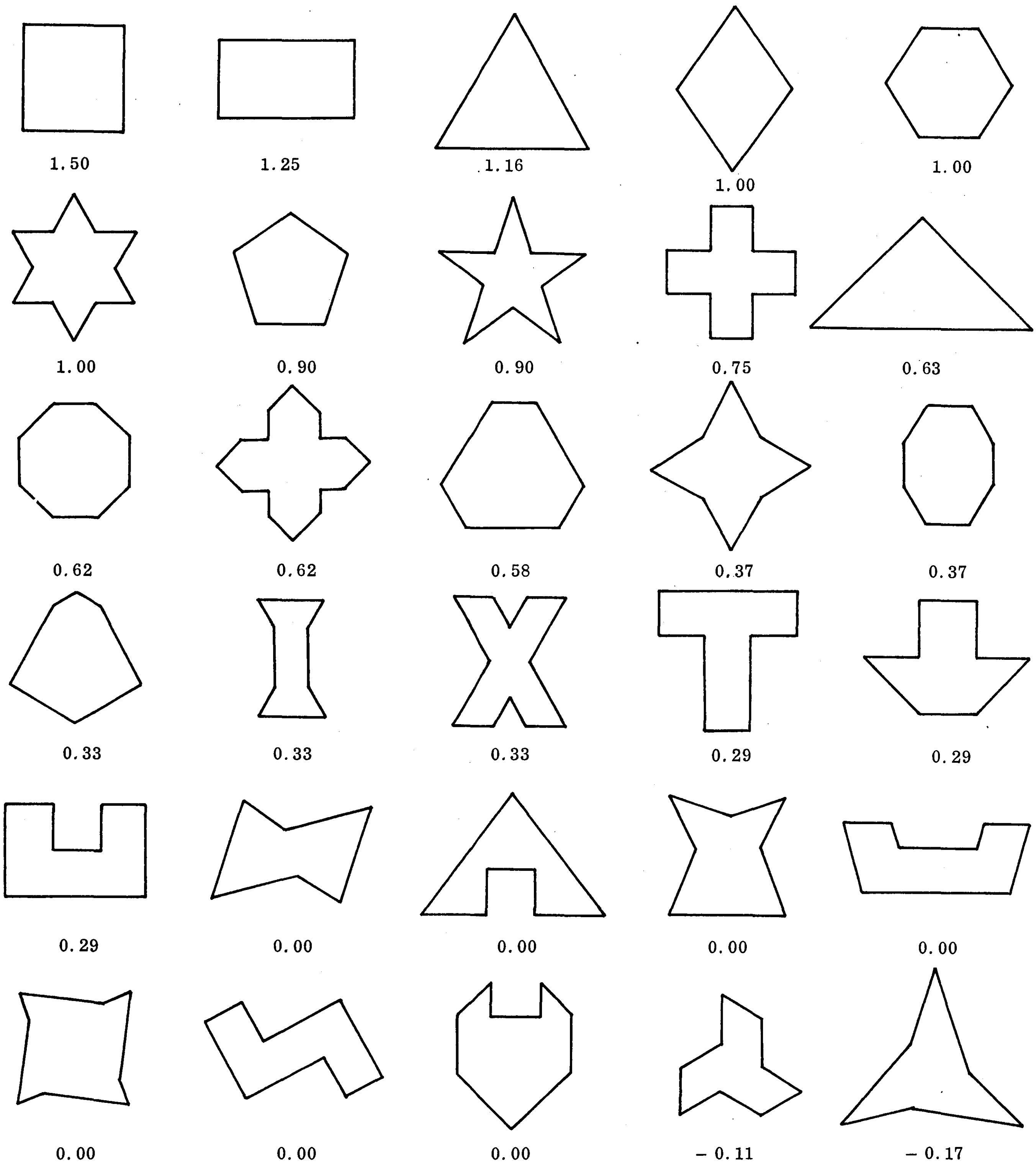
Urns

The next field to which Birkhoff applied "aesthetic measure" was the design of urns. He analyzed them according to relationships beween various aspects, such as the widths at the base, at the top, and at the widest point; the height, the characteristic tangents, etc. The next step he took is of particular interest: he actually designed experimental vase forms based purely on geometric considerations, using uniform relationships to achieve a high value of the aesthetic measure. The results speak for themselves; see the figures. If such handsome vases can be designed according to simple rules like these, surely they can be designed by computers in great numbers, with the more aesthetic ones selected either automatically based on their aesthetic measure, or visually by an artist.

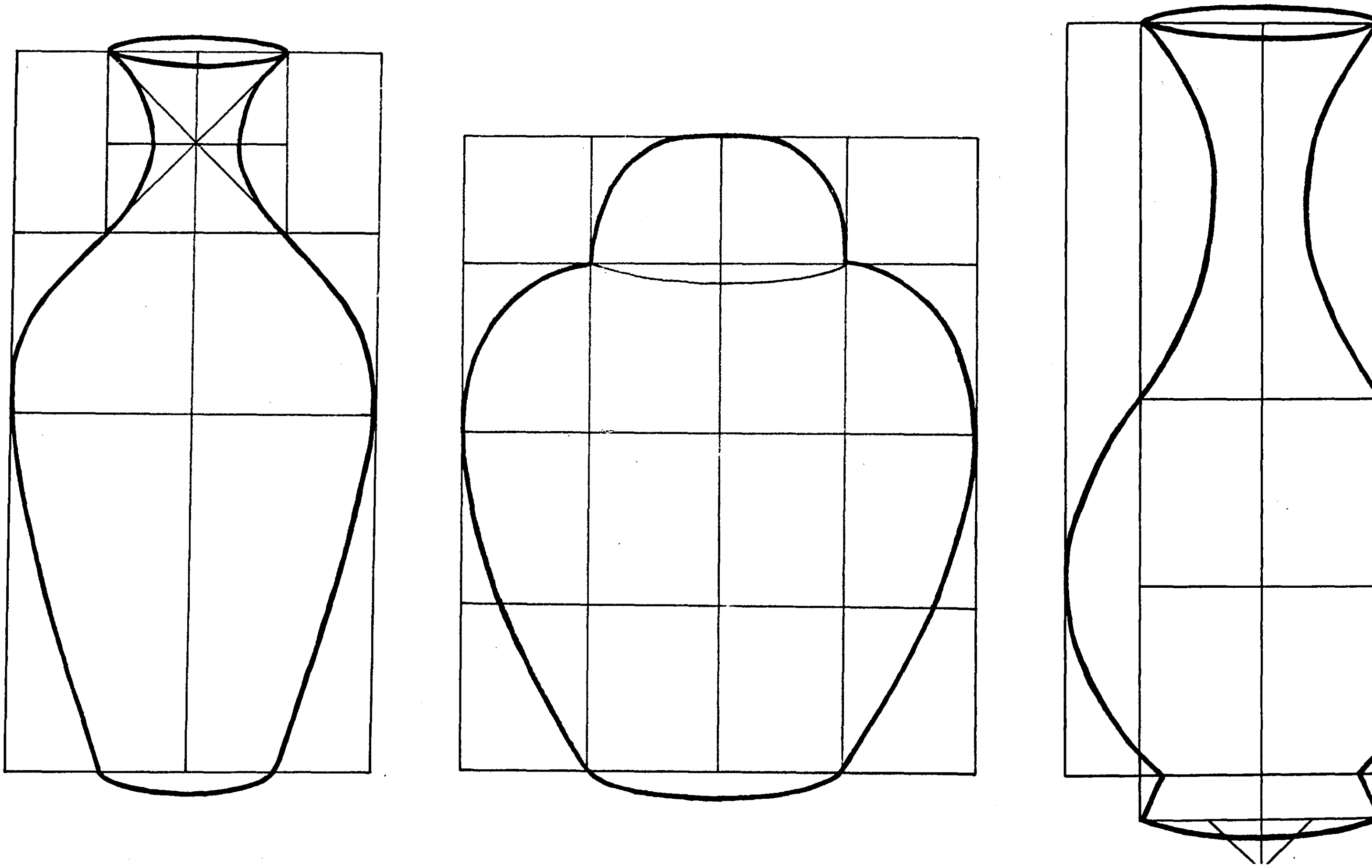
It would be interesting to extend this kind of search for aesthetic measure to more complex designs by evaluating the relationships between the elements which they contain. This might be tedious by hand, but could easily be done by a computer.

Present Project

We shall now describe a present spare-time project, which has the cooperation of a graphic designer, Mr. Arnold Rockman. The plan is to experiment on available equipment



Aesthetic measure computed for polygonal forms (from "Aesthetic Measure" by George D. Birkhoff)



Aesthetic Measure of Vases (from "Aesthetic Measure" by George D. Birkhoff)

(an IBM 705 with line printer) using the FORTRAN language and put out displays using a simple technique of x's, O's and blanks. Initially the circle was chosen as the basic starting pattern. We read in the circle from punch cards, placing it into a section of memory corresponding to an area in the output of 120 lines by 120 digits in each line. We then operate on this by a program producing an experimental design, write it out in the 120 lines on the printer, and then proceed to the next programmed experimental design.

The first problem which appears is building up a language of generalized sub-routines, not only applicable to the initial circle, but also to be useful later on for other figures. Some of the subroutines which need to be defined are: shifting left or right, up or down, or diagonally; rotations and reversals; changing scale to enlarge or reduce the figure in whole or on part.

For an initial experiment, we could divide the circle into its four quadrants, and then obtain a variety of possible patterns by moving them relative to each other, superimposing them on each other, adding textural interest by printing some as plus signs, others as minus signs, etc.

Randomness

The next step might be to apply various distortions to a pattern. Applying strictly random fluctuations might give us chaos and might not be very "interesting" or "aesthetic." Randomness must be controlled and continuity maintained, which is achieved automatically in nature. One way to do this might be to use random numbers distributed exponentially, so that small distortions would be more frequent than large ones. Furthermore, we could impose a maximum for the deviation of any point relative to its neighbors. This could be done more easily using angular co-ordinates, varying the radius and angle and imposing limitations on the derivatives of the curve, but that is a more appropriate system for line drawings.

By applying distortions which include random numbers we would be able to control the amount of disorder we introduce and to observe the effect of various manipulations, depending on how tight or loose is the control we keep over the variations and distortions.

In the system reported at M.I.T. called Sketchpad the form to be manipulated could be drawn on a display scope with an electronic pencil; then programmed manipulations could be produced at the console of the computer; and the result was immediately seen on the output screen. The process could then be repeated and modified according to the desire of the experimenter. If a large parallel-processing computer with interrupt features were available, then each designer sitting at his own console could work with a display screen and keys for controlling his designs.

We have mentioned several avenues of exploration of the uses of computers in artistic design. It is hoped that this article may stir interest by some researchers in experimentation in artistic design by computer.

THE COMPOSER OF MUSIC AND THE COMPUTER

Albert Seay
Paris, France

The history of music is the record of the search for new means of musical expression, experimentation with new ways of arranging sounds, and exploration of new methods of producing those sounds. All these means have the end goal of satisfying the esthetic demands of changing generations. In the past, one has seen the predominance, at one time or another, of the mass and motet, the opera, the symphony; there have been ages where the principle generator of sound has been the voice, the violin family, the wind instruments. Each age has found its own individual artistic means of musical expression, one that fulfilled its esthetic needs, and one that characterized its approach toward the musical art. Our time is no different.

Electronic Means

For this reason primary interest on the part of many composers of late has been directed toward the exploration and exploitation of electronic means to make music. Not only does the world of electronics provide new ways of organizing sound on more complex bases than in the past, but it also provides new ways of producing those sounds, methods which give a more immediate communication from creator to audience. With the present-day ability of the composer to create directly in sound, without the intermediary of the performer or the interpretor, the composer can have a primary relationship with his public and transmit his artistic thought undistorted by a third party.

This aspect of electronic utilization is that which seems to interest most composers at the present time: the ability to insure that his musical ideas, no matter how complex, can be concretely realized and without misunderstanding of meaning.

Like any musical novelty of the past, the full comprehension of the potential of these new paths opened by discoveries in the electronic world has been slow and laborious. As in previous periods, the first attempts to use this medium were primarily in utilizing the new within the framework of the old. To give but one example, in the nineteenth century the invention of the saxophone was followed by a long period in which its employment was primarily as a louder substitute for the oboe and clarinet. We have seen this trend in the earliest use of electronic means, with the development of the electronic organ, the "Solovox," the "Theremin." All these more or less entered the musical scene as imitators of and replacements for the conventional, used conventionally. The initial efforts, indeed, of early experimenters with the capabilities of the vacuum tube were directed toward imitation of that which already existed, not the exploration of the new. Elaborate analyses of all kinds of tones were made, with the general goal of reproduction of these tones by other than the normal methods of the past, by blowing, plucking, pounding, or scraping.

Tape Recorder

With the development of the tape recorder and the varieties of electronic means of sound reproduction available to the artist, the change toward a concept of new forms of tonal experience as valuable in themselves and without reference to imitative procedures has beeen accelerated. Combined with the expansion of serial technique to all the elements of music and not simply the arrangement of pitches within specified series of mutations, the new resources were rapidly explored as ways of exerting more complete control over the final product and the individual elements within it.

True, the first products of the tape recorder as a musical instrument were primarily somewhat mechanical perversions of the original material, gained by such comparatively simple procedures as speeding up, slowing down, reversing, filtering, etc. In some cases, the basic tape took its starting point from a recording of natural sound, humanly produced, leading to what has since been labeled as "musique concrete"; in others, where the sound was artifically generated by electronic means, it was later subjected to the same manipulations. While of interest to many composers, these procedures could not completely satisfy in degree of control, particularly due to an ever increasing desire to rely upon mathematical mutations as the determinant of the forward motion of the musical work. As a producer of controlled sound, the tape recorder and its accessories could show new tonal horizons to the composer, but could not give him as complete a control as he might desire; the basic tone subjected to mutation was outside his hands.

What was needed was a method whereby the composer could build his tones from the foundations, subjecting them to his desires completely, without the need to reshape what had been done previously. Even in those cases where he could build electronically what he wished, the mechanical processes of cutting, splicing, rerecording and editing of tapes required an outlay of energy not always congenial or rewarding.

Analog Computer

The initial introduction of the analog computer as an aid to the serialization of music met with some response, particularly in France, where, under the name "musique cybernetique," it gained some prominence for a time, particularly around 1958-1959. Here, programming was done for sequence of tones, their length and their concurrent production. The resultant series of numbers was then transformed into a conventional musical score, to be performed by conventional instruments. Compositions so derived found their principal place as background music, the greater part for films. While electronic methods of tone production could have been used, too much labor in taping processes would have been demanded and was thus not resorted to. Certain demands for control of serialization was easily satisfied, but control of tonal production did not enter into the situation nor was it possible to eliminate the interpreter, the performer.

With an understanding of the difficulties involved in the coordination and merging of the two basic approaches outlined above, it is easy to see why the place of electronic music was, until recently, a comparatively small one. While it was easy enough to arrive at new tonal sensations or to develop, with electronic help, complicated patterns of sound, it was not so simple to combine the two factors without what seemed to many musicians to be excessive time and effort. For the average composer, it was far easier to utilize either technique within an already established framework of tradition, where the ratio of music produced to hours spent in creation was not intolerable. Attempts to program computers to write music from stored directions were, to the composer, a waste of effort, for the results had little or no artistic value, serving as little more than musical curiosities; only where such experiments led to increased understanding of electronic capabilities and applications to the problems of the composer were they considered useful.

Digital Computer

The addition of the high-speed digital computer to the electronic resources available to the musician has been of almost revolutionary impact. It has shown a way to solve the question of control over all the elements within a musical composition. Not only is there now a higher degree of precision in the final product, but the onerous processes of mixing, splicing, etc., are avoided; no manual manipulations are required. True, there is a time lag between the composer's actions and the audible results, but this is no different from the older situation, where the realization of an orchestral work could not and did not immediately follow the conception.

The Digital Computer Musical Process

In an article in the *Journal of Music Theory*, Spring 1963, James C. Tenney, an associate member of the technical staff of the Bell Telephone Company Laboratories at Murray Hill, New Jersey, has given a thorough technical description of the processes involved in adding the digital computer to the tools available to the composer. The comprehensiveness of this article for the interested reader, makes it basic to an understanding of what composers can do with the latest in electronic circuitry. It is possible, however, to summarize here the broad process by which the final work is achieved; from these, it will be seen exactly why the innovations discussed are of such importance in the history of electronic music.

Tenney outlines four broad steps that must be taken: (1) the "transformation from musical conception to numerical specification" (the digital computer); (2) this "score," to use a normal musical term, made of numbers which define the parameters of sound, duration, frequency, amplitude, waveform, etc., are then transformed again to a new set of numbers, these defining the successive instantaneous amplitudes of the sound waves themselves (analogue computer); (3) the conversion of these numbers to sound signals is recorded on tape; (4) the tape is finally played back on conventional equipment.

The stages involved here are in many ways analagous to compositional methods of the past, using normal instruments of the conventional type. First is the initial conception of the work within the mind of the composer; than its transformation to schematized drafts; next, the actual writing of the score; and, finally, its performance. The major difference lies in the area of control by the composer, for the definition of the various elements is much more precise. In the preparation of compositions in the past, the probabilities of unclear definition of desired results were quite high, for the composer might well notate his music incorrectly, or misunderstand the problems of the instrumentalist, and then he would be faced with personal reinterpretations on the part of each successive performer. Further, the initial conception might well have been conditioned by a standardization of musical means, that is, the standard groupings of tone-producing elements derived from custom. Simply put, why write for a string quartet? The answer often was that such a combination existed, needed repertoire and would perform new works, while a composition for, let us say, saxophone, xylophone, tympani and viola, could never be presented without special effort and without extra expense.

Supremacy of the Composer

To the music historian, the advent of electronic means and methods as a medium for musical expression is not surprising. The path of music in our Western civilization, unlike that of others, has been a steady advance toward the supremacy of the composer over the performer. Beginning with improvisational techniques, directed exclusively by the performer, there has been a steadily rising demand on the part of the composer that the performer occupy himself with the reproduction of the composer's desires and not the expression of the performer's personality as reflected in the work at hand. The limitation of the performer's role to that of reproducer has been a slow but certain one; the ever-increasing definition of the composer's desires has been a characteristic of our musical history for many centuries.

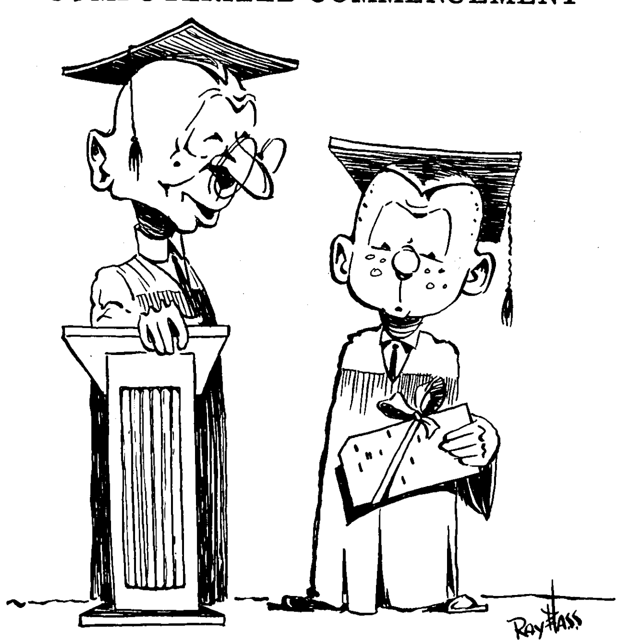
It is obvious that one cannot say exactly what the future of electronic music produced through the help of computers will be. It can be, like any valid means of artistic expression, anything that the creative mind behind it wants it to be. It can be used to provide new paths in sound sensation, in tonal organization, in intellectural abstraction, in sensual pleasure; all of this will depend upon the goal of the individual artist. What is certain, however, is that we are facing a new musical age which, like other ages before it, is now developing its own means of musical expression, in tune with the esthetic demands of its own time and reflecting the innate artistic drives of the present day.

Electronic Music Laboratories

All this is apparent to most musicians of today, as may be seen in the steady growth of electronic laboratories in our universities and schools of music, for it is in these situations that tomorrow's composers are being educated. Where only a few years ago, such laboratories were most often adjuncts to radio and television systems, today we find them in increasing number as part of the educational scene. In North America alone, there are now school laboratories and, what is more important, organized courses in electronic techniques as pertinent to the composer. These courses have the same functions as previously in curricula that included orchestration and conducting. Yale, Columbia, Illinois, Toronto—these four universities come immediately to mind; but even the smallest of colleges today has some sort of introductory course that gives the embryo composer some idea of the new musical means which he may have at his disposal.

The use of computers in music is thus not a passing novelty, but a logical step forward in the historical process. So far as the musician is concerned, it is a way to express his thoughts and to communicate with his audience. While newer techniques in the preparation of the raw material and its refinement are still in the future, it is now evident that, just as the development of the orchestra in the eighteenth century led to a Beethoven, a Berlioz, a Wagner, and a Richard Strauss, so will the growth of computer capabilities lead to equally great artists of the future. There is still great music to be composed; the computer will be one of the tools.

COMPUTERIZED COMMENCEMENT



"Congratulations, — and remember — do not bend, fold or mutilate your diploma."

A COMPUTER SHARING PLAN AT WORK

Patrick A. McKeown
Assistant Director, Data Processing Division
U. S. Navy Aviation Supply Office
Philadelphia, Pa., 19111

Computer sharing has worked very successfully among the government agencies in the Philadelphia area. The U. S. Navy Aviation Supply Office (ASO) in Philadelphia, Pa., has contributed heavily of its data processing talent, time, and equipment in helping to make computer know-how and equipment sharing pay benefits to both the contributor and the receiver of services. By contributing its services ASO has been able to fill in the valleys in its machine loading schedules, and to provide needed services at minimal cost to other government agencies on an out-of-pocket cost reimbursable basis. To ASO, this has had the added advantage of helping to reduce equipment operating costs while helping fellow agencies to accomplish their mission. But, we are getting ahead of our story. Let's back it up to the beginning.

Experimental Plan

The U. S. Bureau of the Budget, after about a year of study in 1961 by the Computer Sharing Plan Working Group, initiated its Experimental Regional Sharing Plan for Electronic Computers in June of 1962. The Philadelphia Region was picked to implement this experimental plan and to establish the First Computer Sharing Exchange on a test basis to check its feasibility. The test period was set for 6 months to 1 year. On completion of the test, the Bureau of the Budget would evaluate the plan, and, if it were found successful, would extend it to other Government Regional areas.

Objective

The objective of the plan was to promote and facilitate arrangements for the cooperative sharing of available *unused* electronic digital computer equipment time and services, among, and for the mutual benefit of, the Federal Government Agencies in the Philadelphia Regional area. This area includes parts of Pennsylvania, Delaware, and New Jersey.

The objective was in direct consonance with President John F. Kennedy's memorandum of November 1961 issued to the heads of government departments and agencies. This memorandum established Regional Executive Boards to provide means for closer coordination among field agencies in regional areas to improve management in common areas of administration, and to pool resources wherever possible in the interest of economy in government operations.

ASO's Data Processing Division, as well as other government data processing installations in the area, started sharing their talent, time, and equipment in August 1962. A government activity in need of computer services may enter into the program by means of a request either in verbal or written form. These requests are funnelled through the Computer Sharing Exchange and forwarded to the agency capable of performing the desired service, i.e., Analysis, Programming, Computer Equipment time, peripheral equipment time, and clerical services incidental to the completion of the end product.

Register

The Exchange has a register of all equipments in use in government agencies in the Area. When requests for services are received they are applied against this register for an appropriate installation and then forwarded to that installation. Contact is then made directly between the contributor and receiver of the desired services.

Equipment

The Data Processing Division in ASO has a large installation and staff in operation and is in a position where it can help other agencies who have little or no equipment. It has in operation: two IBM 1410s, with two 1301 Random

Access Disk Files, five IBM 1401s, one Univac 490, one Burroughs B283, an Automatic Digital Communications Network, and sixty pieces of unit record equipment. This equipment is manned on a two to three shift basis, by a staff of 18 Analysts, 41 Programmers, 117 Operators, and 64 Clerical/Administrative personnel.

TABLE 1

Computer Equipment in Government Installations in the Philadelphia Region Used in the Regional Sharing Plan

Number	*Model*
2	Alwac IIIE
1	Burroughs 220
1	Burroughs 283
2	Control Data G-15
2	IBM 650
17	IBM 1401
2	IBM 1410
1	IBM 1620
1	IBM 7070
2	IBM 7080
1	IBM 7090
1	LGP-30
3	RCA 301
2	RCA 501
1	Univac III
1	Univac SS 80
1	Univac SS 90
1	Univac 490
1	Univac 1004
1	Univac File Computer

Reimbursements

With this range of equipment, talent, and resources, ASO rang up an impressive record of computer sharing services during 1963 that totalled $95,376.00 in reimbursable services, and $3,251.00 in non-reimbursable services. September, 1963 was a record month with a resounding tally of $17,567.00. Most of this service was a result of large scale printing services on IBM 1401 dual printers over week-end operations. All of these services were performed with no interruption to ASO's own schedules.

ASO's rates for services to other government agencies are figured on an "out-of-pocket cost" basis. The cost estimate for proposed projects is figured by applying estimated hourly time for equipments and personnel against a standard hourly rate chart which has been averaged to include prime time and extra shift rates (100% Prime Shift rate—40% Extra Shift rate—averaged to 70% rate—regular or overtime hourly rates for personnel). The total estimated job cost is then supplied to the requester who sets up a financial allocation in the total amount. As work is performed, hourly charges for equipment and operators, analysts, programmers and/or clerks are recorded.

Upon completion of the services, total costs are computed and the bill is given to the requester who arranges for the transfer of funds from his original allocation to ASO funds. Reports of projects accomplished on a sharing basis, showing the hours, rates charged, and total charges are forwarded each month to the Computer Sharing Exchange, thus completing the cycle. The Exchange consolidates all reports into a single report for the U. S. Bureau of the Budget.

Services Provided

ASO has been able to provide a wide range of services to other Navy Activities, Marine Corps., Army, and Defense Department installations. These services have included complete analysis, programming, and help in analyzing problem definitions (even the use of some of our own programs slightly modified). Equipment services represent the biggest part of ASO's dollar charges. ASO has systematized, on a formal paying basis, some services which were formerly performed on an informal non-paying basis, and at a profit to both agencies.

Seminar

To acquaint potential users among government agencies with the Computer Sharing Program, ASO, along with data processing representatives from five other government agencies in the area (U. S. Army Electronics Materiel Agency, Defense Clothing and Textile Supply Center, Veterans Administration, Internal Revenue Service, and the Social Security Administration) conducted an Automatic Data Processing Seminar.

The seminar was held under the auspices of the Philadelphia Federal Executive Board. It covered such basic subjects as: Basic EAM/ADPE, Fact Finding Regarding Present System, Systems Application Study, Feasibility Determination, Obtaining Hardware Services, Obtaining Systems Programming Services, Introduction to Block Diagramming, Additional Applications, Integrated Systems, Prevailing Systems, Random Access Concepts, Source Data Automation, Communications and ADP Sharing.

The seminar has familiarized personnel from other government agencies in the tri-state area with the capabilities of automatic data processing in existing installations. It was also helpful in easing the timidity that the uninitiated sometimes feel as a result of the glamour and mystery that has surrounded computers. The sessions were especially helpful to requestors, by providing a better definition of their problems and informing them of advanced techniques which have provided services not previously possible.

Meeting Time Limits

The Regional Computer Sharing Plan as it is operating at ASO is highly successful from two points of view. From the point of view of the requester, it has helped other government agencies in the area to get vitally needed work completed within specific time limits at very reasonable prices (much lower than Service Bureau rates). It has aided other government data-processing installations to meet "impossible" schedule dates on some of their priority projects that were urgently required to fulfill government missions. It has permitted other government agencies to keep operating costs down by not having to install equipment and/or in not expanding equipment requirements that may not have been fully used nor justified.

Using Valleys in Schedules

From the contributor of services point of view, ASO has been able to increase its utilization of existing data processing equipment by scheduling *unused time* (the valleys in the production schedule that give us all fits) at its convenience. ASO has benefitted further by the receipt of reimbursable funds for services performed. Of course, this pleases us in that it is a credit item on our Operating Costs Report and this is in perfect harmony with President Lyndon B. Johnson's latest directives to all federal agencies and employees on government operations in connection with the Cost Reductions Program.

Washington Region Next

The Regional Computer Sharing Plan has been most successful. In fact, the Bureau of the Budget has taken steps to extend the plan. A Computer Sharing Exchange was established in the Washington Region for agencies in that area in January of this year. Based on ASO's experience, that Exchange should have the same measure of success as the one in Philadelphia, or, perhaps even better now that the kinks have been ironed out of the systsem.

Chart 1

STAFFING NUMBER OF COMPUTERS - APRIL 1964

1a. Manual Input Systems - Monthly Rental Range up to $2000

System	Monthly Rental	Number Installed, a	Number On Order, b
CDC 160/160A	$ 1750	345	22
DEC PDP-4	1200	32	12
DEC PDP-5	500	12	26
LGP-21	725	90	45
RPC-4000	1875	98	3
IBM 1401G	1900	0	750
IBM 1620	2000	1450	60
Monrobot XI	700	355	185
NCR 310	2000	45	4
NCR 390	1850	535	205
PB 250	1200	150	10
SDS 910	2000	44	42
TOTAL:		3156	1364

Staffing Number, d = 3458

1b. Small Scale Systems - Monthly Rental Range $2001 to $8000

System	Monthly Rental	Number Installed, a	Number On Order, b
ASI 210	$ 2850	15	2
ASI 2100	3000	2	3
B 250/60/70/80	5300	252	175
DDP 24	3080	11	28
DEC PDP-1	2400	54	7
DEC PDP-6	6000	0	1
GE 215	5500	14	15
GE 225	7000	160	30
GE 425	6500	0	22
H 200	4200	0	375
H 400	5000	92	34
IBM 1401	3500	6550	750
IBM 1440	2800	630	2650
PB 440	3500	1	9
RCA 301	6000	396	150
SDS 920	2700	31	15
SDS 930	4000	0	6
SDS 9300	7000	0	2
UNIVAC 80/90-STEP	8000	360	5
UNIVAC 1050	7200	22	176
TOTAL:		8590	4455

Staffing Number, d = 9132

THE COMPUTER PERSONNEL REVOLUTION

In today's computer literature one can hardly escape articles describing the extraordinary growth of the computer industry and its anticipated expansion during the next decade. These articles are full of such key phrases as "total information systems" and "management by exception"; and in general they tend to be systems-oriented. The purpose of this article is to examine a basic issue which has been largely ignored so far, namely, the revolution in computer personnel requirements which is being created by the great expansion of the computer industry.

The American economy has always so far been able to fill employment gaps. Now the problem at hand is to develop a large supply of people capable of effectively utilizing the advancing computer technology, people who are trained to utilize the new methodology at or near its potential, the people who will enable rosy industry forecasts to be realized. One can confidently assert that there is going to be a serious *shortage* of properly-trained personnel. To support this assertion, we will look at the probable personnel requirements and then at some methods of meeting the requirements.

Present Personnel Requirements

To begin with existing requirements: the need for personnel in the computer field today can be expressed on the basis of known quantitative data concerning the industry. The April 1964 **Computers and Automation** census provides the basis for the estimates and extrapolations which follow. This census gives data concerning presently installed systems and systems "on order." The latter category is interpreted to mean systems which will be installed within two years, or, for purposes of this article, in the near future.

The method of determining present personnel requirements is based on classifying computer installations by size of computer, and approximating to personnel requirements for each size of computer.

1c. Medium Scale Systems - Monthly Rental Range $8001 to $25,000

System	Monthly Rental	Number Installed, a	Number On Order, b
B 5000	$ 16,200	25	15
CDC 924	11,000	23	8
CDC 3200	9,000	0	30
GE 210	16,000	72	4
GE 235	10,900	5	10
GE 435	12,000	0	8
GE 455	18,000	0	2
GE 465	24,000	0	1
H 800	22,000	60	5
H 1400	14,000	4	12
IBM 1410	12,000	285	205
IBM 1460	9,800	150	350
IBM 7010	19,175	8	24
IBM 7040	14,000	30	55
IBM 7070/2/4	24,000	450	100
NCR 315	8,500	155	102
RCA 3301	20,000	0	9
RCA 501	15,000	94	5
UNIVAC III	20,000	53	82
UNIVAC 418	11,000	3	5
TOTAL:		1417	1032

Staffing Number, d = 1965

1d. Large Scale Systems - Monthly Rental Range $25,000 and up

System	Monthly Rental	Number Installed a	Number On Order b
CDC 1604	$ 35,000	56	15
CDC 3400	32,000	0	10
CDC 3600	52,000	12	18
CDC 6600	150,000	1	2
H 1800	30,000	3	6
IBM 7044	26,000	18	17
IBM 7080	55,000	63	19
IBM 7090/4/II	70,000	307	220
Philco 212	52,000	6	6
Philco 2000-210/11	40,000	19	6
RCA 601	35,000	3	2
UNIVAC 490	26,000	27	21
UNIVAC 1107	45,000	16	13
TOTAL:		531	355

Staffing Number, d = 744

Notes to Chart 1.

1. Data for April, 1964, "Computers and Automation" census used exclusively.
2. All systems which may be considered special purpose computers were eliminated.
3. All systems not in production were eliminated.
4. All card processors, without stored program capability, were eliminated.
5. For systems sold, only, a factor of 1/50 of the purchase price was used as an average rental.

Dick H. Brandon
President, Brandon Applied Systems Inc.
New York, N. Y.

In detail, the personnel requirements are computed using the following assumptions and calculations:

1. Computers are defined as all systems listed in the **Computers and Automation** census with the exception of special-purpose computers and externally programmed machines. This definition eliminates machines such as the UNIVAC 1004, and the A.M. 900 series.
2. All systems are then classified into four categories strictly on the basis of cost; specifically, cost is determined by the "average rental" indicated in the census. the four classifications are manual input, small scale, medium scale, and large scale. Chart 1 shows the April 1964 census reclassified into the four categories, showing the number of computers installed and on order in each class
3. We now need to estimate the number of personnel complements or installation teams represented by the number of computers reported in the census. The number of personnel complements or installation teams cannot be a simple addition of the number of installed computers plus the number of computers on order, since many of the on-order systems will replace existing systems and/or installations, and many installed computers exist in multiple installations. So we adopt a compromise, constructing a number to stand for the equivalent number of computers supposing that each computer had one whole installation team. We call this compromise the "staffing number" of computers, and we vary it according to the classification of the computer. As an example, in large-scale systems there are very few multiple system installations, and the on-order figures represent considerable impacting, i.e., large-scale systems on order will replace installed medium-scale systems or other large-scale systems.

Chart 2

FORMULAS FOR STAFFING NUMBER

System Classification	Remarks	Number Installed	Number On Order	Staffing Number
a. Manual-input	Half the installed systems are installed in multiple installations; 20% of the on-order systems will be "second" or will replace already installed systems $d = .75a + .8b$	3156 (x0.75)	1364 (x0.8)	3458
b. Small-scale	Use as peripheral equipment and replacement is heavier than in manual-input systems $d = .7a + .7b$	8590 (x0.7)	4455 (x0.7)	9132
c. Medium-scale	Few multiple systems, heavy replacement $d = .95a + .6b$	1417 (x0.95)	1032 (x0.6)	1965
d. Large-scale	No multiple systems, heavy replacement $d = a + .6b$	531 (x1.0)	355 (x0.6)	744
TOTAL:		13,694	7,206	15,299

Chart 3

PRESENT PERSONNEL REQUIREMENTS - ESTIMATED

Category of System:

	a. Manual Input	b. Small Scale	c. Medium Scale	d. Large Scale	Total
Number of Systems	3,458	9,132	1,965	744	15,299
Average Requirements Per Installation:					
a. Analysts	.5	2.0	4.0	9.0	
b. Programmers	1.5	5.0	8.0	15.0	
c. Operations	1.5	2.5	5.0	8.0	
Total Requirements:					
a. Analysts	1,729	18,264	7,860	6,696	34,549
b. Programmers	5,187	45,660	15,720	11,160	77,727
c. Operations	5,187	22,830	9,825	5,952	43,794
TOTAL:					156,070

NOTE: "Analysts" includes systems analysts, problem analysts, mathematical analysts, and their supervisors, with responsibility for problem analysis to the point of job specification. "Programmers" includes logical analysts, coders, testing and documentation personnel, and their supervisors, with responsibility for translating the specification into a working system. "Operations" includes console operators, tape handlers, satellite computer operators, and their supervisors, but not EAM operators, librarians, or input-output personnel.

The compromise consists of the following rule: If a equals the number of installed computers, b equals the number of computers on order, and d equals the staffing number (our compromise figure), then the approximate formulas that we adopt for use in estimating are:

$d = a + .6b$, for large-scale systems;

$d = .95a + .6b$, for medium-scale systems;

$d = .7a + .7b$, for small-scale systems;

$d = .75a + .8b$, for manual-input systems.

This final calculation reveals the need for over 34,000 analysts, nearly 78,000 programmers, and about 44,000 operators to service the 20,900 computers presently installed and on order—a grand total of 156,000 trained computer people.

Estimated Future Personnel Requirements

A variety of estimates are available concerning the market for computers in the 1970's. A consensus of the most reliable of these indicates that by 1970 the number of systems installed will approximate 52,000, with another 10,000 on order. It is not unreasonable to assume that the distribution of these systems will be comparable to the distribution of today's systems within the four classifications. For example, since 12% of today's systems fall into the medium-scale category, it is assumed that 12% of 1970's systems will fall into that category. Chart 4 is a representation of the four categories of systems as they might appear in 1970. Chart 4 also shows these same 1970 figures with their appropriate "staffing number" calculated in the same way as for today's systems. If we project these figures into actual personnel requirements (see Chart 5), based on the estimated requirements per installation, we are led to the rather frightening conclusion that the number of trained people required is 104,000 analysts, 240,000 programmers, and 132,000 operators. This grand total of 470,000 computer specialists is almost twice the number of doctors in the United States today!

Will this really happen?

Effects of Technology

It is farfetched to imagine that in the six years remaining before 1970, the number of people in the computer field can be tripled. In the first place, the educational facilities for this kind of an undertaking are not available, nor is the economic capability for absorbing a training program of this magnitude. If, in fact, staffing patterns and procedures normal for today were required for the computer systems of 1970, it is highly unlikely that the capability would exist to use the 52,000 systems properly.

A number of technological changes may be expected that will reduce the number of persons required in each of the projected installations. To appreciate these changes, and to arrive at a reasonable assessment of their impact, they are listed and discussed below.

1. *Automatic Programming.* This often misapplied term is best defined to mean the use of more advanced languages

Chart 4

STAFFING NUMBER OF COMPUTERS - 1970 - ESTIMATED

Category of System	Number Installed	Number On Order	Staffing Number
a. Manual-input	11,980	1,890	10,500
b. Small-scale	32,620	6,190	27,200
c. Medium-scale	5,380	1,430	6,000
d. Large-scale	2,020	490	2,300
TOTAL:	52,000	10,000	46,000

Chart 5

PERSONNEL REQUIREMENTS - 1970 - PROJECTED AND ESTIMATED WITHOUT TECHNOLOGICAL CHANGE

Category of System	Number of Systems (Staffing Number)	TOTAL REQUIREMENTS Analysts	Programmers	Operations
a. Manual-input	10,500	5,250	15,750	15,750
b. Small-scale	27,200	54,400	136,000	68,000
c. Medium-scale	6,000	24,000	48,000	30,000
d. Large-scale	2,300	20,700	34,500	18,400
Subtotal	46,000	104,350	234,250	132,150
TOTAL:			470,750	

Chart 6

PERSONNEL REQUIREMENTS - 1970 -
PROJECTED, INCLUDING TECHNOLOGICAL CHANGE

	Category of System:				
	a. Manual Input	b. Small Scale	c. Medium Scale	d. Large Scale	Total
Staffing Number	10,500	27,200	6,000	2,300	46,000
Average Requirements Per Installation:					
a. Analysts	.4	1.8	3.5	8.0	
b. Programmers	1.0	3.0	5.0	10.0	
c. Operations	1.0	1.5	3.0	5.0	
Total Requirements:					
a. Analysts	4,200	48,960	21,000	18,400	92,560
b. Programmers	10,500	81,600	30,000	23,000	145,100
c. Operations	10,500	40,800	18,000	11,500	80,800
TOTAL:					318,460

and compiler systems. This will reduce the tediousness and routine which programmers must now go through. Also, automatic programming will increase the efficacy of documentation and of testing, and perhaps it will eliminate the coding function. Probably automatic programming will not eliminate logical analysis; it certainly cannot eliminate all aspects of testing; and most likely it cannot eliminate the major factors involved in good documentation. It may be reasonably assumed that the impact of automatic programming, as defined above, will reduce total programming requirements by approximately 25%.

2. *Libraries.* The use of libraries constructed by manufacturers or by user groups will certainly become increasingly popular. The availability of libraries will have a significant impact on the need for systems analysts and on the need for programmers. However, no amount of library work can eliminate all of the unique problems which each organization faces. Therefore, considering the impact of automatic programming on programming requirements, it may be estimated that the reduction in personnel brought about by much greater use of libraries, will be approximately 10% in systems analysts.

3. *Monitor Systems.* Monitor and operating systems have tremendous merit in the proper management of operating installations. It is expected that by 1970, over 80% of all computer installations will be completely operated under monitor system or operating system control. Consequently the operating personnel requirements will be reduced, although of course there will remain an irreducible minimum. Although it will be less in specific cases, the over-all reduction can be estimated to be approximately 40%.

4. *Organizational Centralization, and Decentralization of Input/Output Facilities.* The organizational structure of the data processing function in corporations is now being changed to achieve over-all economics and increased efficiency. However, the total economies achieved by such measures as (1) centralizing corporate administration programming and (2) decentralizing input preparation and output operation, are somewhat offset by the need for satellite operations and the need to have standby programming capability within these satellite operations. It is therefore estimated that organizational changes of this type will reduce the need for programming by about 5%, but will increase the need for operators by about 5%.

5. *Software Packages.* The market for software packages to be purchased is likely to continually increase. Unquestionably a number of software organizations will develop additional proprietary systems which they will make available for sale. As in the case of libraries and shared-user programs, there will be some impact on programming and systems analysis requirements. Since purchase prices for these software packages will probably be heavy, the total reduction of installation facilities is estimated to be 5% in systems analysis.

Software Development. All of the above technological improvements will require implementation in and of themselves. This means that the creation of these improvements is going to require additional manpower. For example, if COBOL and FORTRAN must be implemented for each and every system available today, a safe estimate is that perhaps 5,000 man-years of programming effort will have to be invested in that implementation. Therefore, there is an offsetting cost in the technological changes which will be available by 1970. Briefly this cost is the cost of creation of software, and it can be estimated to be approximately 10% in programming and 5% in systems analysis requirements.

Totaling these estimates, the following is the net effect:

- A net reduction in systems analysis requirements of approximately 10%;
- A net reduction in programming requirements of 35%;
- A net reduction in operations requirements of 35%.

These changes are reflected in Chart 6, which uses the 1970 extrapolations of Chart 5 with the modification made by these changes. Based on this expected reduction, approximately 92,000 systems analysts will still be required. The number of programmers has been reduced by approximately 80,000, to 145,000, and the number of operators has been sharply reduced to 80,000. But the grand total is still 318,000 people.

The requirements indicated by these calculations raise doubt about the ability of existing educational facilities to provide this manpower in the six years remaining before 1970. During that time 160,000 trained computer people will have to be developed. The burden that this places on the American educational system is comparable to the situation in the late '40s when there was a shortage of engineers, and the present situation with a shortage of doctors. Since a four-year education started in the fall of 1964 does not conclude until 1968, and since another two years of experience are required before a person can be considered fully trained, emphasis on preparation for a career in data processing must begin now. This emphasis can take several forms:

1) Increased industry support to the teaching of data processing at schools of all levels;
2) Increased publicity concerning data processing as a profession;
3) Starting college degrees in data processing, i.e., Associate in D.P., or B.A.—Data Processing;
4) Adding data processing courses to the curricula of vocational schools.

GE COMPATIBLES-600

Patrick J. McGovern
Associate Publisher

Last month Harrison Van Aken, General Manager of General Electric's Computer Department, predicted that there would be only *four* major U. S. firms supplying complete electronic computing systems by 1970. This figure strokes two off the oft-quoted total of six finishers in the 1970 computer industry predicted by Control Data's Willian Norris last summer.

No matter whose crystal ball has the right digit, Van Aken and his Phoenix-based team of computer designers, programmers, and "problem solvers" gave strong indications last month that they intend to be among the finishers when they took the official wraps off two members of its new family of large-scale computers, the Compatibles-600. Introduced were the GE-625, featuring a 2usec. memory cycle for a 72-bit pull, and the GE-235, with a 1 usec. memory cycle for the same bit pull.

The computers feature a 36-bit word, divided into 6 characters of 6-bits each. Shunning the new ASCII code. the new GE computers use BCD/binary code for data manipulation and arithmetic. Eight index registers (plus five more on option) are available in each system. There are 170 basic instructions. The GE-625 performs fixed point add and multiply in 3.0 usec. and 7.0 usec. respectively . . . floating point add and multiply takes 3.0 usec. and 6.0 usec. respectively. The GE-635 cuts execution time on fixed and floating point add to 1.8 usec. and 2.7 usec. respectively. Multiply times are approximately equal to those of the 625.

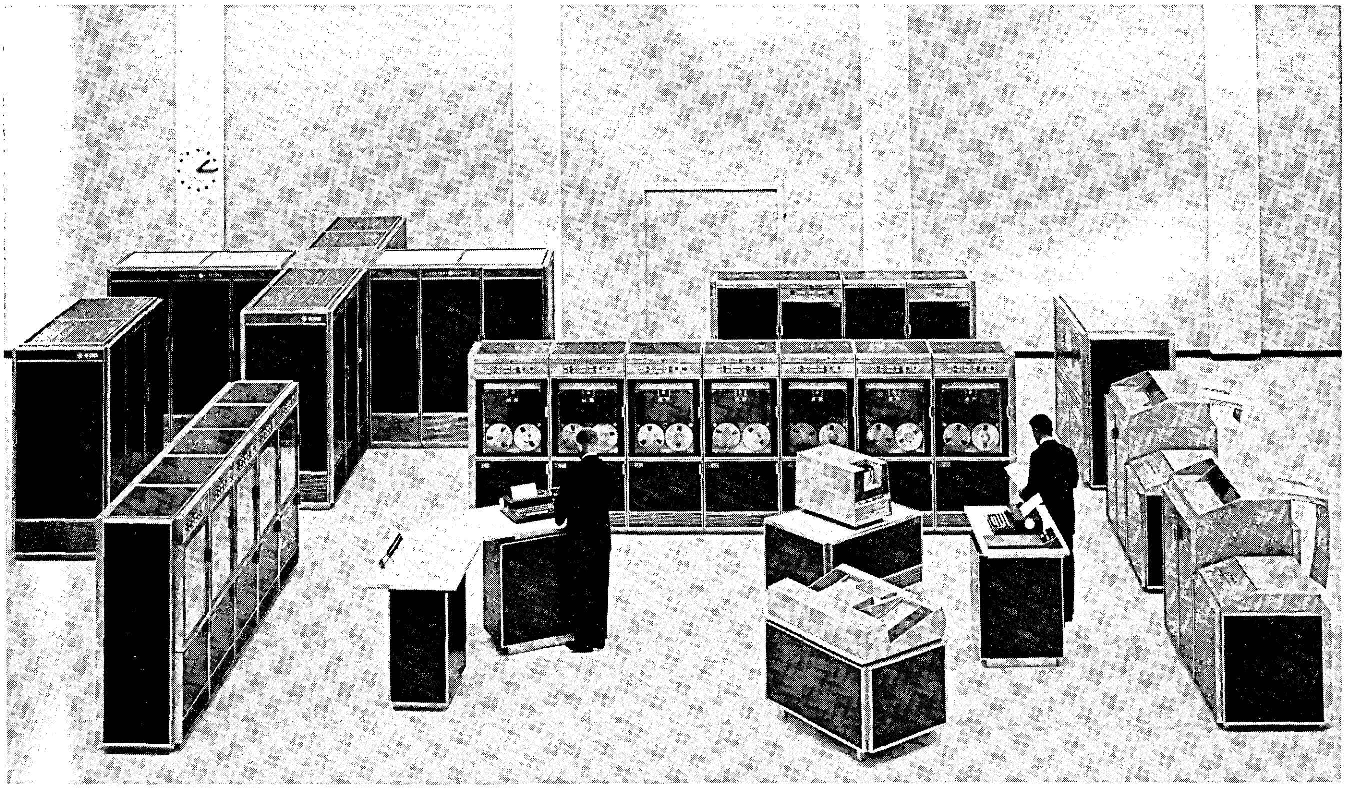
The 635 is now the largest computer in the GE line with a price tag of $2 million and up (lease prices start at $45,000 per month). The GE-625 is priced at approximately 25% less.

"Hardware Development"

In creating the design specifications for the first two members of the Compatibles-600, GE drew heavily upon its extensive internal experience with large-scale scientific computers, particularly with the IBM 7000 series. Included in the hardware design team for the 600 family were Harry N. Cantrell, a past president of SHARE, and formerly a manager of computer systems for GE's Large Steam Turbine-Generator Department where he managed an IBM 704 computer; William J. Heffner, a former member of SHARE where he worked with several 7090 installations in developing a debugging technique for FORTRAN; Russell C. McGee, a former president of SHARE's data processing committee who managed a 709 and 7090 computer at GE's Hanford Atomic Products Operation; James A. Porter, who has served on the executive board of SHARE; and Dr. Donald L. Shell, who was the first vice-president of SHARE and the chairman of the SHARE 709 System Committee. In fact, the manager of the entire Compatibles-600 computer project at GE is Dr. John Weil whose previous assignment was managing a large IBM computer installation at GE's Atomic Power Equipment Department.

Not unexpectedly, design specifications for the 600 family read like a hypothetical "current limitations list" drafted by a frustrated IBM 7000-series user. Design criteria included:

1) Faster "turnaround" time for jobs
2) Low "overhead" time during which the processor is not doing useful work



The GE-635, shown above, is now the largest computer in General Electric's line. It adds more than a half-million numbers a second. Computer design and programming were developed currently as a joint effort of engineers, scientists, and mathematicians who were former users, programmers, and supervisors of large-scale computer installations in several GE departments.

3) "Multiprogramming" capability so that several jobs can be worked on virtually simultaneously
4) "Real-Time" applications, such as accommodation of individual console stations in a time-sharing net
5) Integrated series of processor and memory sizes
6) Horizontal growth capability, allowing for a tailored system.

To achieve these specs, GE's 625 and 635 offer a system consisting of three major modules plus a complement of peripheral devices including a data communications network controller. Memory, Processor, and Input/Output Controller are the three modules. These modules can be arranged in a variety of configurations; using as many of the Memory modules (up to 262,144 words can be directly addressed per processor) as needed for the required storage; as many Processor modules as needed to provide the computation capability; and as many of the Input/Output Controller modules as required for the complement of peripheral devices included in the installation.

Multi-Processing and Multicomputers

Both multiprocessor and multicomputer configurations are available in the Compatibles-600. In multiprocessor systems, only one control Processor (Processor Module A in Figure 1) is used. All other Processors in the system are usually subservient to the control Processor. They may execute portions of the object program being worked on by the control Processor, as directed by that Processor, and they may share Memory with the control Processor. However, subservient Processors can not receive program interrupts nor can they directly initiate I/O transfers.

In a multicomputer configuration there is more than one control Processor in the system. Assuming that both A and B in Figure 2 are control Processors, A could control Memory modules 1 and 2 and initiate I/O activities in the Input/Output Controller module I. Processor B would control the remaining modules and peripheral devices, the entire system being regarded as separated into two computers. Such an arrangement permits sharing of Memory modules by two or more Processors.

Software

Primary characteristics of the 625 and 635 software include the following:

- Comprehensive Operating Supervisor—The GEneral Comprehensive Operating Supervisor (GECOS) controls the placing and running of all other programs. As the executive system, it handles real-time operations, multiprogramming, and a variety of hardware configurations. Included in the Comprehensive Operating Supervisor is the Input/Output Supervisor, which initiates input/output activity for all peripheral devices. The Comprehensive Operating Supervisor is tailored to each installation. Project manager Weil states that GECOS is "the most complete executive routine in the computer industry."
- Random Access System Programs—The Macro Assembler Program and other system programs are for call-in from the system Disc or Drum Storage Unit.
- Automatic Programming—This is the standard mode of operation with the 625 and 635. It includes FOR-

TRAN IV and COBOL-61 Extended. A FORTRAN II to FORTRAN IV conversion routine is provided. Generator programs and a language translator round out the list. All of these system programs produce coding acceptable to the Macro Assembler Program.

- Utility Routines—GE supplies an integrated library of service programs, including input/output media conversion routines.
- Other Software—A Sort/Merge Program capable of accepting file/record data and parameters as well as COBOL output coding, a COBOL report generator, and a separate 9-PAC report generator, are standard software offerings.

One of the most significant aspects of the development of the Compatibles-600 is that the software development occured in parallel with the hardware design, and the requirements of both activities interacted extensively. And like the hardware design, software development called on the technical talents and experience of people in a number of GE's departments (GE currently uses about 200 computers and employs approximately 2000 programmers).

For example, the FORTRAN IV compiler is being developed by the Missile and Space Division of GE. The Macro Assembly Program and Loader is being done at GE's Advanced Engine Technology Department. The COBOL compiler and Comprehensive Operating Supervisor are being done by the main software team at the Computer Department. An anticipated result of this parallel development is that when the first GE-600 computer, a 635, is delivered to GE's Telecommunications and Information Processing Department late this year, a complete operating software system will accompany it.

Peripherals

Among the peripherals available on the GE-600, as well as on the GE-400, is a new line of GE-built magnetic tape transports. The new transports employ pneumatic drive and photocell protective devices designed to lessen scratching and stretching of the tape.

Two basic tape-handling mechanisms are used in six models: a single-capstan, low-inertia drive for tape transfer rates from 7,500 to 80,000 characters per second; a multiple-capstan, constant-speed drive for the high range up to 160,000 characters per second. Both designs accommodate ½-inch-wide tape and record in seven and nine channel widths (the latter allowing the new ASCII code).

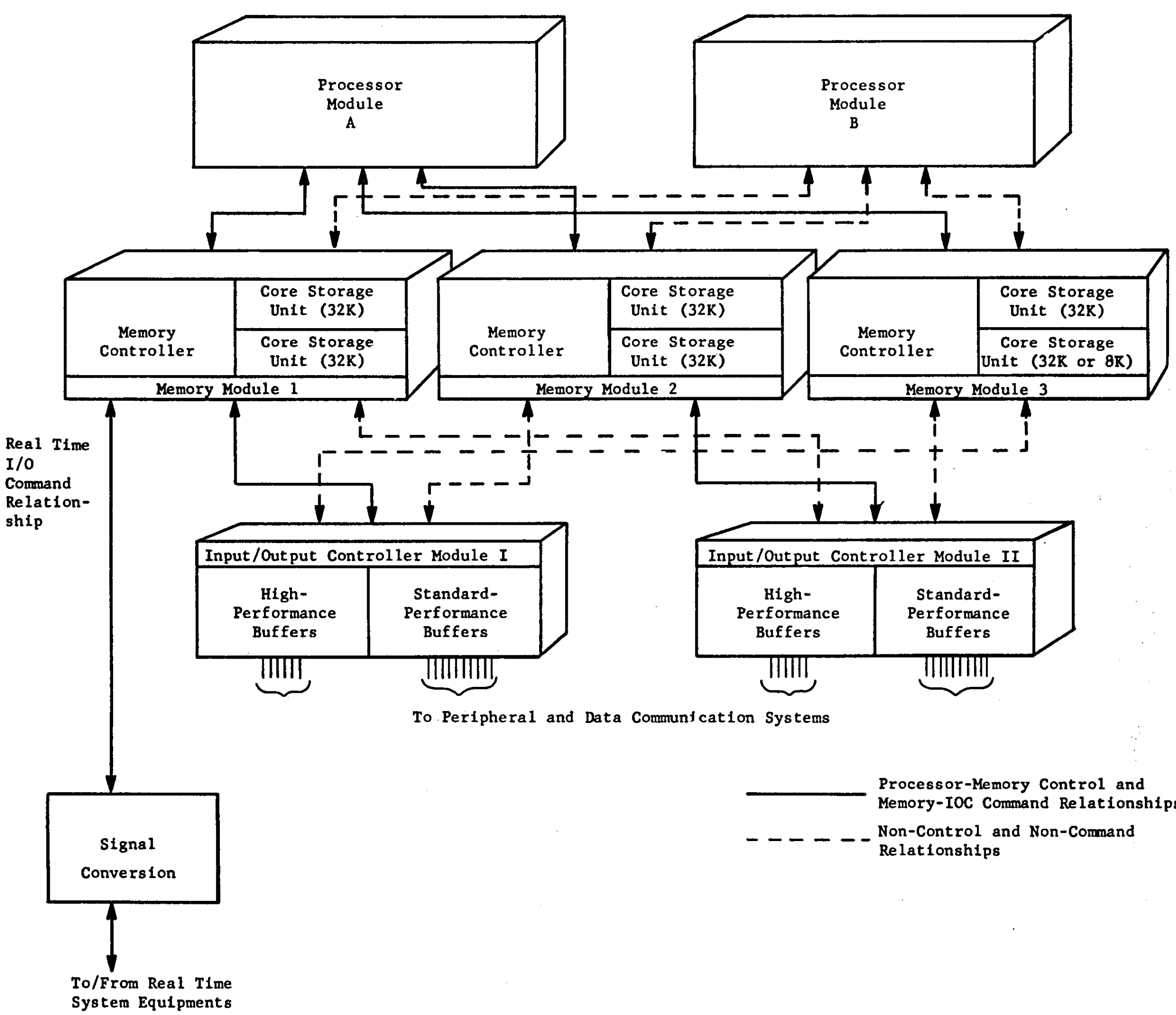


Figure 1. Typical Multiprocessor Configuration of a GE-600 Computer With Real-time Capability

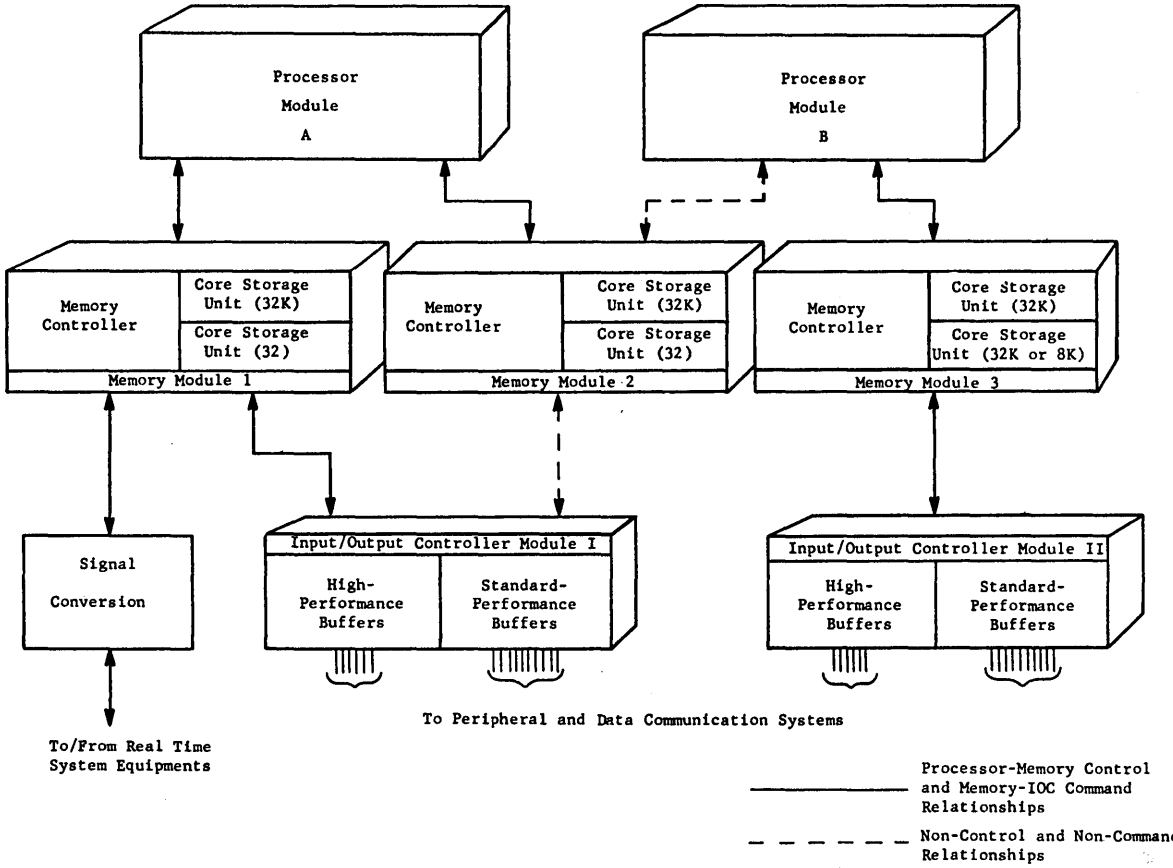


Figure 2. Typical Multicomputer Configuration of a GE-600 Computer

Other peripherals include: Disc and Drum Storage subsystems; 900-cpm card reader; 300 cpm card punch; 136-column, 1200-line-per-minute printer; and Datanet-30 data communications processor.

GE-600 MARKET

The most immediate market for the GE-600 appears to be as a replacement for such large computers as the IBM 7090 and 7094, Philco 2000, Control Data 1604A and Univac 1107. Of these, the 300 some installations of 7090 series computers is the most significant. The GE-635 is about four to five times faster in operating speeds than the 7090, for about 20% less cost. This performance comparison is at least one of the factors accounting for GE's decision to replace eight 7090 computers used internally with 600 computers during the next eighteen months. In fact, the total internal market for the GE-600 is estimated to be between 14-18 machines during the next two years.

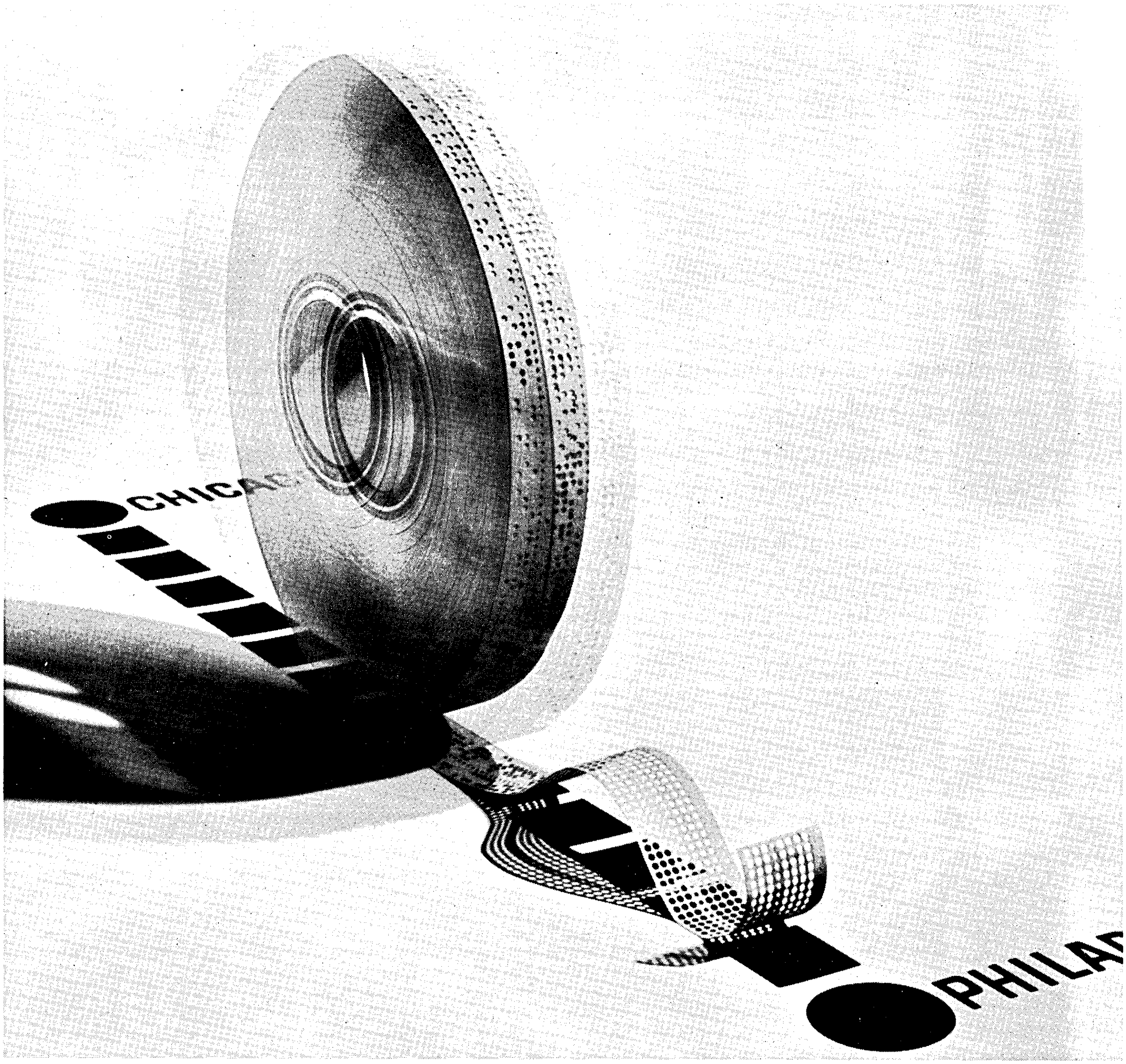
GE's market strategy for the GE-600 is apparently based upon the following points:

1. The GE-600 will be available for delivery early in 1965, about ten months before IBM is scheduled to start deliveries on the System/360.
2. GE is stressing the point that a 635 is already operating in Phoenix. Before the end of the year, GE will offer time testing on FORTRAN IV programs.
3. GE will offer a combination hardware/software simulator for 7090 series computers, allowing users to continue to run their production programs while reprogramming gradually in GE-600 language.
4. GE is offering an "unlimited use clause" in their lease contracts for the 600, offering the user unrestricted use of the computer for a fixed monthly rental.

In addition, GE is pushing hard to get a pioneering order in the computer time-sharing field, such as from Project MAC at M.I.T., so they will, at an early stage, have a tested, efficient operating system for the rapidly developing applications using direct-access multiple computer consoles.

GE does have a very favorable market situation for the 600 in the military/space command and control system field. The 600 is backed up with an admirably integrated series of aerospace and military computers, viz., GE's Light Military Electronics Department has developed four microminiaturized aerospace computers, the A-212, A-224, A-218, and A-605. The A-605 is program compatible with the M-605 and M-625, two ground-based military computers. The M-625 is the technical equivalent of the GE-625 computer, but built to military environment specifications. GE is currently bidding this combination of "total environment" computer systems to NASA and the Pentagon with indications of an encouraging response.

Next step in the GE-600 line? The 645 is not yet fully defined, but current indications are that it will be geared to handling multi-segmented memory allocation, and direct addressing to storage capacity in the millions of words.



IN JUST THREE MINUTES THIS PAYROLL CAN TRAVEL FROM PHILADELPHIA TO CHICAGO. FARE: $1.54

This is what DATA-PHONE service has done for business communications.

It gives computers an electronic "voice" that travels via regular telephone lines, at regular telephone rates.

At speeds up to 2500 words per minute, DATA-PHONE service can send anything that can be punched on cards or tape—orders, technical data, waybills, inventories.

Like to know more? Just ask your Bell Telephone Business Office to have our Communications Consultant contact you.

BELL TELEPHONE SYSTEM
Serving you

Circle No. 13 on Readers Service Card

"ACROSS THE EDITOR'S DESK"

Computing and Data Processing Newsletter

TABLE OF CONTENTS

NEW APPLICATIONS

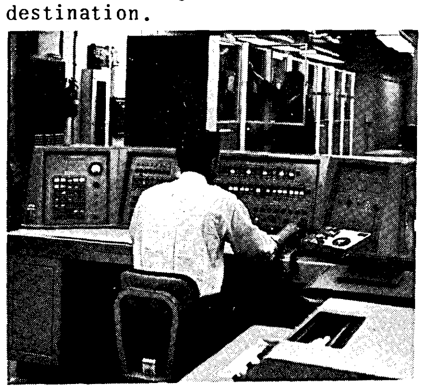
COMMAND CONTROL SYSTEM — PROJECT 465L

The major elements of the Strategic Air Command's new Command Control System — Project 465L — are now being phased into SAC Headquarters, Omaha, Nebr. SAC's underground war room is being remodeled to accommodate elements of one of the largest command control systems ever produced.

The ITT Data and Information Systems Division, a subsidiary of ITT Corporation, is prime contractor for the system. Together with half a dozen direct subcontractors and hundreds of second and third tier subcontractors, the division has been designing, developing, manufacturing, and installing the elements of Project 465L since the Fall of 1958.

Basically, this is a gigantic two-way communications system funneling information to SAC Headquarters and sending operational instructions to the force. There are three major subsystems involved: Data Transmission; Data Processing; and Data Display.

The data transmission element is the special "store and forward" switching concept developed to handle the traffic generated by such a broad information network. Heart of the switching system is the Electronic Data Transmission Communications Central (EDTCC). The EDTCC (there are four — one at each SAC headquarter site) directs information by absorbing it first in its memory, analyzing it according to a program of instructions stored in the memory, and then forwarding it to its correct destination.



— Electronic Data Transmission Communications Central (EDTCC), Project 465L, Prototype Equipment located at the ITT Data and Information Systems Division test facility.

At speeds measured in thousandths of a second, messages coming into the EDTCC in the form of tiny electronic pulses are decoded, checked for legality of address, checked for computer system compatibility (parity), checked for proper format. The system then sends out the re-encoded message, holding it in storage until it receives acknowledgement from the receiving station that the message arrived correctly.

If the messages sent to the EDTCC fail to meet any of these tests, the sender is automatically queried. The query and the message may be repeated several times; if the message still comes in incorrectly, it may be forwarded with a notation of the error. In passing the message along, the EDTCC selects the best of several routes, or, if it detects trouble in a particular line, it will automatically select a clear alternate. The system also allows for various grades of message priority and is capable of pushing a high priority message through to bypass less urgent material. The routing and checking is so rapid that it is not perceptible to anyone observing 465L operations.

The SAC Control System automates the entire data handling process using giant computers as the storehouse and control element for the flood of information which comes from input/output stations on SAC bases and stations around the country. Three high-speed, large capacity, Super SAGE type computers are used: two are located at Offutt AFB and one at March AFB. The redundancy is required for reliability, planning, and other off-line processing functions.

The data processing central is a specially designed stored program computer with a word length of 48 data bits and two parity bits. It has a core storage element made up of four units, each capable of storing 16,384 forty-eight-bit words. The system includes drum memory data storage and magnetic tape storage. There is also a disc file data storage system capable of storing nearly 13,000,000 words. The central processor has an access time of 2.5 microseconds and is capable of executing approximately 400,000 operations per second.

— Data Processing Central (DPC), Project 465L, Prototype Equipment located at the ITT Data and Information Systems Division test facility.

Most of the information stored in the computer can be called up by the Commander in Chief of SAC at his pleasure, but certain types of emergency information entering the system force themselves to his attention.

The end product of the system is the information that comes out in the SAC command post. Display equipment will be installed at Offutt AFB; March AFB, Calif.; Westover AFB, Mass.; and Barksdale AFB, La.; any of the four will be able to serve as a fully equipped SAC central headquarters at any time.

Depending on the nature of the information and on the needs and desires of the Commander in Chief, the information may come out as hard copy from a high speed printer, as one of a series of full-color wall displays, or both.

High-speed electronic printers display much of the information from the computer-communication system to the SAC Commander. The method of converting information into large wall displays represents a major advance in data manipulation. The system makes a 70mm positive film of the information. Three images of each message appear on the film, and a powerful beam of light carries them about 30 feet to the screen. Before striking the film, however, the light beam is split into the three primary colors by special mirrors. Combining these colors, gives the display system a color code of seven distinct colors for easy recognition of various types of information. The complete cycle, from display request to projected image, requires less than 15 seconds.

— Data Display Central (DDC), Project 465L, Prototype Equipment located at the ITT Data and Information Systems Division test facility.

The 465L system enables the SAC Commander in Chief to issue various alerts and orders to the battle forces of the command. He will have a more advanced, much faster method of managing the tremendous investment in weapons and equipment that make up the hardware of his fighting force and the means to exert positive control in greater depth over his command. Ultimately, it is capable of transmitting the order to launch the SAC forces against the enemy.

FARE COLLECTION AND TICKET VALIDATION SYSTEM

The Long Island Rail Road has begun a one-year test with an electronic turnstile revenue collection system at their Kew Gardens and Forest Hills stations (New York). Funds for the test were contributed by the Federal Housing and Home Finance Agency and New York State.

The revenue collection system, manufactured by Litton Industries' Advance Data Systems division, Los Angeles, Calif., is the first such system to be used in the United States by a railroad or rapid transit system. The test will be conducted on New York bound trains from Forest Hills and Kew Gardens.

Under the system, a commuter can buy a one-trip, five round-trip, weekly or monthly round-trip ticket from Kew Gardens or Forest Hills to New York. Each ticket will be magnetically coded to show the commuter's boarding point, destination, number of trips purchased, and the period in which the ticket can be used.

The commuter inserts his ticket in a slot in the turnstile housing and the magnetic code on the ticket is "read" by an electronic computer which cancels one ride and activates an "enter" sign on the turnstile housing. The passenger removes his ticket from the slot and passes through. The number of rides remaining on the passenger's ticket is also displayed. Average time for the operation is 1/12 second. (If the ticket is invalid for any reason, it is rejected and the bearer cannot pass through.)

A control console in the ticket agent's office maintains an up-to-the-minute count on turnstile boardings. The console also permits the agent to electronically unlock the turnstiles from his booth if desired. Since every boarding is recorded on a tape that can be tabulated by a computer, the Long Island will be able to determine the number of passengers riding between these stations and New York each day and the peak load times.

DELTA AIRLINES FIRST TO OWN COMPUTER CONTROLLED SWITCHING NETWORK

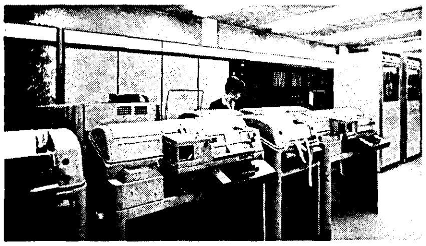
The largest privately owned computer controlled teletypewriter message switching system has recently been put into operation by Delta Airlines at Atlanta, Ga.

Some 80,000 administrative and operational messages are being handled daily by the 256-line system. The system has the capacity to handle 240,000 messages in a 24-hour period. The average message length is 300 characters.

Nerve center of the system is a communications processor known as Data Central. Designed and installed by Collins Radio Co., it consists of dual C-8401 processors running in parallel to insure continuous 24-hour, 7-day-a-week operation. AT&T is providing 83B2 terminal equipment and circuitry for the network. Delta estimates that the new system will reduce its costs for message transmission and switching from 15¢ per message under the former WADS (Wide Area Data Service) system to 9¢ per message using the new system. Delta is acquiring the Collins system, valued at approximately $1.8 million, under a lease-purchase plan.

The switching system handles such vital messages as departures and arrivals, position reports, reservations and weather reports.

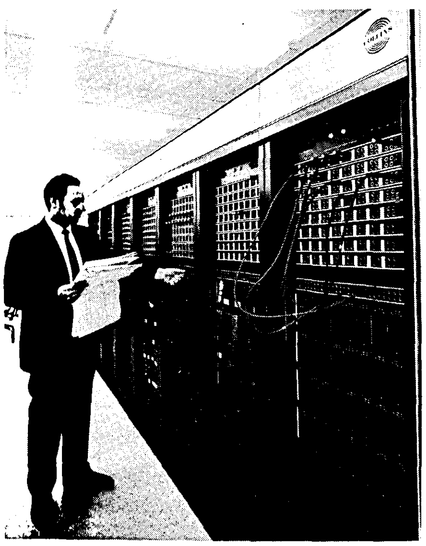
Data Central polls each teletype station in the network and recognizes traffic requirements.



— Delta Air Lines' Data Central switching system with processing equipment in the background and control positions in foreground.

If a circuit is available, a message will go through Data Central in microseconds. If the addressed station is busy, the processor will store the information and forward it when the line is available.

The Delta program permits continued use of the airline's internal code as well as the standardized airline code without operator intervention. One-word addresses are also used to send messages destined for special groups of stations or all stations. Format flexibility permits air-to-ground transmission of messages with addresses following the messages. Data Central accepts and sends such messages to their proper destination.



— A Collins systems engineer checks out the line termination or jack units of the Delta Data Central system.

There is constant reporting of any line or station malfunction with the processor taking corrective action. Automatic message accounting assures message transmission. Data Central also "remembers" messages for logging or retransmission.

The easier procedures for addressing messages without a need to include routing information simplifies training of personnel and minimizes errors.

The system is readily expandable. More and more lines can be added at minimum cost and time.

NEW CONTRACTS

FERRANTI AWARDED $1 MILLION CONTRACT FOR ELECTRONIC QUOTATION BOARD

The Montreal and Canadian Stock Exchanges have awarded a $1 million contract to Ferranti Electronics for the manufacture and installation of the first stage of an electronic quotation board system for their new home in Place Victoria. Total cost of the three-stage system is expected to be around $1.5 million. Contracts for the second and third stages have not yet been awarded.

The Ferranti contract covers the installation of two information input islands — two kiosks on the trading floor through which all transaction information is fed — and seven electronically operated quotation display boards along one wall of the exchange floor. The new boards will be able to transmit information at the rate of 6000 numbers of characters a minute — sufficiently fast to handle up to 100 times the present daily peak volume of the two exchanges.

BECKMAN RECEIVES CONTRACT FOR $1 MILLION PLUS FROM LEAR SIEGLER

Beckman Instruments, Inc., Fullerton, Calif., has received a $1.3 million contract from Lear Siegler, Inc., for two data acquisition systems and data processing digital computers to be used in development of the Saturn Space Vehicle of the National Aeronautics and Space Administration. The systems will monitor and record information from static test firings of the Saturn rocket engines at speeds to 5000 samples per second, and will edit, correct and tabulate test data for evaluation by digital computers. Delivery to Lear Siegler at NASA's Marshall Space Flight Center, Huntsville, Ala., is scheduled for September.

NRL ORDERS DDP-24 FOR UNDERWATER ACOUSTIC STUDY

Computer Control Company, Inc., Framingham, Mass., has received an order for a DDP-24 general purpose digital computer from the U.S. Naval Research Laboratory, Washington, D.C. It will be used for the handling and mathematical processing of digital data from field experiments in underwater acoustics, including spectrum analysis and correlation studies. The DDP-24 will be installed at the U.S. Naval Research Laboratory.

AIR FORCE EASTERN TEST RANGE AWARDS COMPUTER CONTRACT TO BECKMAN

In addition to contracts for several ground based telemetry systems and peripheral equipments, Beckman System Division, Fullerton, Calif., has been requested to provide a real-time digital computer to the Air Force Eastern Test Range.

The contracts, now totaling $4.3 million, were awarded to Beckman for the development of equipment to process PAM/PDM/PCM/PACM telemetry signals from missile and space flights supported by the Eastern Test Range. The contract requirements include nine ground-telemetry systems, six test units, two telemetry data formatting systems, two test analyzers, a Model 420 Systems Computer, and four display subsystems.

POTTER RECEIVES $1.3 MILLION PLUS AWARD FROM UNIVAC

Univac Division of Sperry Rand Corporation has awarded a contract in excess of $1.3 million to Potter Instrument Company, Inc., Plainview, N.Y. The award covers production quantities of the Potter MT-36 Digital Magnetic Tape Transport.

EIGHT VAN MOUNTED DDP-24s ORDERED FOR ANTI-SUBMARINE WARFARE SIMULATION

Computer Control Company, Inc., Framingham, Mass., has received an order for eight DDP-24 van mounted computers from Melpar, Inc. The computers will be the digital computer portion of four 2F64A Weapon Systems Trainers; two DDP-24's will be used in each trainer. The trainers, being built by Melpar, will be used to train Navy helicopter pilots in Anti-Submarine Warfare.

TELECOMPUTING SERVICES AWARDED CONTRACT FOR $1.3 MILLION BY NASA

Telecomputing Services, Inc., a subsidiary of Whittaker Corp. (formerly Telecomputing Corp.), Los Angeles, Calif., has been awarded a $1.3 million contract by the National Aeronautics and Space Administration for computer operations at Slidell, La. Under the contract, TSI provides direct support to the Marshall Space Flight Center's Michoud Operations, in New Orleans, where SATURN boosters are being manufactured.

EAI AWARDED CONTRACT FOR HYBRID SYSTEM

A contract for an amount in excess of $1 million has been awarded to Electronic Associates, Inc., West Long Branch, N.J., by General Dynamics Corp. for a HYDAC 2000 Hybrid Digital-Analog Computer system. This HYDAC 2000 system incorporates three PACE 231R-V analog computers equipped with the analog memory and logic system, a Series 350 digital operations system, and associated peripheral equipment. Initially it will be used in the USAF/Navy F-111 supersonic jet tactical fighter program by General Dynamics, prime contractor. The primary mission of the system will be in simulating the performance of the aircraft.

PDP-5s ORDERED FOR USE IN CONTROL SYSTEMS

Westinghouse Electric Corp., Pittsburgh, Pa., has purchased five Programmed Data Processor-5 computers from Digital Equipment Corp., Maynard, Mass., for use in computer-based control systems. Westinghouse will use the PDP-5 in a new system called Prodac 5, being built by the Power Control Division for application in the electric utility industry. Use of the PDP-5 is expected to bring the system price within reach of many users who could not justify the cost of systems based on larger computers.

JPL AWARDS CSC NEW PROGRAMMING CONTRACT

Computer Sciences Corp., El Segundo, Calif., has received a new contract for computer programming services in excess of $150,000 from the California Institute of Technology's Jet Propulsion Laboratory. The contract provides for a continuing CSC effort on JPL's new Space Flight Operations Facility (SFOF) which will be used to control National Aeronautics and Space Administration unmanned lunar and interplanetary space probes.

NASA AWARDS MULTI-MILLION CONTRACT TO COLLINS RADIO

The National Aeronautics and Space Administration has awarded a contract for approximately $20 million to Collins Radio Company, Dallas, Texas, to provide a world-wide spacecraft ground tracking network in support of the Apollo program. Tracking, telemetry, up-data, television and voice communication will be handled by the single unified system.

The program requires assembly and installation of nine complete tracking and data acquisition systems with 30-foot diameter antennas. In addition, there are 30 partial electronic systems which will be used to implement existing 85-foot antennas and as test and training units. These will later be incorporated in shipboard installations.

As prime contractor, Collins will have responsibility for design, development, fabrication, erection, installation, integration and checkout and acceptance testing. Additional support requirements include spare parts, test equipment and training of personnel. NASA's Goddard Space Flight Center, Greenbelt, Md., has over-all responsibility for construction and operation of the network.

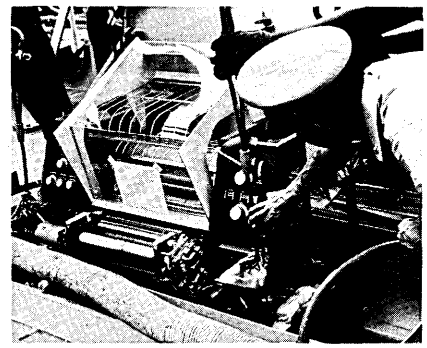
COMPUTER CONTROL RECEIVES ORDER FROM NAVY

A Digital Computer Maintenance Trainer has been ordered from Computer Control Company, Inc., Framingham, Mass., by the U.S. Naval Aviation Engineering Service Unit, Philadelphia, Pa. The device will be used to train engineers to maintain and program the digital computer portion of various weapon systems.

NEW INSTALLATIONS

SEA-GOING CARD PROCESSORS TO KEEP TABS ON NUCLEAR SUBS

A deck officer on the USS Proteus (AS-19) checks clearances as a partially-dismantled UNIVAC 1004 Card Processor is lowered through a hatch. The 1004 will be the nucleus of the Ballistic Missile



Submarine Tender's data processing section. It will help to process data associated with the large inventory of spare and replacement parts as well as the vast array of miscellaneous items which are necessary to maintain and supply a squadron of nuclear-powered submarines. Other 1004's will perform similar tasks on the USS Holland, USS Mars, and the USS Sylvania. Programmed instruction courses are supplied with each 1004, so that members of crews can learn how to use and maintain the 1004 regardless of the ship's assignment, location, or port.

FIRST GE-415 INSTALLED

First installation of General Electric's new GE-415 small-to-medium-class computer was made just 60 days after its announcement (see Computers and Automation, May 1964, p. 56). The system has been delivered to the National Aeronautics and Space Administration's John F. Kennedy Space Center, Cape Kennedy, Fla.

AIR FORCE INSTALLS 174TH COMPUTER

The 174th NCR 390 computer manufactured for the U.S. Air Force has been installed at Carswell Air Force Base, Fort Worth, Texas. The 174 computers are processing payrolls for over 800,000 military personnel at every major Air Force base throughout the world.

SCORE OF IBM SYSTEM/360's TO BE LEASED BY PAPER COMPANY

International Paper Company, New York, N.Y., will lease IBM System/360 computers (estimated value $10,000,000) to form an information and control system, described as the most comprehensive ever undertaken in the paper industry. The integration of nearly a score of System/360's into the new information network is being developed jointly by technicians from IBM and International Paper.

The system will eventually provide full information on what is happening — as it is happening — in I-P's nation-wide manufacturing, financial, scientific and marketing functions. It is also expected to lead to more precise process control. Conversion from the company's present IBM computer capabilities to the proposed system has been started and will be phased in over a period of years.

FIRST SDS 930 DELIVERED

The first SDS 930 computer has been installed at the MIT Lincoln Laboratory, Lexington, Mass. It will be used to develop new numerical techniques for the solution of scientific and engineering problems, and to debug programs, subroutines, and systems packages that will be run on an IBM 7094.

Since Scientific Data Systems, Santa Monica, Calif., introduced the 930 last November, orders have been placed for more than 10 of the machines.

EYE AND EAR HOSPITAL TO USE DIGITAL COMPUTER

Digital Equipment Corp., Maynard, Mass., has delivered a special-purpose digital computer to the Eye and Ear Hospital of the University of Pittsburgh. It will be used on-line for studying hearing disorders.

The computer is called HAVOC, for Histogram AVerage Ogive Calculator. HAVOC computers accept neuroelectrical signals from four channels, average away random noise, calculate histograms and ogives of signal amplitude, latency and interval, and display and plot the results.

CANADIAN WHEAT POOL USES COMPUTER TO SPEED MEMBERS' GRAIN SETTLEMENTS

The Saskatchewan Wheat Pool (SWP), Regina, Sask., has installed a new computer system which has reduced by three months the time required to calculate and prepare 73,000 annual dividend checks. The system, based on a National Cash Register 315 computer with CRAM (Card Random Access Memory) calculates the amount of cash and credits earned by members through grain deliveries to SWP elevators and simultaneously writes the dividend checks. All accounts can now be updated and dividend checks printed in 15 hours, compared with approximately three months formerly.

Planned future applications include inventory control of farm supplies, handling the Pool's construction payroll and cost distribution, general accounting, and special scientific studies.

SO. CAL. BLUE CROSS INSTALLS HONEYWELL 1400 SYSTEM

The Southern California Blue Cross has installed a Honeywell 1400 electronic data processing system at its Los Angeles Headquarters. Records of more than 1,500,000 members are being maintained on the computer, including customer accounting, hospital admission data, claims payments and personal information. In addition, important statistical reports are being prepared by the 1400 to expedite internal office operations.

The Blue Cross of Southern California system consists of a central processor with 12,000 words of memory, eight high-speed tape units, a high-speed printer, a card reader/card punch, and a paper tape reader. This system is the 12th Blue Cross installation in the country to use Honeywell computers.

3C DELIVERS DDP-24 TO DUKE UNIVERSITY

Computer Control Company, Inc., Framingham, Mass., has delivered a DDP-24 general purpose digital computer to the physics department of Duke University, Durham, No. Car. The computer is used on-line in film analysis for basic research study of the interactions of elementary particles at high energy. The program is partially supported by the U.S. Atomic Energy Commission.

ORGANIZATION NEWS

IEEE MERGES COMPUTER ACTIVITIES

The IEEE's former Professional Technical Group on Electronic Computers and Computer Devices Committee formally merged during the Spring Joint Computer Conference in Washington, D.C. The newly merged organization is called the IEEE Computer Group.

Keith W. Uncapher, The RAND Corporation, Santa Monica, Calif., was elected Chairman of the newly merged organization. Membership is in excess of 10,000 making it the largest computer engineering organization.

The IEEE Computer Group will assume the responsibilities and obligations of its predecessor organizations in the American Federation of Information Processing Societies. It also will serve the computer profession as a whole through conferences, meetings, workshops, and its major publication, Transactions on Electronic Computers. The Group includes computer standards activities and various administrative supporting committees.

HOLLEY COMPUTER PRODUCTS AND ADCOM CORPORATION ACQUIRED BY CONTROL DATA

Control Data Corporation and Holley Carburetor Company, joint owners of Holley Computer Products Company, have announced an agreement for Control Data to acquire from Holley Carburetor all of its common stock of Holley Computer Products Company in return for an undisclosed amount of Control Data stock. The agreement is subject to approval by Holley Carburetor's Board of Directors.

Holley Computer Products, located in Warren, Mich., supplies drum printers to numerous major computer manufacturers as well as to Control Data. The company will function as a wholly owned subsidiary of Control Data Corporation.

Announcement also has been made of the completion of negotiations for the acquisition of Adcom Corporation of Chatsworth, Calif. The agreement, subject to Adcom Corporation stockholder approval, and approval of the California Commissioner of Corporations, covers the acquisition by Control Data of all the stock of Adcom in return for an undisclosed amount of Control Data stock. Adcom Corporation manufactures a complete line of high-speed analog conversion equipment used in data acquisition systems.

EDUCATION NEWS

KINDERGARTEN YOUNGSTERS LEARN TO READ BY MACHINE

In the Long Island community of Freeport (New York), 20 kindergarten children have been taught how to read, in 30 hours of instruction, by a computer-controlled machine. The machine has also taught reading to four retarded children and to an 18-year-old high school dropout who had been fired from his job in a warehouse because he couldn't tell one label from another. The computer used to teach reading is a part of the Edison responsive environment system developed by the Thomas Alva Edison Research Laboratory.

The teaching device looks something like a piano with a typewriter keyboard. The temptation is irresistible; the child plunks a key. The machine speaks: "L", it says. And the letter "L" appears in large type on a roll of paper in front of him. The child plunks another letter and again a recorder calls it out and the letter appears in type.

Then things become harder as the machine takes charge. In a patient, friendly voice the child is instructed to hit a key. All the letters except the one that was asked for are locked. By trial and error, the child finds the right key.

During the same five months the Freeport tots were going to daily 30-minute sessions in front of their computer-controlled machine, another group of the same age and talent was taught reading by three skilled teachers using conventional methods. The children taught by the machine finished 1.7 months ahead in reading skills of the teacher-taught group, according to Dr. John Henry Martin, superintendent of schools in Freeport.

NEW PRODUCTS

Digital

NCR 395 — ELECTRONIC ACCOUNTING SYSTEM

A new electronic accounting system which combines the performance of a small computer with the economy of a conventional accounting machine, has been announced by the National Cash Register Company, Dayton, Ohio. The desk-size business system, called the NCR 395, uses computer addresses and instructions. It has a magnetic disc memory of 120 14-digit words which can be accessed by multiple read-write heads at the rate of 29 times a second. The entire memory can be cleared in 4 seconds, or read and printed out in less than 50 seconds.

— NCR 395 magnetic disc memory is shown here in front of some of the system's 250 logic modules.

The 395 has approximately 250 logic modules produced by a programmed wire-wrap technique which eliminates soldered connections and increases reliability. The process is similar to that used in missile electronics. An NCR 304 computer system helped design the 395 by determining optimum wire paths and fix-points.

According to Owen B. Gardner, NCR's vice president for data processing, the 395 will handle virtually any accounting job, from dairy route control to industrial accounting and including statistical reporting, tax billing, and financial accounting. The flexibility of the 395 results from various decision-making features which give it computer capability.

— NCR's new Class 382 alphanumeric card reader for the 395 system can be programmed for any task in minutes.

Alphanumeric card-handling ability is provided by a new peripheral unit, the Class 382 card reader which reads 100 cards a minute. This is a typewriter-size device which is cable-connected to the 395. It processes cards at random for internal sorting, and can be programmed in less than 5 minutes by a miniature paper disc and hand punch. The 382-395 combination permits completely automatic runs. The machine can be left unattended to produce alphanumeric information with complete descriptions from cards. Card output units and punched tape peripherals are also available.

— Operator Florence Eardly touches button that controls one of system's peripherals, the new 100 CPM alphanumeric card reader.

Because of its modular design, a 40-total basic system can be expanded to either 80 or 120 totals as the user's requirements change. Full alphanumeric input and output can be added at any time to a basic system

NCR has shipped 20 of the new systems to key locations for dem-

onstration purposes. Regular deliveries are scheduled to begin this fall.
(For more information, circle 30 on the Readers Service Card.)

NDC-1000 — AIRBORNE GENERAL PURPOSE COMPUTER

A new airborne computer, the NDC-1000, has been announced by the Nortronics Division of Northrop Corp., Palos Verdes, Calif. The 35-pound digital computer is said to be capable of feats of computation and data handling worthy of many large ground-based computers.

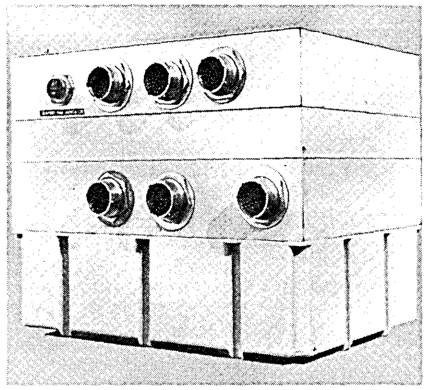
It is .66 cubic feet in size and requires only 89.5 watts of power for operation. Approximately 1400 integrated circuits are contained in the computer which uses microelectronics for 95 per cent of its circuitry.

The large instruction repertoire of 60, and the unusual number and operation of the index registers, give the NDC-1000 its versatility. Up to 32 index registers are stored in eight blocks of four each. To specify an index register, the four index bits of the instruction word define the specific index register in the block and the block is defined by a set of index block address flip-flops. The address flip-flops are controlled by the computer set instructions. (The computer has a word length of 24 bits.)

Also unusual is the multiple index operation. The instruction word contains four index bits, one for each index register of a block. If one or more registers are specified, the effective address is the algebraic sum of all index registers, and the operand field of the instruction word.

Field arithmetic is the third major computation feature of the NDC-1000. There are eight field instructions including, add, subtract, write, read and compare. A field instruction performs the operation requested over the bits defined by ones in the field register. The field register (stored in a thin film scratchpad memory) may be loaded with any patter of one's and zero's.

Flexibility in memory size and type enable the computer to contract or expand to handle the changing problems encountered by airborne computers of today. It has address capability for up to 65,000 words of memory, and the



— NDC-1000 airborne computer

central processor is designed so that it can use either a coincident current core type or a thin film memory. This allows the NDC-1000 to fit the speed, cost and operational requirements of a variety of applications.

Another aspect of flexibility built into the computer is its input/output buffer, which has a capability of addressing up to 1024 external devices and of operating through up to 15 data channels.
(For more information, circle 31 on the Readers Service Card.)

GE-205, FOURTH OF COMPATIBLES-200

General Electric Company's Computer Department, Phoenix, Ariz., has announced the GE-205, a small computer for business data processing and the scientific and engineering markets. It is the fourth and lowest-priced member of the Compatibles-200 family of general-purpose computers, and is GE's first entry into the low-cost computer market.

The new GE-205 is upward-compatible with others of its line, the GE-215, GE-225, and GE-235. It comes with a complete set of proven programming packages. A card program generator package is available for easy conversion from tabulating systems to the GE-205.

The small computer system is used in its simplest configuration for engineering-scientific applications; and for business data processing by adding peripheral equipment. A minimum configuration includes a GE-205 central processor with console typewriter, 4000-word memory and perforated-tape reader-punch. Inputs may be punched cards, perforated tape, Datanet-15 or Datanet-30 data communications systems.

The GE-205 can add some 14,000 five-digit figures per second. Short word lengths are 20 bits; long words, 40 bits. The computer, in addition to being used with various peripherals, may include such auxiliaries as a high-speed auxiliary arithmetic unit for floating-point calculations used in higher mathematics.
(For more information, circle 32 on the Readers Service Card.)

H-2200 ANNOUNCED — HONEYWELL EDP FAMILY GROWS

Another new computer system, known as the Honeywell 2200, has been announced by Honeywell. The H-2200 is a moderate-cost, high-performance system with approximately twice the processing power of the smaller Honeywell 200 computer introduced in December last year (see Computers and Automation, January 1964, p. 32).

The new system has many of the features of the H-200. The machine is completely program compatible with the H-200 and with five major competitive computer systems, including the 1410 and 7010. It has a large memory capacity and simultaneous processing features.

Its internal speed is one microsecond (millionth of a second) for a complete memory cycle. The main memory ranges in size from 16,000 to 131,000 characters. In addition, it has a second memory, which is both a control memory to select and interpret instructions, and a "scratchpad" memory to simplify operator control of the system. The control memory has a 250 nanosecond (billionth of a second) access time.

A traffic control unit, similar to but larger than that used in the H-200, permits the H-2200 to perform eight input and output functions simultaneous with central processing. Multi-programming and memory protection features allow the system to run three programs concurrently in main memory.
(For more information, circle 33 on the Readers Service Card.)

SDS ANNOUNCES TWO NEW COMPUTERS

Two new general purpose digital computers, the SDS 925 and the SDS 92, were recently announced by Scientific Data Systems, Inc., Santa Monica, Calif. With the two new machines, SDS is now marketing 6 compatible general purpose computers.

The SDS 925 is designed for scientific and engineering computation and for real-time systems integration. It has a 1.75 usec. memory cycle time and a 24-bit plus parity, word length; memory is available in units of 4096 words, 8192 words, and 16,384 words. Addition, including indexing, requires 3.5 usec. The instruction list for the 925 is identical to that of the SDS 910 except for some additional input/output instructions. A complete set of field-proven software and peripheral equipment is immediately available for the 925 because of its program compatibility with other SDS 900 series computers.

The SDS 92 is a small, high-speed general purpose computer designed for uses such as: computer-controlled systems; format conversion; "off-line" processing for a larger computer; repetitive, high-speed computation; nuclear experimentation and pulse height analysis. The 92 has a 12-bit plus parity bit, word length and a 2.1 usec. memory cycle time. Basic core memory is 2048 words and is expandable to 32,768 words — all directly addressable. There are two independent arithmetic registers, either of which can be used as an accumulator. The SDS 92 adds or subtracts in 4.2 usec.; optional hardware is available to provide multiply and divide instructions. The SDS 92 instruction set is comparable to those of medium-scale computers. Its input/output system is similar to that of the SDS 900 Series, and operates with MAGPAK. (For more information, circle 34 on the Readers Service Card.)

Digital-Analog

HYBRID COMPUTING SYSTEM FOR SCIENTISTS, ENGINEERS

A new HYCOMP 250 digital computer and data conversion package has been developed by Packard Bell Computer, Santa Ana, Calif. Engineers, scientists and computation laboratories using analog computers or planning to install one can now move up to hybrid analog/digital computing at a fraction of the cost of large-scale hybrid computing systems.

The new system includes a Packard Bell PB250 digital computer, a Flexowriter electric input/output typewriter, and 64 channels of analog-to-digital and digital-to-analog conversion. These are housed in a single mobile rack which can be wheeled up to any one of several makes of analog computers, plugged in and operated without additional engineering.

— New low-cost hybrid analog/digital computing system shown consists of Packard Bell's PB250 digital computer (left) and T-50 desk-top analog computer manufactured by Computer Products, Inc.

The PB250 computer supplied with HYCOMP 250 is equipped with 2320 words of memory and a Flexowriter with paper tape punch and reader for basic input/output communication. Standard PB250 peripheral equipment can be added as required. The PB250 has 51 commands and provides 12-microsecond addition and subtraction with correspondingly fast execution speeds for other functions. A full library of software is available, including the CINCH interpreter, an engineering/scientific compiler, conversion and input/output routines, trigonometric subroutines, etc.

The HYCOMP 250 package with PB250 computer and data conversion package is priced at $49,500, making a complete hybrid system available for less than $100,000 — about one-third the cost of typical large-scale hybrid systems. (For more information, circle 35 on the Readers Service Card.)

Data Transmitters and A/D Converters

TYPE 630 DSC

A real time interface between a computer and Teletype stations has been developed by Digital Equipment Corporation, Maynard, Mass. The new Type 630 Data Communication System (DCS) can accommodate 64 Teletype stations and is applicable for multi-user time sharing systems, message switching systems, and data collection-processing systems.

The basic function of the Type 630 DCS is performing serial-to-parallel conversion on incoming characters from the Teletype and performing parallel-to-serial conversion on outgoing characters from the computer. It also performs two-way conversion between Digital voltage levels and the Teletype signal levels. Various combinations of data rates, unit codes, station types, and station signal levels can be handled by the system.

A feature of the system is its high-speed scanning capability. The Type 630 scans the Teletype input stations and determines which are operating or are ready for operation. It also decodes and interprets computer instructions, notifies the computer when it is needed by a station, and sends information to the computer or to the Teletypes — as specified by the computer. The Type 630 Data Communication System is available as an option on all of Digital's computers.
(For more information, circle 36 on the Readers Service Card.)

FILM READING SERVICE OFFERED BY I.I.I.

Information International, Inc., Cambridge, Mass., (manufacturers of fully automatic film reading systems) has announced the availability of a new film reading service for reading scientific data recorded on 16, 35, or 70 mm film, at the rate of approximately 5000 points per second.

The film reading system is based on three major elements: a general purpose digital computer, together with a visual display scope; an I.I.I. Programmable Film Reader; and computer programs for using the computer and film reader.

It is operated completely under computer control, and does not require a human operator.

Films may be sent to I.I.I. for processing. Data on the film will be digitized by the firm and recorded on magnetic tape for storage or further computer processing. (For more information, circle 37 on the Readers Service Card.)

MAGNETIC TAPE-TO-COMPUTER TAPE CONVERTER

A new cartridge magnetic tape-to-computer tape converter has been developed by the Lufkin Research Laboratories, Inc., Los Angeles, Calif., a subsidiary of The Lufkin Rule Company. This converter is a solid state off-line processor for high speed accumulation and validity checking of information acquired and recorded on magnetic tape. It performs computer-ready tape formating and control functions automatically with a minimum of operator controls and handling.

Input data source is a magnetic tape cartridge that requires no threading. It may be inserted into the converter in seconds. Tape control functions also may be connected to digital communications systems for recording directly from wired data sources. Logic, incorporated to safeguard accuracy, detects missing information and initiates corrective routines to prevent the recording of erroneous data on the output tape.

The Lufkin converter is designed to be used wherever data is acquired from many remote sources which must be assimilated by computers or logged into an accessible medium.
(For more information, circle 38 on the Readers Service Card.)

CONTROL DATA 8030 RECORD TRANSMISSION SYSTEM

Control Data Corporation's Industrial Group, Minneapolis, Minn., has recently announced the CONTROL DATA 8030 Record Transmission Terminal. This data terminal is an advanced communication tool used in management information systems for transmitting day-to-day business and scientific information between a company's outlying locations and its computing center. Such information may be transmitted over voice grade telephone lines as well as over higher speed lines.

The major element of the 8030 terminal is the CONTROL DATA Teleprogrammer, a small stored program data processor that directs and controls the flow of information being transmitted either to its own family of peripheral equipment, to a central computing center, or back to the sending terminal — all automatically. Other elements of the data terminal include a communication unit and standard peripheral equipment that the user may require, such as magnetic tape handlers, line printers, card reader and punch, etc. More than one peripheral device may be operated simultaneously with the Teleprogrammer in any of the data terminals.

In the CONTROL DATA 8030, all information is fully checked at both the sending and receiving terminals. In addition, codes and even media can be converted in the transmission process, e.g., information on magnetic tape can be transmitted from one terminal and reproduced as punched cards or printed data at the receiving terminal.

The 8030 may also be used as a satellite to Control Data's computer-directed Information Control Systems in transmitting data to and from remote locations by a central communication system. Furthermore, when not being used as a communications tool, the 8030 can be operated as an off-line peripheral processor.
(For more information, circle 39 on the Readers Service Card.)

LOW-COST DIAL-O-VERTER PUNCHED CARD TRANSMITTERS

The Digitronics Corporation, Albertson, N.Y., has developed two new low-cost Dial-o-verter Punched Card Transmitter Terminals which provide punched card transmission over regular telephone lines and are suited for such applications as punched card transmission from warehouses, branch plants and sales offices to computers.

Models D511 and D512 transmitters provide transmission to Dial-o-verter magnetic tape or paper tape terminals, to on-line printer data terminals, as well as to on-line computers. Both terminals eliminate the necessity of converting punched cards to hard copy. Other advantages offered by the new terminals include simplicity of operation and the capability of being used with a Digitronics D400 printer (sharing one subset) for off-line conversion from cards to printed copy.

The D511 and D512 read 80-column punched cards at 100 cards-per-minute and 400 cards-per-minute respectively with actual card reading rate dependent on Data-Phone and telephone line facilities available. Connection to the new 202C or 202D reverse channel Data-Phone is standard. Operation with other Data-Phones is optional.
(For more information, circle 40 on the Readers Service Card.)

Software

FINDING THE RIGHT MAN FOR THE RIGHT JOB

The problem of finding the right man for the right job may be solved by a new computer technique developed by the Radio Corporation of America, New York, N.Y. The new computer program, Personnel Search Program, results in a swift and economical answer to the problem by providing management with an easily-accessible inventory of its "human resources".

The initial step in developing a "human resources inventory" is the preparation of a master file, recording on magnetic tape the employee's name, address, age, weight, health, education, training, skills and experience, with a continuing updating of the information.

The personnel department representative need have no computer knowledge. After the questions for a particular search have been chosen, they are fed into an RCA 301 data processing system by means of punched cards. Then the computer, using the basic program sequence, takes over and the magnetic tape files are searched. Information on employees who fill the bill is turned out on the computer's high-speed printer.

Up to 100 independent requests can be pursued by the computer in one search of the master file. In the case of a company with 10,000 employees at widely scattered installations, the computer can produce a list of employees eligible for a specific job in two minutes or less

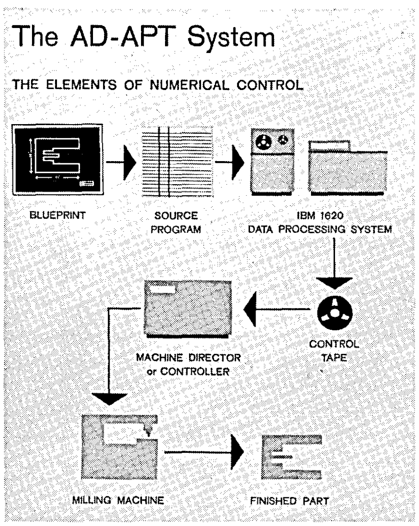
The use of the Personnel Search Program and the RCA 301 will give management the ability to make

the most efficient use of all available talents through detailed reports of the skills and experience of its employees.
(For more information, circle 42 on the Readers Service Card.)

AD-APT

The use of a small computer to generate complex instructions for numerically controlled machine tools has been demonstrated by IBM Corp., New York, N.Y. The computer, and IBM 1620 data processing system, was being operated under control of a new program called AD-APT. This program contains capabilities which formerly were available only on computers with much larger storage capacity.

This is possible because the 1620 is linked directly to an IBM 1311 disk storage drive. The random access storage device can hold two million digits of information which are available to the computer for immediate processing.



The chart above illustrates how a small-scale data processing system, the IBM 1620, can help produce a finished part from a blueprint drawing. The computer, operating under control of the new program AD-APT, converts English-like statements from a source document into instructions for numerically controlled machine tools. These instructions then direct the machine tool through the cutting operations necessary to produce the finished part called for in the blueprint.

AD-APT is an outgrowth of a government sponsored project to prove the feasibility of using a small scale computer for numerical control. The program is an adaptation of an earlier computer program known as APT (Automatically Programmed Tools). The AD-APT program will be available without charge to users of the IBM 1620 data processing system during the third quarter of 1964.
(For more information, circle 44 on the Readers Service Card.)

ALPS NOW AVAILABLE FOR H-800 AND 1800 SYSTEMS

A new linear programming aid for users of large-scale Honeywell 800 and 1800 computer systems has been released by Honeywell EDP, Wellesley Hills, Mass. The software called ALPS, for Advanced Linear Programming System, is designed to handle large and complex problems at high speeds.

ALPS is controlled by means of agenda, which are instructions that permit operators to control internal processing. A total of 16 agenda are available, only five of which are required. The 11 additional agenda permit flexibility in processing. The system also possesses extensive input and output capabilities and can be restarted without recomputation.
(For more information, circle 43 on the Readers Service Card.)

IBM TRANSLATOR CONVERTS 1400 SERIES RPG PROGRAMS TO SYSTEM/360 LANGUAGE

A new program has been announced by IBM Corp., White Plains, N.Y., which translates Report Program Generators from 1401, 1440 or 1460 language to System/360 RPG language.

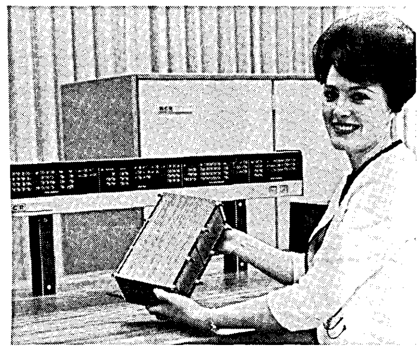
This is accomplished by processing, on a 1400 series computer under control of the new translator program, an RPG program to be converted. The resulting RPG program card deck can be processed in the same manner as a program written originally for System/360.

IBM previously had announced an optional feature of System/360 (read-only storage unit) that enables programs written for the 1401, 1440 and 1460 to be processed by System/360 Models 30 and 40. The System/360 RPG translator program, which does not require the use of the optional read-only storage unit, will be available without charge in the third quarter of 1965 to users of the IBM 1401, 1440 or 1460 data processing systems.
(For more information, circle 41 on the Readers Service Card.)

Memories

NCR ANNOUNCES FIRST USE OF A THIN-FILM MAIN MEMORY IN BUSINESS COMPUTER

The cylindrical thin films, used in the NCR 315 RMC (Rod Memory Computer), newly announced by National Cash Register Co., Dayton, Ohio, represent the first commercial application of thin-film technology to a computer's main memory. Usage of other types of thin films for computer memories has thus far been confined to relatively small "scratch-pad" memories.



— NCR's new 315 RMC (Rod Memory Computer). Miss Marie Coates of NCR's Electronics Div. holds a section of the new memory which contains wire Rods coated with magnetic thin film.

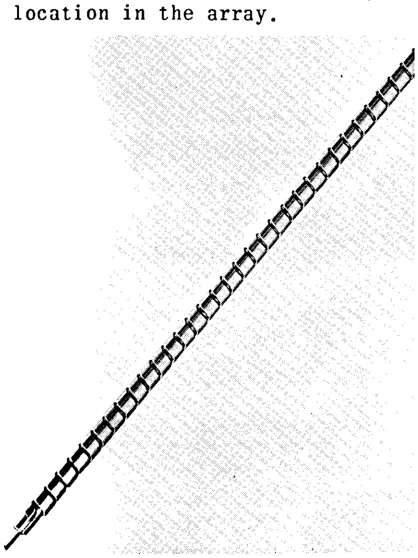
The unique main internal memory can store up to 240,000 decimal digits (4 data-bits each) or 160,000 alphanumeric characters (6 bits each). The basic cycle time is 800 nanoseconds (billionths of a second), an entire order faster than conventional microsecond computer memories.

The basic elements in NCR's solenoid-accessed Rod-type memory are tiny metal rods which are coated with a thin film and wrapped with wire windings. In an automatic and continuous production technique, a hair-like beryllium-copper wire is plated with nickel-iron thin film by continuous-process electrodeposition. This film completely surrounds the wire substrate and is 4000 angstroms thick. (An angstrom unit is a ten-millionths of a millimeter.)

The plated wire is cut into desired lengths and assembled in a three-dimensional array to form a completed memory — which is about half the size of a comparable standard 315 core memory. In the

— Miss Marie Coates of NCR's Electronics Div. displays some of the thin-film Rods used in the 315 RMC. A memory module is shown on top of the cabinet.

computer, electrical pulses sent through microscopic coils in the memory stack magnetize the film in pre-determined directions and at pre-determined locations. Information, in the form of pulses, can then be read out of the memory by sensing the magnetic state of the cylindrical thin film at any given location in the array.



— Microscopic view of one of the Rod elements used in NCR's new 315 RMC (Rod Memory Computer).

Since the thin-film Rod can be mass-produced and easily assembled, it results in relatively low production costs for an ultra-fast, reliable memory system.
(For more information, circle 46 on the Readers Service Card.)

BEAM OF LIGHT FROM LASER DRILLS MICROSCOPIC HOLES IN METAL

The Radio Corporation of America's Aerospace Systems Division, Burlington, Mass., has used the concentrated light from a ruby laser to drill in tungsten wire, holes as small as one ten-thousandths of an inch in diameter — invisible to the naked eye. Burton Clay, project engineer for the device, said this unique laser drilling application could lead to extremely compact and fast micro-energy units for computers.

He explained that the key to compactness and low electrical energy requirements in these memories lies in drilling holes very close to each other in magnetic wire. The smaller the holes, the closer together they can be drilled. The laser, set up on an optical bench which controls precisely the spot at which the microscopic hole will be drilled, is the only device which will efficiently drill such holes in metal, according to Mr. Clay.

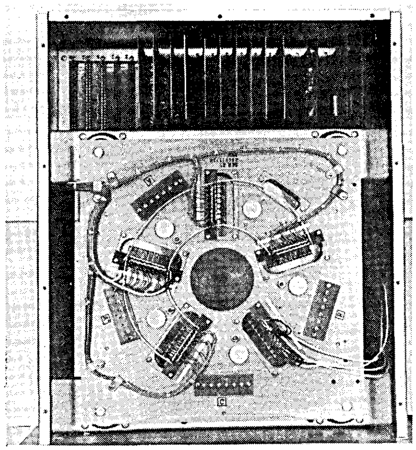
Metal drills are too big, very slow and are unsuited to drill through a substance as hard as tungsten. Electron beam drills require a vacuum in which to perform their functions, and take several seconds to do the job with possible injurious heating occurring in the metal. The laser drill goes through in a millionth of a second, so fast that the surrounding material never gets a chance to heat up.

Mr. Clay noted that the laser drilling method speeds up the action of the computer memory because the wires carrying the memory information, which pass through the holes, need change the polarity of only a portion of the metal between the two holes to store a bit of information.

INTEGRATED CIRCUIT TEST SYSTEM WITH MAGNETIC DISC PROGRAMMING

Fairchild Semiconductor Instrumentation, Palo Alto, Calif., has developed an integrated circuit tester with a magnetic disc programming unit that simplifies operation and expands flexibility.

The disc eliminates laboriously wired program cards and punch-tape controlled test routines. Test speed is improved by almost a full order of magnitude. The disc, used on Fairchild's Model 4000M integrated Circuit Tester, provides 36 data tracks for test information, and additional tracks are used for control of machine operation. Each of the 36 test tracks is divided into 25 tests, with 40 characters per test and four bits per character.



Nine hundred tests may be made on a single device type, or more typically, 25 tests on 30 device types, 50 tests on three device types, and 75 tests on one device. Any combination to suit user requirements within a 900 test limit may be programmed.

The selection of a test program for a particular device type, once the program is entered on a magnetic disc, is accomplished by flicking a switch. This permits the testing of many different device types by an unskilled operator during the same work period. If more than 25 tests are required for a device, the unit will automatically continue onto any selected additional test track. A 16-key, adding machine type, letter and number-coded keyboard is provided for entering or changing stored data.
(For more information, circle 47 on the Readers Service Card.)

Information Retrieval

RANDOMATIC

A new system, called "Randomatic", automatically retrieves random-filed information on any file, aperture or microfiche card. It is an electro-mechanical device which retrieves the desired card or combination of cards in less than two seconds — from unlimited numbers of cards.

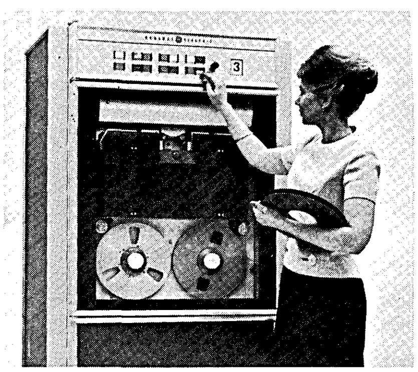
The system, announced by Microdealers, Inc., Waltham, Mass., consists of an automated desk-top filing "module" for open storage of the cards. This has a built-in indexing punch for edge-coding the cards. It also has a plug-in electrical connection to a small push button keyboard which is like an adding machine. The push buttons operate the file modules and, when punched correctly, will "search" the file and produce the desired card within two seconds.

One or a number of filing modules may be used with the Randomatic system. The device will handle IBM cards, aperture cards, microfiche, Kalvar film, punched cards, magnetic cards or ordinary cards. Searching is selective and may be for one or many cards; retrieval is automatic for all selected cards. The system is said to cut both clerical and business machine time by as much as 30%.
(For more information, circle 48 on the Readers Service Card.)

Input-Output

GE INTRODUCES NEW TAPE TRANSPORTS

A new line of six computer magnetic tape units has been introduced by the General Electric Company, Phoenix, Ariz. All are available in 7 and 9-channel models and will operate with the Compatibles-400 and the new large-scale Compatibles-600 computers.



— Judy Stacey of the Computer Department's product planning group demonstrates one of GE's new line of computer tape subsystems; a multiple-capstan, constant-speed drive for the high-performance range.

Vacuum-grip drives and photocell protective devices are used to virtually eliminate the inconvenience and expense of broken, scratched and stretched magnetic tape. Nothing but the read-write head touches the oxide-side of the tape.

Two basic tape-handling mechanisms are used in the six models: a single-capstan, low-inertia drive for tape transfer rates from 7500 to 80,000 characters per second; and a multiple-capstan, constant-speed drive for the high range up to 160,000 characters per second. Both designs accommodate 1/2-inch-wide tape and record in standard computer formats, including the ASCII format on the 9-channel models.

Both designs handle tape densities up to 800 bits per inch. Each unit is adjustable for tape density by operator-pushbutton or computer program. High-speed rewind is provided: a full 2400-foot reel is rewound in less than 90 seconds. High-speed rewind is effective even for short lengths of tape. Both designs use 1/4-turn locking hubs for quick loading of tape reels.
(For more information, circle 49 on the Reader Service Card.)

ROYAL 5000 SDW, PUNCHED TAPE SOURCE DOCUMENT WRITER

Royal McBee Corp., New York, N.Y., has announced the Royal 5000 SDW (Source Document Writer). The device consists of a specially designed electric typewriter, solid state circuitry and controls, and a cable-connected paper tape punch/read/control unit. Connectors for an auxiliary punch and auxiliary reader are mounted at the rear of this unit.

The Royal 5000 SDW can be operated from the keyboard at speeds of up to 25 characters per second. Tape can be regenerated at speeds of up to 50 characters per second.

The system produces a punched paper tape, or edge punched cards as a by-product of typing original source documents, such as purchase orders, sales orders, invoices, etc. This tape and/or edge punched cards are used to automatically create up to 90% of resulting voucher checks, invoices, etc. Output tapes from this operation can provide automatic input into computers or punched card data processing systems. The 5000 SDW can also generate punched paper tape to automatically control other tape actuated machines, such as data transmission equipment, numerically controlled machine tools and automatic address-plate embossing machines.
(For more information, circle 50 on the Readers Service Card.)

MICRODENSITOMETER SYSTEM

A new photographic data processing system which will speed up post-flight analysis of photographic data obtained in the Air Force Ballistic Missile Re-entry Systems (BMRS) program, is being prepared at the David W. Mann Co. (A division of Geophysics Corp. of America), Burlington, Mass. The new Microdensitometer system includes advanced electro-optical measuring equipment and digitized data processing techniques.

The system will measure the position (in two coordinates) and the relative lightness or darkness of micron-sized images while scanning photographic plates at rates up to 625 millimeters per minute. In the process, high-speed digital readout information is provided on magnetic tape.

Silicon solid-state components are used in the design, and the basic detector circuit is one in which a feedback signal decreases the voltage on a high-gain photomultiplier detector as light level increases. This action automatically protects the detector from delivering a damaging anode current. Although similar techniques have been used previously to extend the dynamic range (1 to 100,000 in signal level) with logarithmic output, they have not had the necessary frequency response characteristics for rapid digital readout. Information bits can be accumulated at such a rate with this instrument that only magnetic tape recording is feasible for data readout.

In the Microdensitometer system, a precision two-coordinate optical comparator is combined for the first time with a very sensitive photometer. The system provides high reliability under continuous operation, and scanning may be accomplished in either of the two coordinates at speeds up to 1000 times faster — without loss of accuracy — than is possible with a strip chart recorder. (For more information, circle 51 on the Readers Service Card.)

EDITING DEVICE SPEEDS CORRECTION OF PERFORATED TAPE

A low cost, automatic editing device has been announced by Infor/onics, Inc., Maynard, Mass. The EDITOR I permits rapid preparation and correction of data on perforated tape.

EDITOR I, a small, fast perforated tape processor, executes natural editorial instructions, as directed by push button from an "Editor's Console". A first-draft tape is read on the EDITOR's high speed reader; this data is selectively copied, deleted, or reformatted; new data is typed in as required; and a clean tape is produced by the high speed punch. The machine also eliminates the retyping of text whose margins or format have been destroyed by editorial changes. An automatic justification mode redistributes the data correctly.

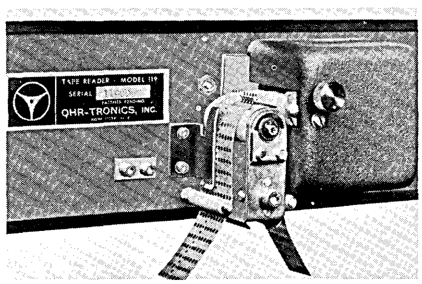
During automatic processing, continuous error checking takes place; incorrect codes will cause an "error-halt" before reperforation. During typing of new data, a two character buffer memory and an "erase-by-backspace" feature permit typists to correct input errors prior to perforation.

The machine is compatible with any input-output keyboard or tape typewriter chosen by the user. It will accept and produce 5, 6, 7, or 8 channel tape up to 1 inch wide, in any tape code. Tapes are processed at rates of 500 words per minute.

The new machine has application in all areas where perforated tape is used, and particularly in data preparation for computers. (For more information, circle 52 on the Readers Service Card.)

PAPER TAPE READER WITH COMMUTATOR

OHR-TRONICS, INC., South Hackensack, N.J., has announced a new paper tape reader with commutator, for block reading applications. Model 119C reads up to 8 channel paper tape, bi-directionally, at speeds up to 30 cps. Sensing of the holes is accomplished by the use of star wheels. When a star whell enters a hole, an arm carrying the star wheel closes a switch. A dual cross-coupled pawl system is used for stepping the tape in either direction.

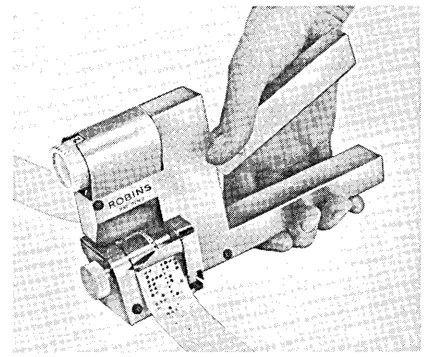


A twelve point commutator is mounted on the sprocket shaft. All points are brought to a 36 pin connector with mating connector supplied. Standard units are wired for 24, 48 or 90 VCD. Coils are designed for continuous duty and are arc suppressed with diodes. Interrupter switches are provided for self-stepping and electrical interlocking.
(For more information, circle 53 on the Readers Service Card.)

ROBINS DATA CODER

Robins Data Devices, Inc., a subsidiary of Robins Industries Corp., Flushing, N.Y., has introduced a new hand held device which simplifies additions and corrections for automated factory procedures. The device, called Robins Data Coder, permits the user to encode data directly into "machine language". Data may be encoded in 5, 6, 7, and 8 channel punched tapes at any spot at any time without first hand writing the information and later having it transcribed with the possibility of error. The new device is also useful for correcting and editing existing tapes by the application of a patch to cover the incorrect information, and the repunching of new data.

The Data Coder weighs only three pounds and measures 7 3/4" x 3 7/8" with all operating parts entirely enclosed. It has a standard code wheel with standard numeric codes plus extra bits which allow encoding of ANY alphanumeric or other code. Custom code wheels with any 18 predetermined codes are available (code wheels are easily interchangeable).



A selector knob in the front of the device permits quick and easy selection of the code desired. An indicator window at the top front shows the exact character being punched. After each code is made, the tape is automatically fed to the next punching position. (For more information, circle 54 on the Readers Service Card.)

NEW LITERATURE

MEMOREX MONOGRAPH NO. 3

Memorex Corporation, Santa Clara, Calif., has announced the third in a continuing series of informative problem-solving literature which deals with a wide range of technical subjects related to magnetic tape use. (see Computers and Automation, February 1964, p. 38).

Memorex Monograph #3 is an 8-page publication titled, "Causes of Failure in Magnetic Tape". The article was authored by D. F. Eldridge, Memorex Vice President and Technical Director. Mr. Eldridge discusses factors which lead to performance deterioration and end of magnetic tape life, and various types of tape failure attributable to both normal use and accidental damage. The object of this new Memorex Monograph is to assist the user to obtain maximum utilization and reliability in the use of magnetic tape.
(For more information, circle 55 on the Readers Service Card.)

MODERN OPTICAL DESIGN

A computer program used to design optical systems is described in a free folder published by IIT Research Institute. The illustrated folder summarizes DIDOC (Desired Image Distribution using Orthogonal Constraints), the mathematical program developed at IITRI to extend the optical designer's capabilities beyond the ordinary practice of the art.
(For more information, circle 56 on the Readers Service Card.)

MEETING NEWS

1964 ACM MEETING IN PHILADELPHIA

The Association for Computing Machinery (ACM) is holding its Nineteenth National Conference this month, on August 25, 26, and 27 at the Sheraton Hotel, Philadelphia, Pa. ACM, founded in 1947, was the first professional association with a central interest in computing machinery.

The featured address will be given at a Conference Luncheon on Wednesday, August 26, by Thomas J. Watson, Jr., Chairman of the Board and Chief Executive Officer, IBM Corp. Introductory remarks will be given by Howard Bromberg of C-E-I-R Inc., ACM 64 General Chairman and there will be an address by incoming President, George E. Forsythe, Stanford University.

Industry and the military are participating in an operational display of the latest developments in computer devices and systems designed for commercial, government and academic installations. The show will be held in the exhibit halls of the Sheraton Hotel.

There will be twenty technical sessions, highlighted by panel discussions, debate forums and special demonstrations. A total of 48 papers (authored by over 60) will be presented. Complete papers of all conference talks will be published in a Conference Proceedings and distributed to all registrants. Post-conference copies will be available from the ACM, 211 East 43d St., New York, N.Y. 10017.

CONFERENCE HELD ON PROGRAMMED MEDICAL INSTRUCTION

The first national conference in the field of Programmed Instruction in Medical Education, was held in June at the University of Rochester (N.Y.) School of Medicine and Dentistry. It was attended by more than 200 physicians and educators from five Canadian and 59 United States medical schools as well as several universities, institutes and publishing houses.

Twenty-nine speakers participated in the pre-conference Introduction to Programmed Instruction and the five conference sessions: Programming in the Total Learning Process; Background for Program Development; Specific Problems in Medical Programming; Research and Evaluation; and informal discussion groups. Methods, theories, problems, and even some answers came into clearer focus at the conference.

Jerome P. Lysaught, assistant professor of education at the University of Rochester and a member of the conference committee said that the conference underscored the major possibilities for medical programming and added, "I think it was agreed that programmed instruction does have tremendous application to teaching medicine."

The conference was sponsored by the School of Medicine and Dentistry and the College of Education of the University of Rochester with support by Pfizer Laboratories. Dr. Hilliard Jason, associate in medical education at the University, was conference coordinator.

BUSINESS NEWS

FABRI-TEK MAKES STOCK OFFERING

An initial offering of 200,000 common shares of Fabri-Tek, Inc. were sold last month to interested investors. Initial offering price was $11.50 per share. Of the shares offered, 100,000 were sold for the company and 100,000 for a stockholder.

Proceeds from the sale of its 100,000 shares will be used by the company to repay temporary borrowings incurred in the purchase and improvement of plant facilities, financing a new manufacturing and research facility, and the purchase of additional machinery and equipment. The balance will be used for general corporate purposes.

Fabri-Tek's net sales in 1962 were $2.4 million; $5 million in 1963; and $7.8 million in 1964, for the year ending March 1964.

CONTROL DATA HAS RECORD SALES

Control Data Corporation has announced that it received a record volume of new orders in June which exceeded new orders received in any previous month in the Company's history.

President William Norris said, "During June, the Company received new orders for equipment worth over $61 million, and these are all firm orders exclusive of Letters of Intent."

Norris pointed out that this flurry of orders followed a previous temporary slowdown in orders for Control Data for two months preceding the forthcoming IBM 360 system announcement of early April 1964, followed by a two months evaluation period by prospective customers. He added that in view of the large amount of publicity attendant to the IBM offering, there was a natural tendency for many buyers to wait and see before making a decision, and that it took the marketplace a couple of months to make its evaluation following the competitive announcement before recent decisions to proceed to buy Control Data equipment. One of the factors taken into account by customers ordering Control Data computers is the fact that Control Data's computers are available today.

RCA CITES RECORD HALF FOR EARNINGS

RCA announced that its earnings during the 2nd quarter of 1964 increased 32% over the same quarter last year to establish an all-time record for the period.

RCA's operating earnings for the first six months of 1964 also established a record for the period, rising 28% over the first half of 1963.

Sales for the six-month period reached a record level of $899,100,000, up about 2 per cent over the 1963 first-half total of $877,300,000.

Among the principal highlights of RCA's operations in the first six months was a 30 per cent rise in domestic orders for RCA electronic data processing systems.

CALENDAR OF COMING EVENTS

Aug. 12-14, 1964: 1964 UAIDE (Users of Automatic Information Display Equipment) Meeting, International Hotel, Sepulveda and Century Blvds., Los Angeles, Calif.; contact M. Hoffman, Program Chairman, 1964 UAIDE Annual Meeting, Dept. 716-61, Atomics International, P. O. Box 309, Canoga Park, Calif.

Aug. 25-27, 1964: ACM Annual Meeting, Sheraton Hotel, Philadelphia, Pa.; contact H. Bromberg, Conference Chairman, C-E-I-R, Inc., Benson East, Jenkintown, Pa.

Aug. 25-28, 1964: 1964 Western Electronic Show and Convention (WESCON) and IEEE Summer General Meeting, Los Angeles Sports Arena and Hollywood Park, Los Angeles, Calif.; contact WESCON, 3600 Wilshire Blvd., Los Angeles, Calif.

Aug. 30-Sept. 5, 1964: Symposium on Sensitivity Analysis of Nonlinear Systems, Dubrovnik, Yugoslavia; contact John E. Gibson, EE Dept., Purdue Univ., Lafayette, Ind.

Sept. 14-16, 1964: 8th National Convention on Military Electronics (MILECON), Washington-Hilton Hotel, Washington, D. C.

Sept. 14-16, 1964: UNIVAC Users Association Fall Conference, New York Hilton Hotel, Rockefeller Center, New York, N. Y.; contact David D. Johnson, UUA Secretary, Ethyl Corp., 100 Park Ave., New York, N. Y. 10017

Sept. 14-18, 1964: 4th International Conference of Analog Computing, College of Technology, Brighton, England; contact The BCS/AICA Honorary Secretariat, Ferranti Ltd., Kern House, 36 Kingsway, London, W. C. 2, England

Sept. 14-19, 1964: Symposium on Component Parameters and Characteristics, Stockholm, Sweden; contact Prof. Herman R. Weed, EE Dept., Ohio State Univ., Columbus 10, Ohio

Sept. 17-18, 1964: 7th Annual Northwest Computing Conference, Univ. of Washington, Seattle, Wash.; contact Robert K. Smith, Northwest Computing Association, Box 836, Seahurst, Wash.

Sept. 17-18, 1964: 12th Annual Joint Engineering Management Conference, Pick-Carter Hotel, Cleveland, Ohio; contact The Institute of Electrical and Electronics Engineers, Box A, Lenox Hill Station, New York 21, N. Y.

Sept. 21-24, 1964: 1964 IFAC/IFIP Conference, International Conference on Application of Digital Computers for Process Control, Stockholm, Sweden; contact IFAC/IFIP Conference 1964, Swedish Conference Office, Box 320, Stockholm 1, Sweden

Sept. 23-25, 1964: 1st International Congress on Inst. in Aerospace Simul. Facilities, Paris, France.

Sept. 30-Oct. 2, 1964: Fall Meeting of the H-800 Users Association, Leamington Hotel, Minneapolis, Minn.; contact H. J. Juenemann, Sec'y-Treas., H-800 Users Association, Computation and Data Processing Branch, Div. of Research Services, National Institutes of Health, Bldg. 12, Room G-104, Bethesda 14, Md.

Oct. 4-9, 1964: National Symposium on Space Electronics, Dunes Hotel, Las Vegas, Nev.; contact Charles H. Doersam, Jr., Grumman Aircraft, Eng. Corp., Elec. Bldg. #5, Bethpage, N. Y.

Oct. 5-7, 1964: 10th National Communciations Symposium, Utica, N. Y.

Oct. 6-13, 1964: Symposium on Hazard and Race Phenomena in Switching Circuits, Bucharest, Roumania; contact Prof. E. J. McCluskey, Jr., EE Dept., Princeton Univ., Princeton, N. J.

Oct. 7-9, 1964: Electronic Information Handling Conference, Hotel Webster Hall, 4415 Fifth Ave., Pittsburgh, Pa. 15213; contact Knowledge Availability Systems Center, Univ. of Pittsburgh, Rm. 270, Hotel Webster Hall, Pittsburgh, Pa. 15213.

Oct. 11-14, 1964: 1964 Fall URSI IEEE Meeting, Univ. of Ill., Urbana, Ill.; contact Inst. of Electrical and Electronics Engineers, Box A, Lenox Hill Station, New York 21, N. Y.

Oct. 12-14, 1964: Systems and Procedures Association of America—Seventeenth Annual International Systems Meeting, Hotel Sheraton, Philadelphia, Pa.; contact John W. Donohue, P. O. Box 8207, Philadelphia, Pa. 19101.

Oct. 12-15, 1964: 19th Annual ISA Instrument-Automation Conference and Exhibit, Coliseum, New York, N. Y.; contact ISA Meetings Assistant, Penn Sheraton Hotel, 530 William Penn Pl., Pittsburgh 19, Pa.

Oct. 13-16, 1964: GUIDE International (Users Organization for Large Scale IBM EDP Machines) Meeting, Royal York Hotel, Toronto, Canada; contact Miss Lois E. Mecham, Sec'y, GUIDE International, c/o United Services Automobile Association, USAA Bldg., San Antonio, Tex.

Oct. 15-17, 1964: Association for Computing Machinery Annual Southeastern Regional Conference, Atlanta Americana Motor Hotel, Atlanta, Ga.; contact I. E. Perlin, Georgia Inst. of Technology, 225 North Ave., Atlanta, Ga. 30332

Oct. 19-21, 1964: National Electronics Conference, McCormick Pl., Chicago, Ill.; contact National Elec. Conf., 228 No. LaSalle St., Chicago, Ill.

Oct. 19-23, 1964: 6th Annual Business Equipment Exposition (BEMA), Los Angeles Memorial Sports Arena, Los Angeles, Calif.; contact R. L. Waddell, BEMA, 235 E. 42 St., New York 17, N. Y.

Oct. 19-23, 1964: 4th International Congress on Cybernetics, Namur, Belgium; contact Secretariat of the International Association for Cybernetics, Palais des Expositions, Place A. Rijckmans, Namur, Belgium

Oct. 27-29, 1964: Fall Joint Computer Conference, Civic Center, Brooks Hall, San Francisco, Calif.; contact Mrs. P. Huggins, P. O. Box 55, Malibu, Calif.

Oct. 29-31, 1964: 1964 Electron Devices Meeting, Sheraton-Park Hotel, Washington, D. C.; contact Rolf W. Peter, Watkins-Johnson Co., 3333 Hillview Ave., Palo Alto, Calif.

Nov. 4-6, 1964: Data Processing Management Association 1964 Fall Data Processing Conference and Business Exposition, Hilton Hotel, San Francisco, Calif.; contact Data Processing Management Association, 524 Busse Highway, Park Ridge, Ill.

Nov. 4-6, 1964: NEREM (Northeast Res. & Engineering Meeting), Boston, Mass.; contact IEEE Boston Office, 313 Washington St., Newton, Mass. 02158.

Nov. 9-11, 1964: Joint Western Mid-Western Region Meeting of the 1620 Users Group, Center for Continuing Education, Univ. of Oklahoma, Norman, Okla.; contact Paul Bickford, Univ. of Okla. Medical Research, 800 N.E. 13th St., Oklahoma City, Okla.

MONTHLY COMPUTER CENSUS

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

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

Most of the installation figures, and some of the unfilled order figures, are verified by the respective manufacturers. In cases where this is not so, estimates are based on information in the market research reference files of COMPUTERS AND AUTOMATION. The figures are then reviewed by a group of computer industry cognoscenti.

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

AS OF JULY 10, 1964

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS**
Addressograph-Multigraph Corporation	EDP 900 system	Y	$7500	2/61	11	1
Advanced Scientific Instruments	ASI 210	Y	$2850	4/62	20	2
	ASI 2100	Y	$3000	12/63	5	2
Autonetics	RECOMP II	Y	$2495	11/58	66	X
	RECOMP III	Y	$1495	6/61	17	X
Bunker-Ramo Corp.	TRW-230	Y	$2680	8/63	11	3
	RW-300	Y	$5000	3/59	40	X
	TRW-330	Y	$5000	12/60	30	X
	TRW-340	Y	$7000	12/63	6	15
	TRW-530	Y	$6000	8/61	22	4
Burroughs	205	N	$4600	1/54	63	X
	220	N	$14,000	10/58	43	X
	E101-103	N	$875	1/56	128	X
	E2100	Y	$535	8/64	0	620
	B100	Y	$2800	11/64	0	29
	B250	Y	$4200	11/61	85	18
	B260	Y	$3750	11/62	58	26
	B270	Y	$7000	7/62	80	38
	B280	Y	$6500	7/62	88	45
	B370	Y	$8400	7/65	0	13
	B5000	Y	$16,200	3/63	33	25
Clary	DE-60/DE-60M	Y	$525	2/60	216	5
Computer Control Co.	DDP-19	Y	$2800	6/61	3	X
	DDP-24	Y	$2500	5/63	34	17
	DDP-224	Y	$3300	12/64	0	5
Control Data Corporation	G-15	N	$1000	7/55	321	X
	G-20	Y	$15,500	4/61	26	X
	160*/160A/160G	Y	$1750/$3000/$4800	5/60;7/61;3/64	376	25
	924/924A	Y	$11,000	8/61	26	5
	1604/1604A	Y	$35,000	1/60	60	X
	3200	Y	$9000	5/64	6	65
	3400	Y	$32,000	11/64	0	18
	3600	Y	$52,000	6/63	21	30
	6600	Y	$110,000	6/64	1	3
Digital Equipment Corp.	PDP-1	Y	Sold only about $120,000	11/60	52	2
	PDP-4	Y	Sold only about $60,000	8/62	39	15
	PDP-5	Y	Sold only about $25,000	9/63	40	40
	PDP-6	Y	Sold only about $300,000	8/64	0	5
	PDP-7	Y	Sold only about $72,000	10/64	0	6
El-tronics, Inc.	ALWAC IIIE	N	$1820	2/54	24	X
Friden	6010	Y	Sold only about $20,000	6/63	137	96
General Electric	205	Y	$2900	9/64	0	10
	210	Y	$16,000	7/59	60	X
	215	Y	$5500	11/63	20	8
	225	Y	$7000	1/61	120	2
	235	Y	$10,900	12/63	15	20
	415	Y	$5500	5/64	3	100
	425	Y	$7500	7/64	0	40
	435	Y	$12,000	10/64	0	21
	455	Y	$18,000	6/65	0	10
	465	Y	$24,000	6/65	0	6
General Precision	LGP-21	Y	$725	12/62	115	59
	LGP-30	semi	$1300	9/56	440	5
	RPC-4000	Y	$1875	1/61	101	2
Honeywell Electronic Data Processing	H-200	Y	$4200	3/64	13	595
	H-300	Y	$3900	7/65	0	4
	H-400	Y	$5000	12/61	97	15
	H-800	Y	$22,000	12/60	62	8
	H-1400	Y	$14,000	1/64	6	6

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS**
	H-1800	Y	$30,000	1/64	3	8
	H-2200	Y	$11,000	10/65	0	9
	DATAmatic 1000	N	---	12/57	5	X
H-W Electronics, Inc.	HW-15K	Y	$490	6/63	3	3
IBM	305	N	$3600	12/57	535	X
	360/30	Y	$4200	7/65	0	660
	360/40	Y	$9600	7/65	0	285
	360/50	Y	$18,000	9/65	0	205
	360/60	Y	$35,000	10/65	0	100
	360/62	Y	$50,000	11/65	0	22
	360/70	Y	$80,000	10/65	0	115
	650-card	N	$4000	11/54	400	X
	650-RAMAC	N	$9000	11/54	80	X
	1401	Y	$4500	9/60	7200	900
	1401-G	Y	$1900	5/64	100	850
	1410	Y	$12,000	11/61	345	170
	1440	Y	$1800	4/63	945	1100
	1460	Y	$9800	10/63	310	620
	1620	Y	$2000	9/60	1500	40
	701	N	$5000	4/53	1	X
	7010	Y	$19,175	10/63	40	45
	702	N	$6900	2/55	3	X
	7030	Y	$160,000	5/61	6	X
	704	N	$32,000	12/55	43	X
	7040	Y	$14,000	6/63	47	48
	7044	Y	$26,000	6/63	35	18
	705	N	$30,000	11/55	86	X
	7070, 2, 4	Y	$24,000	3/60	500	55
	7080	Y	$55,000	8/61	69	8
	709	N	$40,000	8/58	11	X
	7090	Y	$64,000	11/59	55	4
	7094	Y	$70,000	9/62	248	25
	7094 II	Y	$76,000	4/64	35	75
ITT	7300 ADX	Y	$18,000	7/62	8	6
Monroe Calculating Machine Co.	Monrobot IX	N	Sold only - $5800	3/58	158	X
	Monrobot XI	Y	$700	12/60	392	175
National Cash Register Co.	NCR - 304	Y	$14,000	1/60	26	X
	NCR - 310	Y	$2000	5/61	46	1
	NCR - 315	Y	$8500	5/62	188	125
	NCR - 390	Y	$1850	5/61	604	165
	NCR - 395	Y	$650	5/64	20	130
Packard Bell	PB 250	Y	$1200	12/60	155	8
	PB 440	Y	$3500	3/64	4	8
Philco	1000	Y	$7010	6/63	15	0
	2000-212	Y	$52,000	1/63	5	2
	-210, 211	Y	$40,000	10/58	19	2
Radio Corp. of America	Bizmac	N		-/56	4	X
	RCA 301	Y	$6000	2/61	495	145
	RCA 3301	Y	$20,000	7/64	0	20
	RCA 501	Y	$15,000	6/59	96	4
	RCA 601	Y	$35,000	11/62	4	1
Scientific Data Systems Inc.	SDS-92	Y	$900	12/64	0	1
	SDS-910	Y	$2000	8/62	72	35
	SDS-920	Y	$2700	9/62	55	10
	SDS-925	Y	$2500	12/64	0	0
	SDS-930	Y	$4000	6/64	2	13
	SDS-9300	Y	$7000	10/64	0	2
UNIVAC	I & II	N	$25,000	3/51 & 11/57	33	X
	III	Y	$20,000	8/62	70	50
	File Computers	N	$15,000	8/56	40	X
	Solid-State 80, 90, & Step	Y	$8000	8/58	342	1
	Solid-State II	Y	$8500	9/62	41	4
	418	Y	$11,000	6/63	6	7
	490	Y	$26,000	12/61	33	21
	1004	Y	$1900	2/63	1420	925
	1050	Y	$8000	9/63	52	260
	1100 Series (except 1107)	N	$35,000	12/50	15	X
	1107	Y	$45,000	10/62	18	13
	LARC	Y	$135,000	5/60	2	X
				TOTALS	20,285	9,588

X = no longer in production.

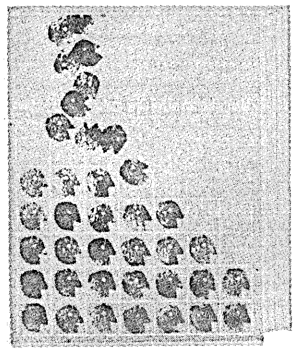
* To avoid double counting, note that the Control Data 160 serves as the central processor of the NCR 310. Also, many of the orders for 7044, 7074, and 7094 I and II's are not for new machines but for conversions from existing 7040, 7070, and 7090 computers respectively.

** Some of the unfilled order figures are verified by the respective manufacturers; others are estimated and then reviewed by a group of computer industry authorities.

here it is!

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

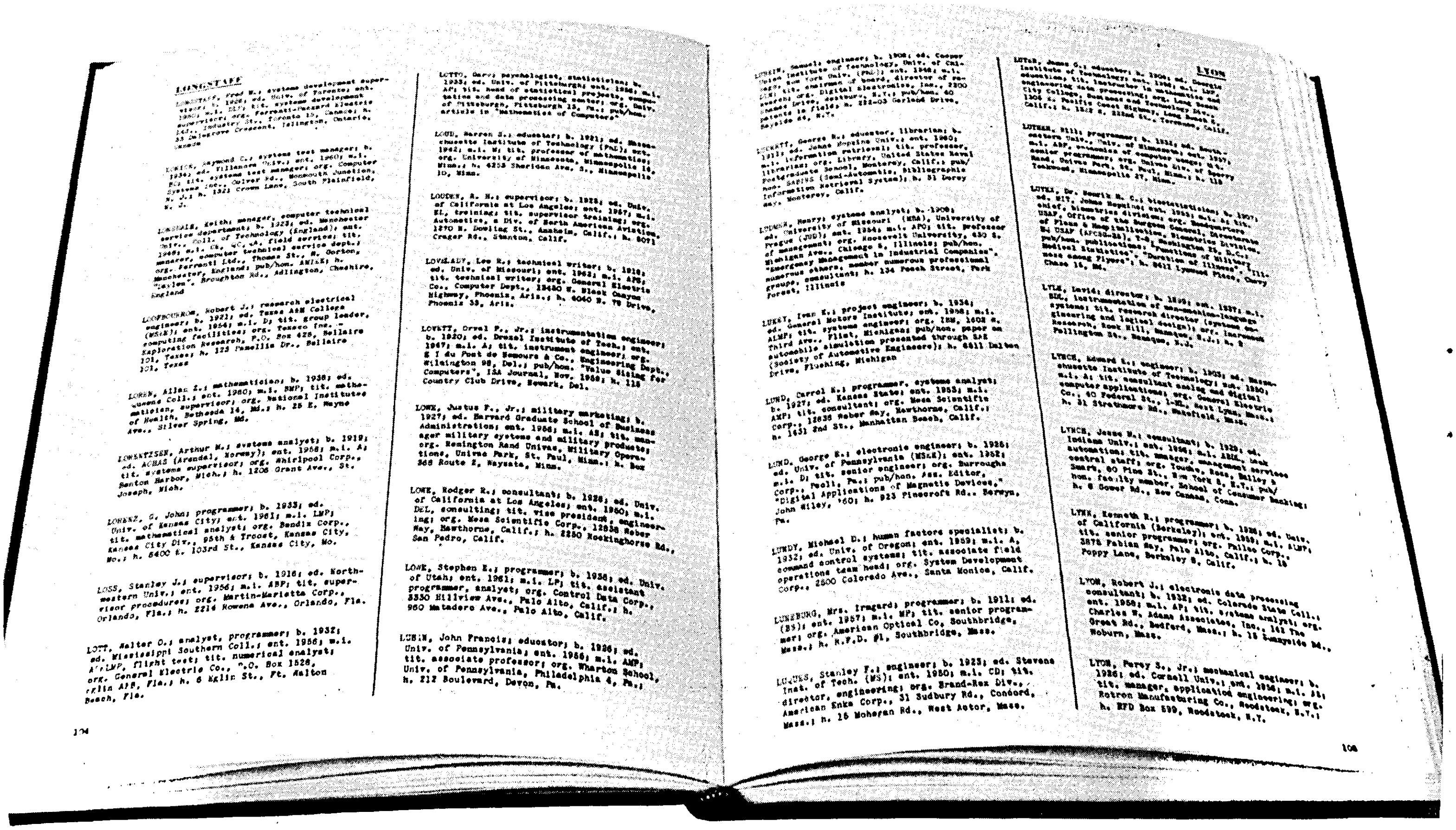
A new comprehensive edition of the **WHO'S WHO IN THE COMPUTER FIELD** is available. This is the first edition in over five years. All entries are complete and accurate as of January, 1963. This handsome, clothbound book is the standard biographical reference on over 5000 leaders in **computer applications/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



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

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

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



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.

American Telephone & Telegraph Co. 195 Broadway, New York 7, N.Y. / Page 30 / N.W. Ayer & Son, Inc.

Audio Devices, Inc., 235 East 42 St., New York, N.Y. 10017 / Page 10 / Charles W. Hoyt Co., Inc.

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

Cross Country Consultants, 16 West 25 St., Baltimore, Md. / Page 9 / Paul Silver Advertising, Inc.

Decisional Control Associates, 1590 Monrovia, Newport Beach, Calif. / Page 18 / Leonard Daniels Advertising

Dialight Corp., 60 Stewart Ave., Brooklyn 37, N.Y. / Page 50 / H. J. Gold Co.

DuPont, Wilmington, Del. / Page 6 / Batten, Barton, Durstine & Osborn, Inc.

Fabri-Tek, Inc., Amery, Wisc. / Page 3 / Midland Associates, Inc.

Honeywell EDP., 60 Walnut St., Wellesley Hills, Mass. 02181 / Page 52 / Batten, Barton, Durstine & Osborn, Inc.

International Business Machines Corp., Armonk, N.Y. 10504 / Page 49 / Benton & Bowles, Inc.

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

National Cash Register Co., Main & K Sts., Dayton 9, Ohio / Page 51 / McCann-Erickson, Inc.

Scientific Data Systems, 1649 17th St., Santa Monica, Calif. / Page 19 / Faust/Day Advertising

NEW PATENTS

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

The following is a compilation of patents pertaining to computer and associated equipment from the "Official Gazette of the U. S. Patent Office," dates of issue as indicated. Each entry consists of patent number / inventor(s) / assignee / invention. Printed copies of patents may be obtained from the U. S. Commissioner of Patents, Washington 25, D. C., at a cost of 25 cents each.

February 25, 1964 (Continued)

3,122,726 / Robert W. King, Jr. and Charles H. Doersam, Jr., Port Washington, N. Y. / Sperry Rand Corp., a corp. of Delaware / Recirculating Binary Data Rate Converter.

3,122,727 / Norman E. Marcum, LaHabra, Emmet R. Quady, South Pasadena and Manfred Wildmann, Buena Park, Calif. / North American Aviation, Inc. / Magnetic Disc Data Storage Device.

3,122,729 / Theodore Paul Bothwell, Watertown and Max Rosenbloom, Dorchester, Mass. / Epsco, Inc., Cambridge, Mass., a corp. of Massachusetts / Logical Circuit.

March 3, 1964

3,122,943 / John M. Coombs, Poughkeepsie, New York / by Mesme assignments to Sperry Rand Corp., a corporation of Delaware / Data Storage Apparatus Controls.

3,122,996 / Henry T. Heatwole, Silver Spring, Md. / Heatwole Associates Inc., Wash., D. C., a corporation of District of Columbia / Information Storage System.

3,122,706 / Walter K. French, Montrose, N. Y. / International Business Machines Corp., N. Y., a corporation of N. Y. / Associative Memory.

3,123,808 / Robert L. Ward, Poughkeepsie, N. Y. / International Business Machines Corp., N. Y., a corporation of N. Y. / Magnetic Storage Device.

3,123,810 / Frederic P. Strauch, Jr., Glendale and Dennis A. Walz, Van Nuys, Calif. / Collins Radio Co., Cedar Rapids, Iowa, a corporation of Iowa / Synchronized Readout System for Data Tape.

March 10, 1964

3,124,260 / Floyd C. Tidball, Saratoge, Calif. / International Business Machines Corp., N. Y., a corporation of N. Y. / Data Storage.

3,124,676 / Dennis James Mynall, Rugby, England / Associated Electrical Industries, Ltd., London, England, a British Company / Binary Digital Multiplier and Adder Arrangement.

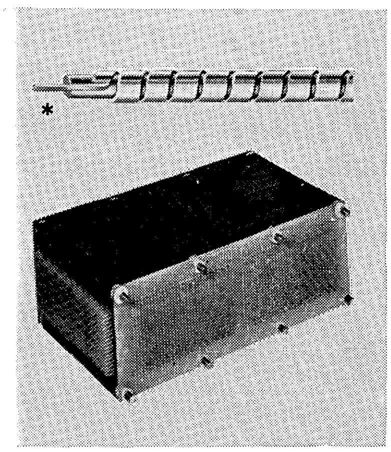
3,124,704 / Ernest H. P. Bigo, Nutley, N. J. and Peter Pleshko, Bronx, N. Y. / International Telephone and Telegraph Corp., Nutley, N. J., a corporation of Maryland / Logic Inverter Circuits.

3,124,761 / John D. Fackler, Bedford and Charles R. Kenny, Purdy's Station, N. Y. / General Precision, Inc., a corporation of Delaware / Gating Circuit.

NCR is proud to announce . . .

the new 315 RMC (rod memory computer)

The first commercial computer with <u>all</u> thin-film main memory



A MAJOR ADVANCE

The new 315 RMC is a major advance in computer technology. Its entire memory of up to 240,000 digits is composed of thin cylindrical wire rods plated with a magnetic thin film. The 315 RMC has an incredible cycle speed of 800 nanoseconds (800 billionths of a second).

*Magnified 10 times.

COMPATIBLE WITH ALL 315 HARDWARE

The 315 RMC is uniquely versatile. Though cycle speed is 8 times faster than the 315, it is designed to be completely compatible with all existing 315s and all 315 peripheral equipment. NCR users, both present and future, can easily move up to a Rod Memory Computer when additional capabilities are required.

COMPATIBLE WITH ALL 315 SOFTWARE

The command and logic structure of the 315 RMC is identical with all 315s. No re-programming is required. All 315 programs and software, including NEAT and COBOL, may be used "as is." For new applications, BEST, NCR's recently announced program generator, reduces programming time by as much as 50%.

ALSO NEW! FASTER PERIPHERAL EQUIPMENT

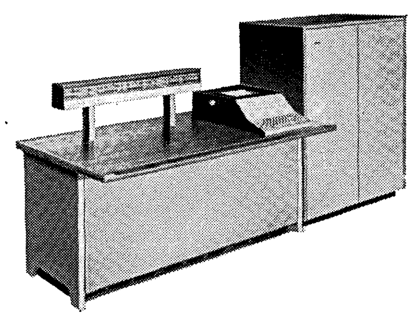
Now available for the new 315 RMC – **and all 315s,** a new line of faster, more efficient peripherals:

- New, faster tape drives; 66KC conversion of data from other computers; 120KC for direct processing
- New 1,000 line-per-minute printer
- New 250 CPM Card Punch
- New 321 Data Communications Controller for expanded on-line and remote inquiry capability
- New built-in floating point arithmetic for scientific applications
- New High Capacity CRAM III (Card Random Access Memory) provides up to 16,000,000 characters of random access storage in each CRAM cartridge.

COMPATIBLE WITH OUR USERS' SYSTEMS

All NCR current and future users benefit from this remarkable new development. The 315 RMC is an important scientific breakthrough—a significant addition to NCR's 315 family. It dramatically extends the life and capabilities of all 315 installations. With a 315, your system can grow as you grow—and you can move up to a high-speed, Rod Memory Computer without paying the penalty in time and money that progress in automation usually costs.

Deliveries of the 315 RMC begin in mid '65. For more complete information, we urge you to send for the booklet describing our new thin-film computer. Write The National Cash Register Company, Dayton, Ohio 45409.



NCR

BE SURE TO VISIT THE NCR PAVILION AT THE NEW YORK WORLD'S FAIR. THE NATIONAL CASH REGISTER COMPANY ®