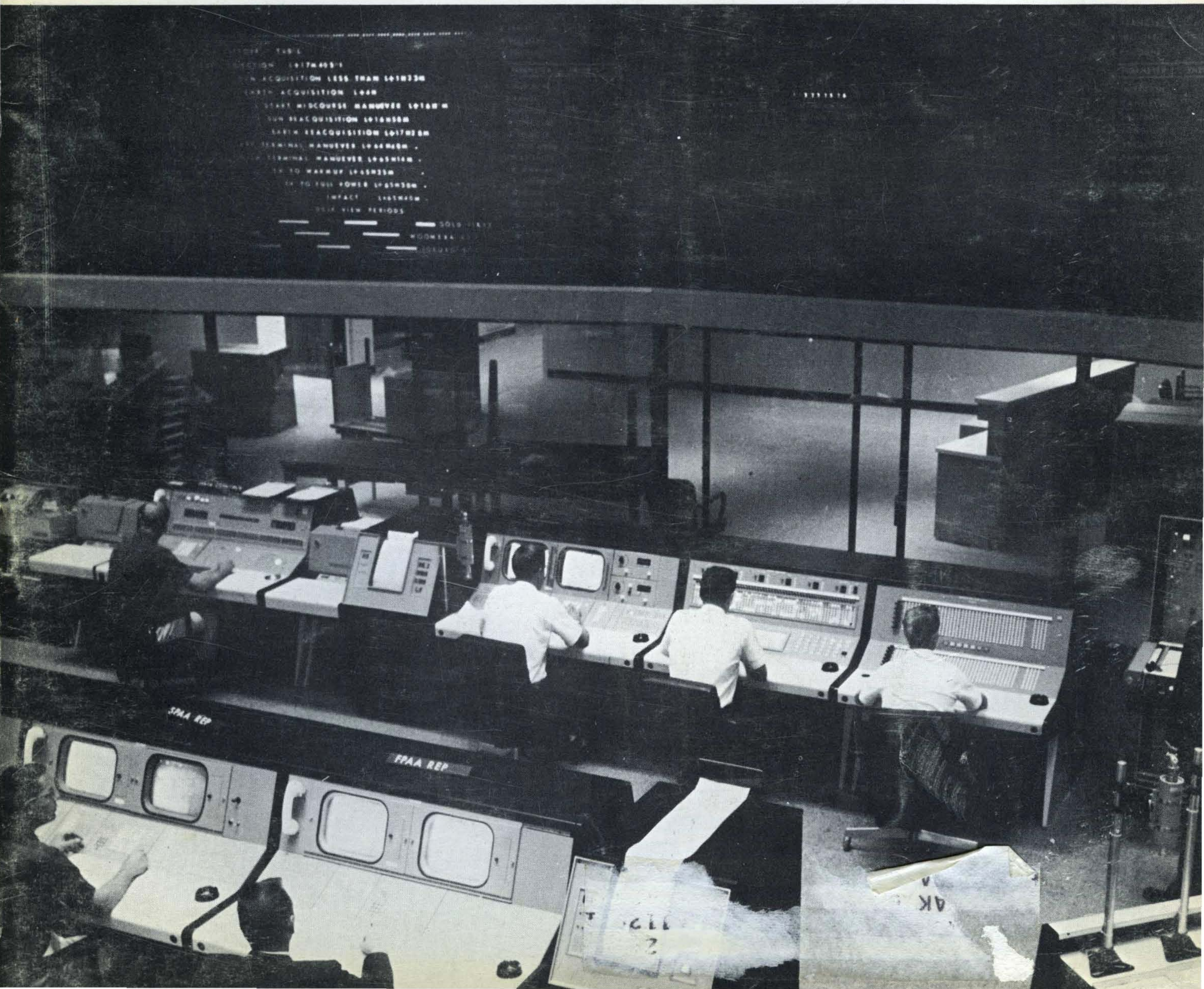
November, 1964

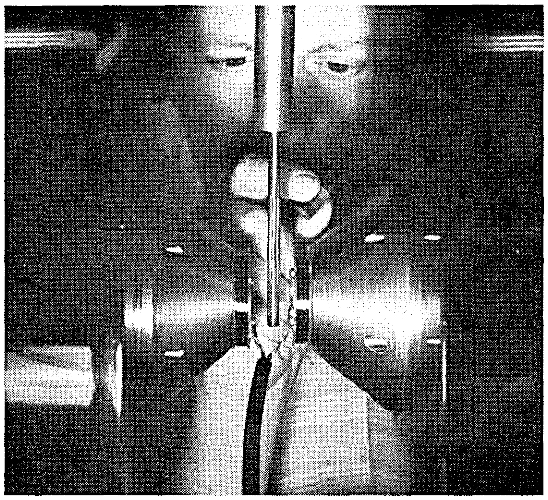
computers and automation

Command and Control Systems



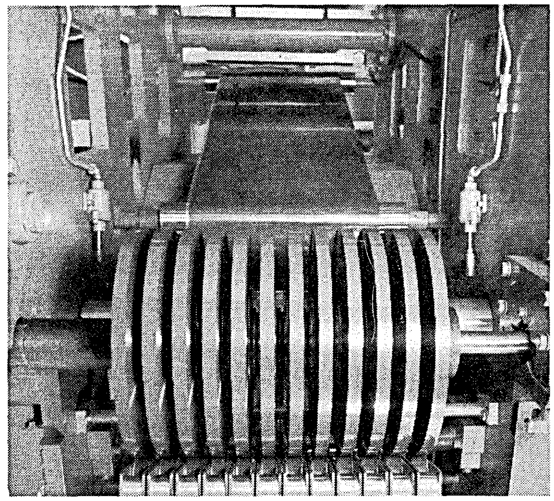
4 WAYS TO IMPROVE COMPUTER TAPE

(And how Memorex did it!)



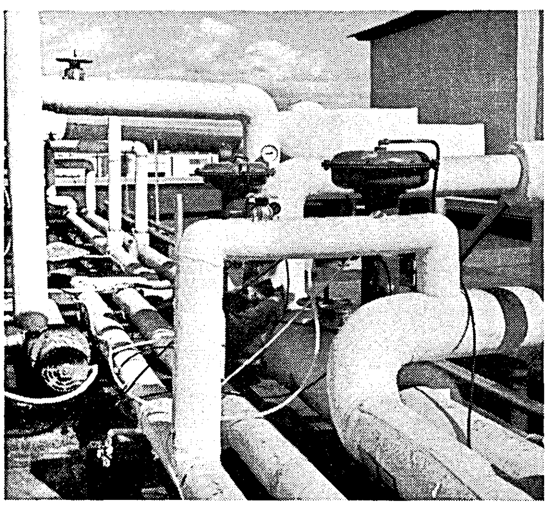
Exercise greater quality control.

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.



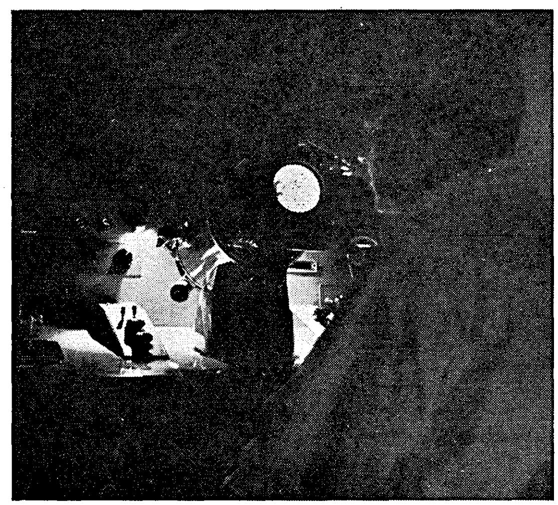
Employ advanced production techniques.

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.

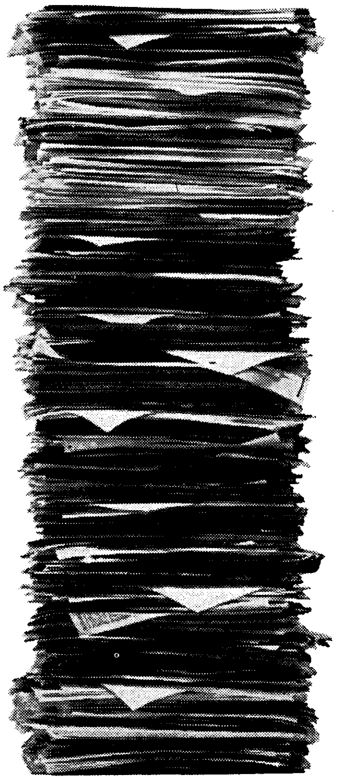
Memorex tape is premium tape. No need to pre-check it. You can place Memorex computer tape directly in service — reel after reel.

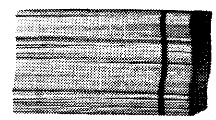
Memorex certification means what it says: Memorex computer tape is error-free. Extra care, extra steps and scrupulous attention to every detail make it that way. We know the importance to you of having a tape you can depend on.

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

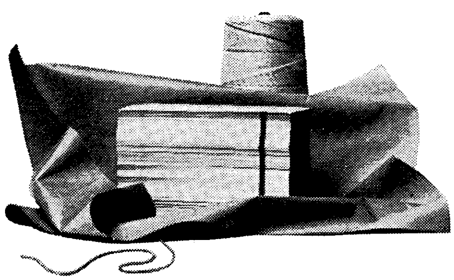
MEMOREX

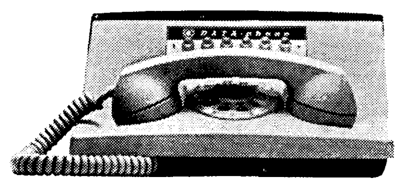
PRECISION MAGNETIC TAPE





when you have a mountain reduced to a molehill...





do you wrap it... or phone it?

Modern data processing achieves miracles in reducing mountains of paperwork to compact "molehills" of cards or tapes.

But what then? How do you move that compressed data across town or across country?

If you're practical (and time-and-cost-conscious), you telephone it.

Bell System DATA-PHONE service can transmit it over regular telephone lines at great speed—and at regular phone-call rates.

DATA-PHONE service is a natural extension of your regular phone service, giving you integrated information handling that pays off in important time savings, better control of costs and greater all-round efficiency.

Talk with our Communications Consultant about it. Just call your Bell Telephone Business Office and ask for his services.

BELL SYSTEM

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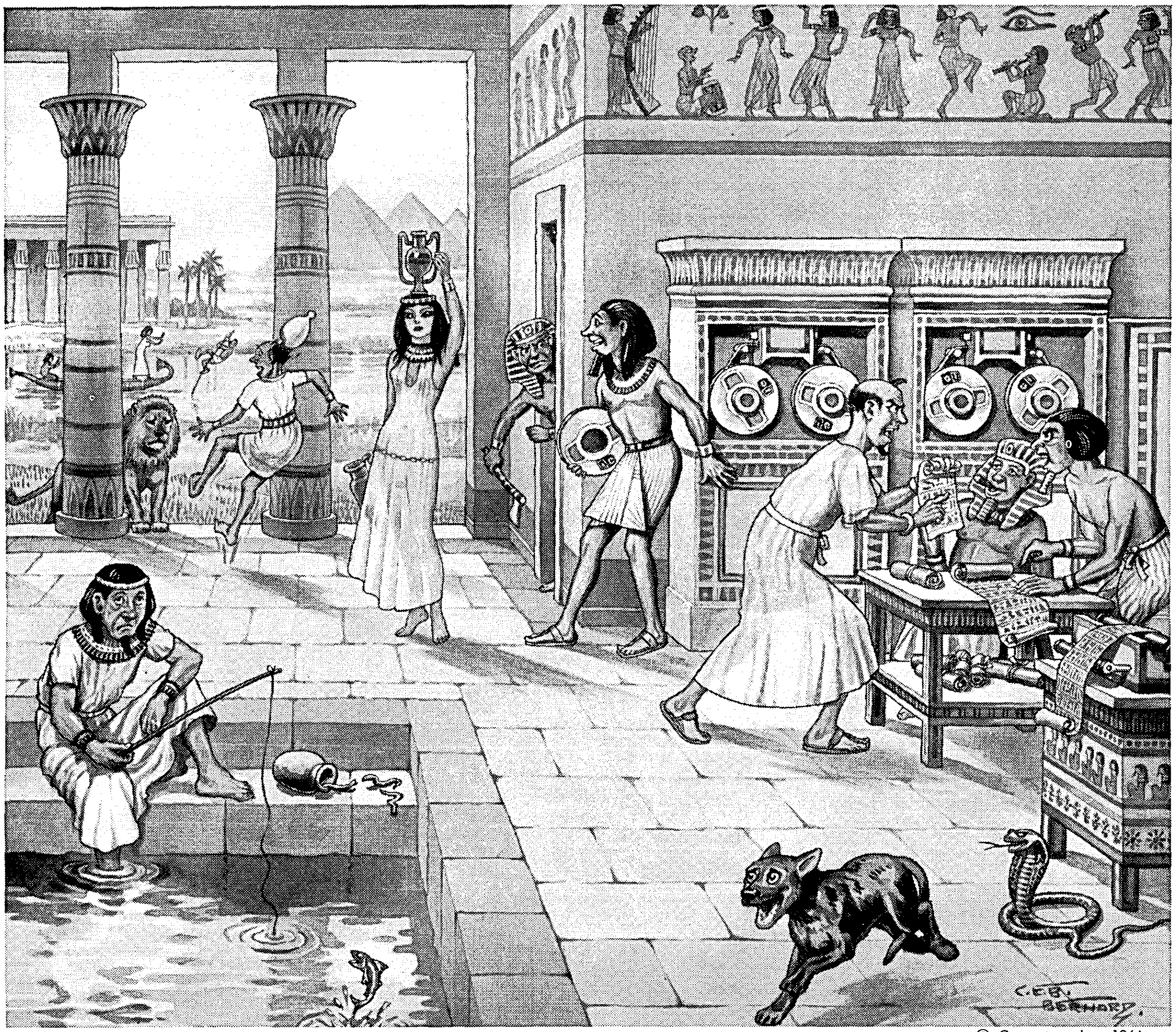
AN OFF-BIT HISTORY OF MAGNETIC TAPE... #3 of a series by Computape



It's about time somebody told the truth about that Mark Antony and Cleopatra bit. Truth of the matter is, Antony did not commit suicide. He was simply surfeited with the perfumed pleasures of Cleopatra's court. It got so there was hardly anything she could do to please him.

"Mark, doll", she'd coo at him, "Didn't I go and make you a Director of the Banks of the Nile? And have you join the Tuthmosis II Pyramid Club? And don't you like throwing peasants to the lions any more? We used to do such fun things together — and now you spend all your time at that silly computer center!"

"Cleo", he would say, "You just don't understand. They've got this crazy new heavy duty computer tape down there, certified to deliver 1,000 bits per inch, with no dropout! I tell you it's incredible!"

Cleopatra's green eyes flashed dangerously. "I warn you, Mark. You go down to that computer place ONCE more and . . . "

"See you later", Mark Antony said. "They promised me they'd let me change the reels this time."

When Octavius Caesar broke into Cleopatra's camp the next day, Antony was nowhere to be seen; there was only the sullen queen and her pet lion, Amenhotep III.

"Where's Antony?" Caesar demanded.

"Ask Amenhotep, why don't you?" muttered Cleopatra.

The lion rubbed his mane against Cleopatra's gown and opened his cavernous jaws in a huge, contented yawn.

From somewhere in the depths came the faint, muffled sound of a voice,

"Friends, Romans, countrymen . . . HAAAAAAALP!"

This fascinating bit of tape history, incidentally, is presented for your edification by Computape, and the moral of the whole bit is crystal clear:

Computape is heavy-duty tape so carefully made that it delivers 556, or 800, or (if you want) 1,000 bits per inch — with no dropout.

Now - if Computape can write that kind of computer tape history — shouldn't you be using it?

COMPUTRON INC.
122 CALVARY STREET, WALTHAM, MASSACHUSETTS

COMPUTAPE — product of the first company to manufacture magnetic tape for computers and instrumentation, exclusively.

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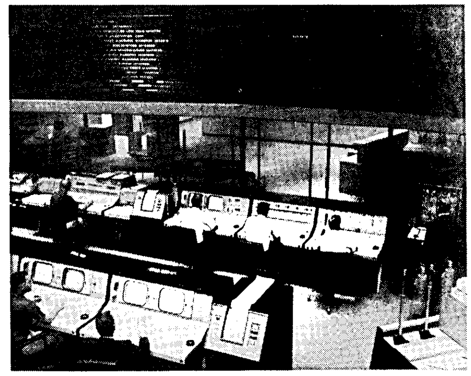
Command and control systems utilizing an intelligence center such as Jet Propulsion Laboratory's shown on our front cover are greatly increasing operating effectiveness and fast response for complex organizations. The requirements of such a system for the Field Army are described by David Weisberg beginning on page 26.



computers and automation

NOVEMBER, 1964 Vol. XIII, No. 11

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

In This Issue

In Every Issue

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c & a
EDITORIAL

Automatic Documentation

One of the big sources of difficulties in using large computer programs after they have been created, used for some time, and modified from time to time is incomplete documentation.

Unlike a computer or a clock, a program is not a physical object that can be examined and dissected. Instead it is a symbolic object—a long list of hundreds or thousands of computer instructions interlinked in complex paths.

If a human being new to the computer program is to use it well and with understanding, he needs an accurate, complete, and understandable description of all the program's features and properties—adequate documentation.

But the documentation is regularly inadequate. The documentation regularly is produced by and depends on people and what they do—the rules actually obeyed in computer installations, the supervision exercised, the records kept by human beings. All such systems are inevitably subject to increase of variation, disorder, and error. Human beings are often careless and often neglectful; and it is very easy for a human being to modify a program and make either no record or a very inadequate one.

Besides, it is naturally difficult for the facile leaping minds of the creators of a big and complex computer program to have the patience to write out good explanations of what they have done. They have little sympathy for the slower minds coming along behind them. In fact, there may be a basic contradiction in human character between the brilliance needed to develop a large computer program, and the patience needed to write a good explanation of it, good documentation.

Every now and then you meet somebody who says "You don't have to understand the computer program, any more than you have to understand the telephone—just use it." For some purposes this may be true, but it is not true in general. A computer program may misbehave on the computer; then to aid the maintenance man, you need to understand the part of the program which is failing. Or a computer program may not behave properly for some unusual cases; in fact they might not have been covered in the original program due to oversight. Or what the program is required to do may be altered to some minor extent; obviously, you would then like to know how to modify the program slightly so that you do not have to work it out all over again. And more reasons besides.

A computer program is much more like a car than a telephone. If your motor car starts to behave badly, it is well worthwhile to know whether the trouble you notice is likely to be in the ignition, the battery, the fuel line, or some other part of the system. And if you bought your car at sea level, and later intend to do some driving at an altitude of 5000 feet or higher, it is well worthwhile to know that part of your car (the carburetor) should be adjusted.

It is difficult for human beings to produce good documentation for large computer programs. But it is desirable to have it. Therefore, the task should be given to a computer, and the computer should automatically produce good documentation.

Is this possible? Yes.

It is possible because from time to time good documentation is produced by the intellect of a human being, and if a human intellect can do this, so can a computer. Human brains are not supernatural.

Is it feasible? Yes.

First, there is always at least some documentation to start with. The creating programmer puts key words, key abbreviations, key comments, into his symbolic program. This provides one of the beginnings. Second, nearly all programs must be modular: segments of them are worked out and tested as subroutines; and each subroutine is given sample inputs and required to produce proper outputs, until it is acceptable. And the subroutine by itself can be translated into a unit of good documentation. Third, there exist analyzing programs; one kind, for example, can, for any program given to it, produce, given each register, a list of all the registers which contain a jump to that register. In this way the actually existing flow diagram of a program can be largely revealed. And so forth. Finally, the process of developing automatic documentation does not have to spring at once like Minerva fully-formed from the brow of Zeus; instead it can grow little by little from small programs to larger and larger programs.

It seems evident that another of the big strides forward in programming will come with automatic documentation. Then a human being coming into a new programming situation can be instructed by the computer itself in understanding whatever he wishes to know about a program.

Edmund C. Berkeley
EDITOR

NEW BURROUGHS B 200

COMPACT COBOL

Are you one of those who have rejected COBOL because it required too much hardware, took too long to compile, or was too slow in execution? If so, this streamlined new version may be just the ticket.

Since its creation in 1959, the value of COBOL (COmmon Business Oriented Language) has never been questioned. But while it worked fine in some large-scale computers, smaller systems simply didn't have the capacity to use it efficiently.

ENTER BURROUGHS B 200 COMPACT COBOL

Developed by Burroughs Corporation expressly for its medium-scale B 200 computer series, this new compiler provides virtually all the benefits of COBOL. As the name implies, it is a trimmer, easier-to-use language. Gone are the redundancies and complications. What's left is a highly efficient, widely applicable program language.

LESS EQUIPMENT, SHORTER COMPILE TIME

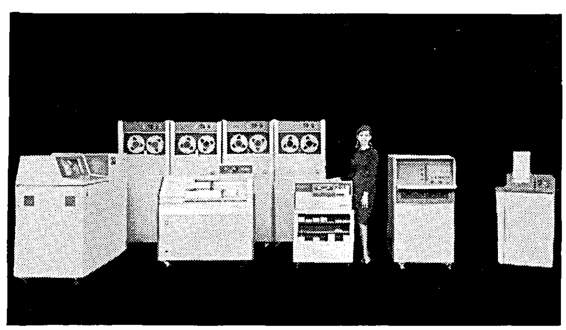
Where once memory sizes on the order of 10,000 to 30,000 positions were needed, Burroughs B 200 COMPACT COBOL requires only 4,800. Where generally six magnetic tapes were needed, now only four are required. And where the use of COBOL often resulted in a compile time measured in hours, the average time with this new version is well under 10 minutes.

EFFICIENT OBJECT PROGRAMS, MAXIMUM THROUGHPUT

The B 200 speeds implementation of Burroughs B 200 COMPACT COBOL with a three-address logic which corresponds closely to the syntax of COBOL. For example: ADD A TO B GIVING C corresponds to the A + B = C logic of the B 200. This, together with the B 200's buffering and demand feeding, helps provide outstanding object program efficiency.

WHAT THIS MEANS

No longer do you need a large-scale computer to reap the benefits of COBOL. Not with the low-cost Burroughs B 200 series computer and new Burroughs B 200 COMPACT COBOL on the scene. We supply both. Write us at Detroit, Michigan 48232. Burroughs—TM



Burroughs B 200 Series Computer

Burroughs Corporation

Circle No. 9 on Readers Service Card

FORUM ON THE SOCIAL IMPLICATIONS OF COMPUTERS AND AUTOMATION

SOCIAL IMPLICATIONS OF AUTOMATION AND COMPUTERS

Professor Victor Paschkis
Heat and Mass Flow Analyzer Laboratory
Columbia University
New York, N.Y. 10027

I am writing with regard to the Forum on the Social Implications of Computers and Automation and particularly in reply to the articles in the July and August issues. It seems to me that both authors present too easy denials of the dangers of automation. I will first deal with the danger of unemployment, which is the only one which the authors recognize, and only as a second point, with additional dangers which they do not even mention.

With regard to unemployment, I will list what I consider the erroneous simplifications of the two authors.

(1) "Automation is just a further labor saving device." However, the magnitude of labor saving is so much larger than, for example, that presented by the first industrial revolution, that a ratio automation/first-industrial-revolution, equals nuclear-weapons/machine-gun.

(2) "Automation is destined to cut the work week. Thus, ultimately, man has to choose between 'more things' or 'more leisure'." Reference to the poverty stricken segments of our own population and of the world is misleading as will be explained below. Outside the two groups mentioned before, we have already an abundance of "things," and the only way out would be a training for creative use of leisure time. Such training is hardly being mentioned and would, within a relatively short time, require training for use of the major part of the day for most people.

(3) Even during the "period of grace," during which the poverty stricken parts of our own country and the world might obtain the necessary material goods, automation does present the danger of unemployment; those laid off due to automation can not be retrained for jobs which have not gone out of existence, in part because of age, in part because of limited natural intelligence, and in part because it is hard to predict which jobs will exist at the end of the training period.

(4) Because of past sins, an undue portion of the unskilled people hit first by automation belong to minority races. Thus, automation contributes to the difficulties originating from the Civil Rights struggle.

(5) During the continuous progress of automation, employment possibilities in different industries will be so vastly different that additional social difficulties may arise; for example, a recent report speaks of an automatic ticket collection machine for transportation enterprises. It does not help ticket collectors who will be thrown out of work that there might be jobs in the construction industry. The suggestion to provide multiple training may be theoretically correct, but requires study and research; and while such study and research may be going on, displacement of workers proceeds at a rapid rate.

Computers present additional dangers:

(1) Inherently, computers can give only yes-no answers. There are problems which have no "yes" or "no" answer.

(2) In order to achieve answers to such questions, values may be hidden in the computer program, while the public is told that the output is an "objective" answer.

(3) The computer tends to shift the government more and more to a government by experts, which, as history shows, is easier prey to totalitarian management than a government not relying on experts to the extreme which computers make possible.

(4) The ease with which computers can assemble information on an individual makes it possible to have a "dossier" for each citizen, again leading to a police state.

(5) The ease of compilation presents a big temptation to use computers for a large-scale polling of the population. It is known how easily one can get different answers, depending on the formulation of the question. Of course, loaded questions can be asked also without the existence of computers. But the ease of evaluation by computers makes the temptation to ask questions more frequent; it is reasonable to assume that the percent of loaded questions in a certain number of questions asked will not decrease by the existence of computers, and, therefore, more loaded questions will be asked.

(6) The great advantage of speed of computation can turn to a danger: the machine cannot have a "second thought"--the term, second thought, refers really not to a thinking process but to an intuitive process, which is beyond the capability of machines. A machine with "second thought" would produce a different result from that of the first thought, and is ready for the scrap heap.

(7) Still connected with speed is the danger, that under certain circumstances, the result of computation may be directly fed into a decision, for

example, in connection with weapons. Decisions over the lives of millions or tens of millions of people should not be automatic, even assuming that the machine is technically beyond doubt. Decisions which would be programmed into the machine would certainly not be understood by the people involved before the program is formulated. Thus, the use of such automatic decisions is thoroughly undemocratic.

DATA PROCESSING MANAGEMENT ASSOCIATION

I. From: Donald Vogel
Huntsville, Ala.

Could you give me information concerning the Data Processing Management Association (DPMA)?

Of particular interest is (1) purpose of DPMA and how widespread is it, (2) the effectiveness and suitability of the DPMA examination for programmers, and (3) the percentage of programmers in the U.S. who have taken the DPMA exam.

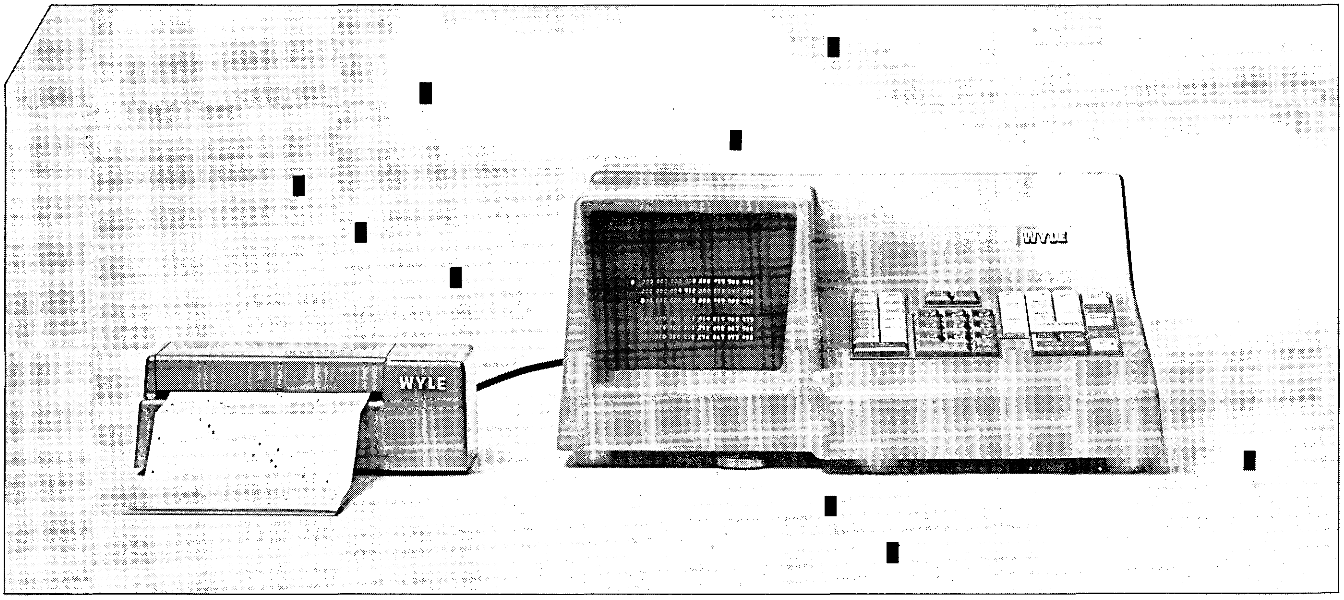
II. From: The Editor

Some of your questions can be answered easily by the Data Processing Management Association itself. Their address is: DPMA International Headquarters, 524 Busse Highway, Park Ridge, Illinois.

In answer to your other questions: in my opinion the Data Processing Management Association is doing a good job in developing examinations and trained Data Processing persons; I think what they will accomplish will steadily improve as the years pass. I am all in favor of the examinations and course of study which they have begun.

At their request, we have given them an advertisement in this issue of "Computers and Automation" to announce their next examination.

One of the most important activities for dealing with the social problems arising from computers and automation is increased education such as the DPMA is systematically providing.



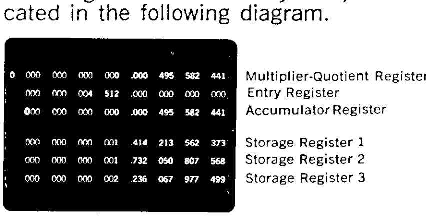
More than a calculator-Almost a computer ...and now with automatic input-$4350

THE WYLE *SCIENTIFIC* IS THE FIRST DESK-TOP COMPUTATIONAL CENTER designed specifically for the solution of complex scientific and engineering problems. Almost as simple to operate as an adding machine, it provides arithmetic capability, efficiency and speed never before available in a calculator.

WITH AUTOMATED DATA ENTRY, it eliminates all the tedious, wasted time of multi-step repetitive arithmetic problem solving. You enter only the variables manually. All the repetitive procedures are run off automatically from a prepared program library of simple punchcards fed into the calculator reader. And you don't have to be a programmer or need additional equipment to prepare your own input library. You simply punch in your instructions by hand on a Wyle stored-program card, which has the calculator keyboard reproduced on it. With this automated input added to the Wyle *Scientific* versatility, you will solve complex problems at speed approaching that of a computer.

NEVER BEFORE CAPABILITIES LIKE THESE

The contents of all registers are displayed, on an eight-inch cathode ray tube, as indicated in the following diagram.



All parts of a problem are visible. The contents not only of the three active arithmetic registers, but also of the three storage registers are displayed at all times. Numbers entered from the keyboard are seen as they are entered and can be verified before use.

Transcription errors are eliminated through complete versatility of transfer from any register to any other without loss of desired data.

All registers handle 24-digit numbers.

Decimal points are entered the same as digits, using an eleventh key, and all input and answers are correctly aligned with decimal point on the output display.

Automatic square root is provided, as is single entry squaring and multiple subtotals.

The calculator has plug-in compatibility with auxiliary input-output devices including printers, paper tape equipment, and other EDP equipment.

Its operation can be learned in minutes, and it functions with the speed, quiet, and reliability of its solid state design.

These capabilities, combined with automatic entry, for the first time fill the technical and economic gap between calculators and computers.

$3950 for basic calculator
(You can add automatic input later)
$4350 complete with automatic input

For further information, write Dept. N, Products Division, Wyle Laboratories, El Segundo, California. Or telephone (213) ORegon 8-4251.

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Circle No. 11 on Readers Service Card


AUGUST 27, 1962
Mariner II interplanetary probe launched from Cape Kennedy; successful midcourse correction of orbit brings it close to Venus.

A LOOK AT HIGH-SPEED PRINTERS

Norman Statland
Auerbach Corporation
Philadelphia 3, Pa.

The initial, general-purpose, electronic digital computers produced over a decade ago were designed primarily for mathematical and scientific applications, in which the volume of output data was relatively low. As long as the computer's use was generally limited to those applications, single-action character printers operating on-line were adequate. The situation changed, however, as the use of computers for commercial applications became more widespread. During the first phase of commercial computer usage, printed forms and documents for distribution outside the organization became an important output product. During the current second phase, emphasis has shifted to management control information, and the computer is called upon to produce an increasing number and diversity of management reports. The result of this is a sharp increase in output volume, and rapid change in both the methodology and hardware associated with output printer systems. These changes have occurred where the high-speed printer unit was the limiting factor on system throughput (measured in units processed per time period).

One change in methodology has been the practice of operating magnetic-tape units off-line under the control of a special electronic unit that transmits data to the line printer. This type of arrangement eliminates the speed limitation imposed by the slowest component when attached on-line, e.g., the line printer.

The use of off-line printer systems, however, is generally limited to large installations where the added expense of the off-line control unit can be justified by the large workload. The best current example of this situation is in the batteries of IBM 1401s now in use as output data converters at many 7090 and 7094 installations. Recent practice in small- and medium-size installations favors the use of high-speed, on-line printers controlled by the system's central processor. It is anticipated that, with the increasing number of small- to medium-size computer systems that are expected to be sold in the next five years, this trend will become dominant.

The trend toward high-speed on-line printers is also helped by the parallel processing equipment features, which are frequently used to reduce the amount of time the central processor spends in controlling the printing operations. The parallel processing concept of on-line print operations uses the program-interrupt logic of the system to enable the central processor to control the printer while carrying out internal processing tasks. The interrupt originates either from the printer or from a control program that periodically examines the print buffer to see if data is needed.

Types of High-Speed Printers

Two basic types of high-speed printers, impact and non-impact, have been developed to solve the problem of high volume output. Non-impact printers generally form images on a paper medium through use of electric charges. The character is transferred via a cathode ray tube or a special process such as Xerography. The image is then fixed by the use of heat or other means. These printers generally produce only one copy on-line—and that one is of questionable printing quality* for distribution outside the organization. Consequently, most of the high-speed printers presently in use are impact printers. As can be seen from the accompanying chart, most of them have printing speeds rated at 600 to 1200 lines per minute.

*Printing quality is subjectively measured by users in terms of smudging, character alignment, and embossment (consistent distribution of ink).

Impact printers use some form of mechanically-driven type wheel or slug, which means a type slug or metal print face is used to imprint the character upon the paper. The paper is then pressed against the print face and inked ribbon by the force of electronically-actuated hammers. In principle, this operation is similar to that of a typewriter, except that high-speed line printers print an entire line at a time. This capability to print a line at a time, rather than just individual characters, eliminates the need for a moving carriage and provides for much greater speeds than were possible with earlier single-character or stick printers. Line printers use continuous-feed paper, which is fed past the print head by a sprocket mechanism engaged through positionable traction clamps. Vertical spacing and skipping of the paper is generally controlled by a paper-tape loop in which the positioning of the page is determined by holes in the specific channels (8- and 12-channel tape being the most popular today). When this control is not provided, the program within the central processor must control the line spacing on the page.

All line printers incorporate some form of high-speed paper skipping which permits the paper to be advanced more than the normal line spacing and at several times the normal speed. Portions of preprinted forms that are not to be printed on can be skipped at speeds up to 35 times faster than normal paper-movement speeds. In the accompanying chart, a comparison between the "Peak Speed" and "1-Inch Spacing" columns shows what effect the spacing of forms can have on over-all, high-speed printer efficiency. Furthermore, it should serve to remind forms designers to consider the particular properties of their high-speed printer when constructing their forms layouts.

All of the printers shown on the accompanying chart are known as "on-the-fly" printers, which use one of three basic types of print heads: a solid drum with the print faces engraved into the drum; multiple wheels locked together to form a print drum; variations of a chain or train of print slugs. Each of these types is a variation of the same basic principle, the use of extremely rapid hammer action to press ribbon and paper against the type face.

Print Characteristics

The sequence of action in a print cycle starts with the computer loading data into the print buffer. The contents of the print buffer are decoded (under control of commutator-like logic) to select the particular characters to be printed at each print position. A rapid-action hammer presses the paper and ribbon against the type face at the exact moment the selected character is in position. The print cycle is completed when the paper movement mechanism advances the paper to the next line position and an independent drive mechanism moves the ribbon to a new print area. During this last phase of the print cycle, the hammer recoils and the type wheel completes one revolution.

Length of time of the total printing cycle is determined by the number of lines printed per minute. This interval is divided into discrete timing units for each available character, with several units allocated for paper advance. Because of this system, in some drum printers, the firing of all hammers at one specified time—say, the third discrete timing unit, would result in having a "C" printed in every position across the page.

Printers can be either synchronous or asynchronous, depending upon the hardware facility built into them at the time of manufacture. Those having a synchronous mode of printing have a specific cycle which commences at a specific point. Printing begins only at the assigned interval.

In asynchronous printing, however, the cycle is flexible and printing can begin at any point on the print head at any time. Firing begins whenever a signal is received indicating that line spacing has been completed and print buffer loading is finished. Firing terminates when a counter indicates that the drum has made a complete revolution past the hammers, or when an indication has been received that all the characters in the buffer have been printed. A special control tape, or the central processor, controls skipping in this case. The Anelex 4-1000 is an example of an "on-the-fly" printer using the asynchronous mode of operation.

In chain printers each hammer is timed individually (e.g., the IBM 1403 and 2201 printers) because each character travels horizontally across many printing positions during the entire print cycle. The chain, holding five identical sets of 48 characters, assembled serially, moves horizontally across the paper. The solenoid-activated hammer at a selected position forces the paper into contact with the ribbon against the chain, each hammer firing independently as the appropriate character on the chain passes the printing position. A train mechanism has now replaced the chain in the IBM 1403 Model 3, and type slugs move in the same horizontal plane as in the chain but at more than twice the speed.

In those cases in which all-numeric printing is necessary, some printers can be equipped with drums or chains on which numeric type faces are repeated several times, frequently with blank print segments utilized as spacers. This arrangement provides access to a specific character at any of several positions, thereby allowing each drum or train revolution to print in less time. This increases the over-all speed and effectiveness of the printer.

The hammer action of "on-the-fly" printers is either "free-flight" ("ballistic") or "controlled-flight." The free-flight hammer stops moving when it contacts the paper and the drum. An important advantage of the controlled-flight hammer (which has fixed spatial movement) is that its depth of penetration can be readily limited; it can be adjusted to various paper thicknesses and number of carbon copies. When such a printer is operating without paper in the tractor feed, the hammers are prevented from striking the print drum by "end-of-paper" safety switches.

General characteristics of "on-the-fly" printers are:

- High speeds (600 to 1200 lines per minute).
- Absence of a platen.
- Ribbon movement parallel with paper motion; ribbon width at least equal to maximum line width.
- Hammers which strike from behind the paper.
- Printing often characterized by a light box framing the characters (chain printers) or lack of horizontal alignment (drum printers).

The detailed physical and operating characteristics of modern, high-speed printers are shown in the accompanying chart; individual entries have been verified by their respective manufacturers.

The Future

Dramatic changes in line printers will not occur in the foreseeable future. Variations of models presently in use and some new models are anticipated, to be sure, but radical improvements in speed are unlikely. A two-fold increase in speed can be anticipated, but speed increases of significantly greater magnitudes seem most unlikely. Primarily, the problems associated with paper-handling and mechanical movement, in the printing action, as well as those problems caused by stresses on the paper itself (particularly multi-part forms), when it is being moved

COMPARISON CHART: HIGH-SPEED IMPACT PRINTERS

Part 1: PHYSICAL FEATURES AND WHERE USED

MANUFACTURER & MODEL	Paper Feed Mechanism	Print Head Storage	Plug-Board	Vertical Spacing Control Tape	Printable Characters	Print Positions	Use
Anelex Corp. / 5-300	Sprocket	Drum	No	12 channels	48-128	72 to 160	RCA 301, 3301
Anelex Corp. / 5-600	Sprocket	Drum	No	12 channels	48-128	72 to 160	GE 210, 225
Anelex Corp. / 5-1250	Sprocket	Drum	No	12 channels	48-128	72 to 160	CDC 160, 1604
Anelex Corp. / 4-300	Sprocket	Drum	No	8 channels	48	120 to 160	Philco 2000
Anelex Corp. / 4-1000	Sprocket	Drum	No	8 channels	48-96	120 to 160	DEC PDP-4, PDP-6
Burroughs Corp. / B-320	Sprocket	Drum	No	12 channels	64	120	Burroughs B100 Series
Burroughs Corp. / B-321	Sprocket	Drum	No	12 channels	64	120 or 132	Burroughs B200 Series
Control Data Corp. / 166	Sprocket	Drum	No	8 channels	64	120	CDC 160-A, 8090
Control Data Corp. / 501	Sprocket	Drum	No	8 channels	64	136	CDC 3000 Series
Data Products Corp. / P-3300	Sprocket	Drum	No	8 channels	64	132	SDS 900/9000 Series
Data Products Corp. / P-4100	Sprocket	Drum	No	8 channels	64	132	
Data Products Corp. / P-4200	Sprocket	Drum	No	8 channels	64	132	
General Electric Co. / PR-20	Sprocket	Drum	No	8 channels	64	136	GE 400 Series
Honeywell EDP / 206	Sprocket	Drum	No	2 channels	56	120 or 132	Honeywell 200, 300, 2200
Honeywell EDP / 222-1, 2, 3	Sprocket	Drum	No	8 channels	63/66	96 to 132	Honeywell 200, 300, 2200
Honeywell EDP / 222-4	Sprocket	Drum	No	8 channels	63/66	120 or 132	Honeywell 200, 300, 2200
Honeywell EDP / 422, 822	Sprocket	Drum	Yes	2 channels	56	120 or 160	Honeywell 400, 800
IBM Corp. / 1403 Mod 1, 2	Sprocket	Horizontal chain	No	12 channels	48	100 or 132	IBM 360, 1400 Series
IBM Corp. / 1403 Mod 3	Sprocket	Horizontal "train"	No	12 channels	48	132	IBM 360, 1410, 1460
IBM Corp. / 1403 Mod 4, 5	Sprocket	Horizontal chain	No	12 channels	48	100 or 132	IBM 1401-G
IBM Corp. / 1443	Sprocket	Horizontal bar	No	12 channels	13-63	120	IBM 360, 1440, 1620
IBM Corp. / 2201 Mod 3	Sprocket	Horizontal "train"	No	12 channels	48	132	IBM 360
National Cash Register Co. / 340-3	Sprocket	Drum	No	6 channels	56	120	NCR 315
Potter Instrument Co., Inc. / LP1200	Sprocket	Drum	No	8 channels	64	48 to 132	
Shepard Laboratories, Inc. / 190	Sprocket	Drum	Yes	6 channels	64	120	NCR 304, 315; RCA 501
UNIVAC Division, Sperry Rand Corp. / 0755-01	Sprocket	Drum	No	No	64	132	UNIVAC 1050
UNIVAC Division, Sperry Rand Corp. / 0755-02	Sprocket	Drum	No	No	64	132	UNIVAC 1050
UNIVAC Division, Sperry Rand Corp. / 7912	Sprocket	Drum	No	No	51	100 to 130	UNIVAC SS-80, SS-90, 490

COMPARISON CHART: HIGH-SPEED IMPACT PRINTERS

Part 2. PRINTING AND PERFORMANCE CHARACTERISTICS

MANUFACTURER & MODEL	Horiz. Spacing (char/inch)	Vert. Spacing (lines/inch)	Form Width (inches) Max.	Form Width (inches) Min.	Max. Copies	Speed in alphanumeric lines/min. Peak	Speed in alphanumeric lines/min. At one-inch Spacing	Skipping Speed (inches/sec)
Anelex Corp. / 5-300	10	6/8	26	3	6	300	257	18
Anelex Corp. / 5-600	10	6/8	26	3	6	600	514	27.5
Anelex Corp. / 5-1250	10	6/8	26	3	6	1250	712	27.5
Anelex Corp. / 4-300	10	6/8	19	3	6	300	257	25
Anelex Corp. / 4-1000	10	6	19	3	6	1000	643	25
Burroughs Corp. / B-320	10	6/8	20	5	6	475	385	25/40
Burroughs Corp. / B-321	10	6/8	20	5	6	700	518	25/40
Control Data Corp. / 166	10	6	18.75	3.50	6	150	133	19
Control Data Corp. / 501	10	6	18.75	3.50	6	1000	643	25
Data Products Corp. / P-3300	10	6	17.50	3.50	6	360(720*)	250	20
Data Products Corp. / P-4100	10	6	19	3.50	6	360(720*)	250	20
Data Products Corp. / P-4200	10	6	19	3.50	6	600(1200*)	360	20
General Electric Co. / PR-20	10	6/8	19	3	6	1200	720	27.5
Honeywell EDP / 206	10	6/8	22	3.50	10	900(1260*)	580	23
Honeywell EDP / 222-1, 2, 3	10	6/8	18.75	4	6	650	490	35
Honeywell EDP / 222-4	10	6/8	18.75	4	6	950	610	35 min.
Honeywell EDP / 422, 822	10	6/8	22	3.50	10	900	560	20
IBM Corp. / 1403 Mod 1, 2	10	6/8	18.75	3.50	6	600(1285*)	480	33/75
IBM Corp. / 1403 Mod 3	10	6/8	18.75	3.50	6	1100(1400*)	750	33/75
IBM Corp. / 1403 Mod 4, 5	10	6/8	18.75	3.50	6	465	395	33/75
IBM Corp. / 1443	10	6/8	16.75	4	6	150 or 240 (430 or 600*)	132 or 196	15
IBM Corp. / 2201 Mod 3	10	6/8	18.75	3.50	6	1100(1400*)	750	33/75
National Cash Register Co. / 340-3	10	6	22	4	6	680(900*)	407	14
Potter Instrument Co., Inc. / LP1200	10	6/8	17.78	4.19	6	1000	650	25/90
Shepard Laboratories, Inc. / 190	10	6	22	3	6	680(900*)	407	14
UNIVAC Division, Sperry Rand Corp. / 0755-01	10	6/8	22	4	6	922	475	20
UNIVAC Division, Sperry Rand Corp. / 0755-02	10	6/8	22	4	6	750	425	20
UNIVAC Division, Sperry Rand Corp. / 7912	10	6/8	21	4	6	600	430	20

* Peak speed for all-numeric data (this type of data may require a special character set).

and imprinted at high speeds, dictate the speed at which mechanical printers can operate.

Changes appearing in future models will, in large part, be improvements in accuracy of registration and reduced price. The present price range of high-speed printers ($30,000 to more than $70,000, exclusive of associated buffer storage and controllers), can be expected to decrease slightly because of improved production methods, if for no other reason. While a downward trend has been in effect over the past few years and is expected to continue, the changes will be comparatively small.

Since mechanical printers appear to be almost as well-developed as possible, any significant improvements in printer performance will, no doubt, come from non-impact printers. Improvement and development of non-impact printers during the last five years have resulted in models designed to produce copy at rates of 5,000 or more lines per minute while employing various chemical and electrical processes to imprint the paper copy. A continuing problem, however, is that of perfecting a convenient method for producing simultaneous multiple copies of sufficiently high print quality to serve as routine business documents, such as bills, checks, and receipts. The non-impact printers, are at present, considerably more costly than impact types, and they do not usually produce printed documents of very high quality. Progress being made in the development of new chemical and physical processes and the use of improved, treated paper should greatly accelerate future advances in this area.

We can anticipate only specialized and limited commercial use of non-impact printers during the next two or three years. General penetration of the commercial market can be expected only after the printers have proved to be practical and economical. In future utilization of high-speed printers associated with computer systems, the following trends may be expected:

- Flexibility and versatility of the computer-printer combination are expected to become as important as increased printing speed. As the concepts of management-by-exception and integrated systems are more widely accepted, there will be a greater variety of reports produced. Although more reports will be produced, less detail will be turned out for each report; therefore the total line volume of these reports should remain static. As management techniques that are more and more scientific are applied to business, the high speed printer will become increasingly important for the production of reports in graph form. This too, will demand increased versatility from the printer.
- In all likelihood there will be increased demands on horizontal and vertical character placement facilities. This is because the volume of billing and other externally-used documents will, no doubt, be in approximate relation to the increase in population and the rise in the standard of living, and probably will be comprised of pre-printed forms. We can also expect an improvement in the ability to print on a wider variety of surfaces (lighter weight and lower quality paper—possibly kraft papers, etc.). Then too, there should be a greater demand for cheaper and more versatile production of forms.
- Printing registration requirements will become more stringent as more re-entry documents and optical reading devices are utilized in commercial systems.

The help of Mr. John Hillegass for his compiling of the accompanying chart is gratefully acknowledged.

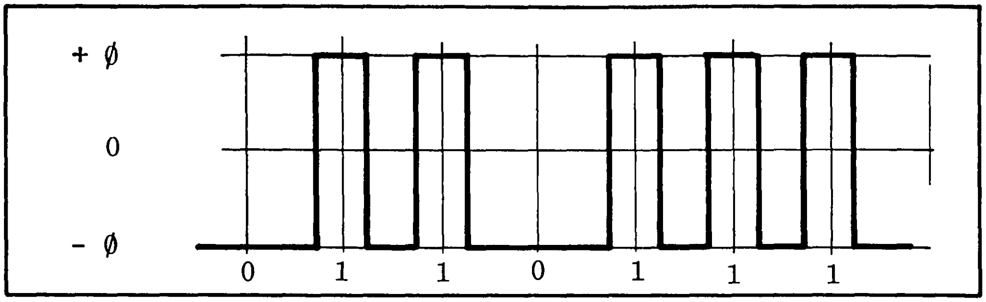

Fig. 1 RB - Return to Bias

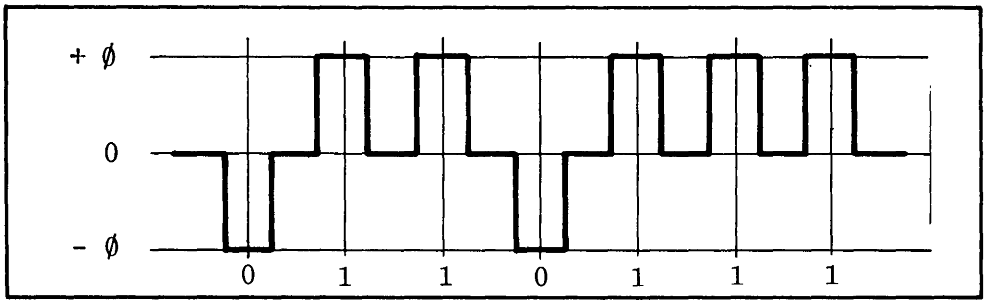

Fig. 2 RZ - Return to Zero

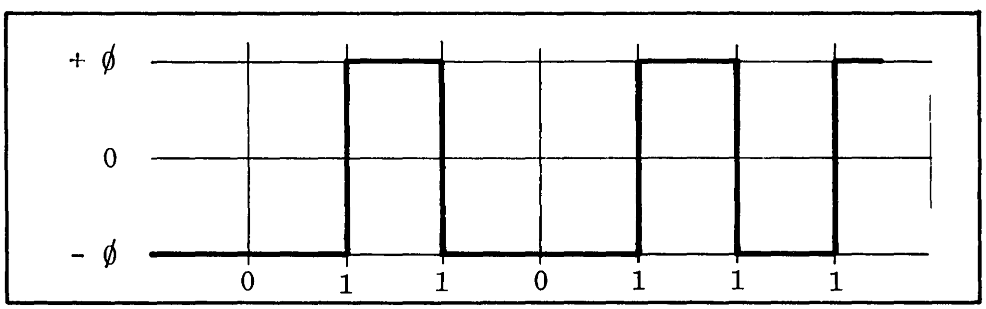

Fig. 3 NRZ - Non-Return to Zero - Mark

DERIVING MAXIMUM UTILIZATION FROM COMPUTER TAPE

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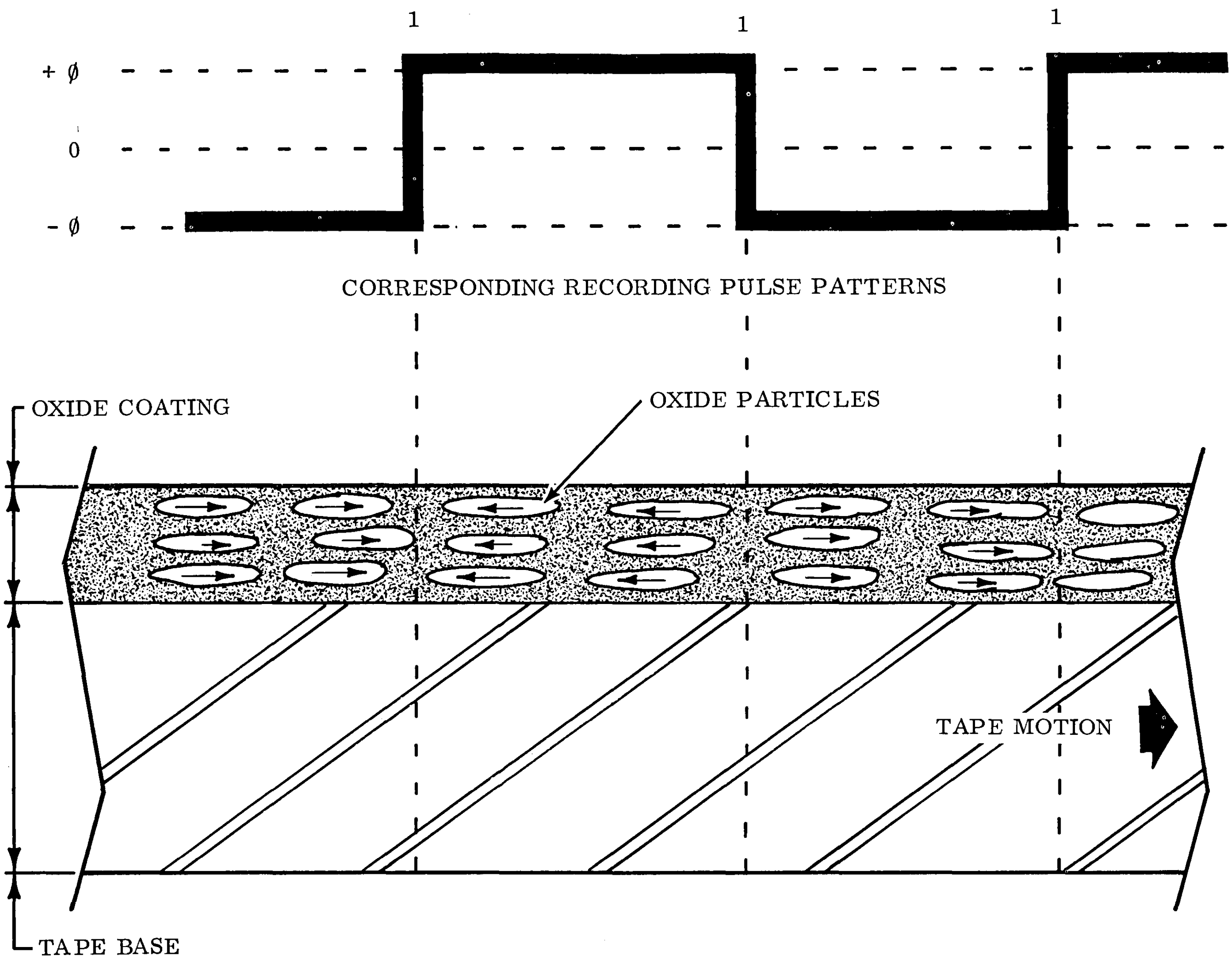
To the average computer operator or supervisor, computer tape is probably the most familiar component in the entire system. Yet, proper understanding of the exact nature and operational principles of precision magnetic tape for computers is held by very few. Computer tape is the only functional computer component handled by an operator on a daily basis. Its reliability and performance are directly dependent upon the operator's knowledge of tape, and his ability to apply this knowledge to develop proper application and handling techniques.

This article will discuss the functional aspects of computer tape: how it works; performance and reliability; proper handling; care and storage; and a look into the future of the magnetic medium.

A few detailed facts and impressive dimensions will be presented but not to overwhelm anyone with the precision workings of tape. Computer tape is very fragile, and may become damaged very easily, and since many of these damages are not visible or apparent to the naked eye, I will discuss these critical areas to provide a proper understanding and appreciation of computer tape; and desire to point out and explain the idiosyncrasies affecting performance of tape.

The function of computer tape is to store the great masses of information processed by a computer. This must be done in a convenient manner that makes the informa-



LONGITUDINAL CROSS SECTION OF COMPUTER TAPE

Fig. 4

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tion readily accessible to the computing electronics. Digital computers are two-state systems. Basic input consists of data in one state or the other, or combinations of the two. The computer electronics can perform functions only when a "1" or a "0" is presented, and binary codes are established to express all numbers in combinations of "1" and "0." Alphanumeric codes are used to express symbols, letters and numbers.

Using a coding system, any number, letter, symbol, or combination thereof may be presented to the computer in the form of various combinations of "1" and "0." Magnetic tape lends itself nicely to this method of input (and output), since a small unit of magnetic energy (bit) recorded on the tape may represent a "1" and the absence of a recorded bit may represent a "0." This is the simplest form. Actually, various techniques may be used to express the change of state on magnetic tapes; three of the more popular methods are these:

Return to Bias (RB) It is possible to record bits on magnetic tape by considering magnetic saturation in one direction as "0." Magnetic saturation in the opposite direction (See Fig. 1) represents a "1." This figure represents a train of bits or pulses for 0 1 1 0 1 1 1. RB must be compared against a clock system to be read properly.

Return to Zero (RZ) This type of recording is illustrated in Fig. 2. With this technique a pulse is recorded for each and every bit, both zeroes and ones. In the illustration, positive pulses represent ones and negative pulses represent zeroes. This form of recording "carries its own clock" since there is a pulse from the head for each and every bit.

Non-return to Zero (NRZ) This system also utilizes positive and negative tape saturation; but the interpretation of the magnetic pattern on the tape is different than in RZ or RB recording. Figure 3 shows how 0 1 1 0 1 1 1 would appear using this system. The NRZ system differs from RZ in that a one is represented as a change of magnetic state, and a zero as no change of state.

The main difference between the operation of computer tape and that of instrumentation or audio tape is the actual recording process. Computer tape utilizes digital format where discrete bits of data are recorded to saturation over a minute section of the tape. Instrumentation tape utilizes analog techniques where a continuous varying signal is recorded below saturation level. If a dropout occurs with instrumentation tape, only a small portion of the wave pattern is lost and the associated adjacent data is not jeopardized. However, if a computer dropout occurs, a finite bit of independent data is lost and the associated record of information is jeopardized. For this reason, computer dropouts cannot be tolerated.

Recording Process

A computer transport "writes" on a tape by saturating small, finite areas of the tape. As previously pointed out, in NRZ recording, a flux reversal signifies a "1," and no flux reversal is a "0." Let's see what actually happens inside the tape during this process.

Assume that all "1"s are being written. If we are using an 800 BPI (bits per inch) system, then 800 "1"s or saturated areas will be written on each track along every inch of the tape. This means that every inch of tape must be capable of supporting 800 separate and distinct bits of information. Quick mental arithmetic reveals that this leaves only a very small physical portion for each bit. Also, the tape must accept the individual bursts of energy from the head in a crisp, clean manner. That is to say, the resolution or measure of pulse rise time must be controlled to very tight tolerances. Here is where oxide processing and dispersion become important.

Magnetic tape consists of individual oxide particles firmly held in a suitable binder that is coated on flexible base film. The magnetic coating thickness generally represents 20 to 30 per cent of the total tape thickness.

The heart of magnetic tape is the oxide particle itself. In virtually all computer tapes, the oxide used is gamma ferric oxide ($Fe_2 0_3$). The oxide particles are acicularly (needle) shaped, approximately 4 micro-inches thick and 25 micro-inches long. They are held in the binder in much the same manner as almonds are held in a chocolate bar.

A computer is able to "write" on a tape because of the nature and characteristics of flux fringing in the vicinity of the recording head gap. The flux in the head is established by, and is proportional to the input signals or current pulses flowing through the head windings. This flux fringing penetrates the magnetic coating and saturates all the oxide particles under the influence of the fringing pattern. In the case of 800 BPI, it is obvious that each bit or saturation pattern must be put down in a crisp, perfect manner because the physical dimension of the recorded bit is extremely small.

In recording pulses a perfect tape would have infinitely small particles that are all magnetically saturated in one direction for each pulse. At the exact point where a "1" is to be recorded, each particle would be saturated in the opposite direction. The transition would be perfect with no interface or boundary effects. Pictorially, this can be generalized by Figure 4.

In this overly simplified diagram a "1" which is signified by a flux reversal, is written perfectly because each particle is saturated in the proper direction. There is no "inertia" in the transition from one state to another which would give a gradual or imperfect pulse rise time. Tapes, however, cannot be manufactured in this simple way. Literally millions of particles must be packed into the coating to deliver the proper output, and practical limitations of dispersion technology make it impossible to achieve the ideal condition.

As the packing density increases, the physical volume (or number) of magnetic particles for each bit decreases, which makes it even more important to have perfectly uniform particles that are properly processed and dispersed. To satisfy this requirement, it would be feasible to use smaller and smaller oxide particles; however, resolution is only one factor to consider in the complex equation of a balanced tape design.

Computer Tape Errors

With the advent of advanced computer techniques providing superior data handling capabilities, computer tape with greater reliability has become an essential requirement. In addition to better reliability, tape bit-packing density requirements have increased to the point where conventional quality-control procedures are inadequate to insure 100 percent error-free tape. An error-free tape checked at 200 BPI or 556 BPI may not be error free at 800 EPI. By errors, we mean permanent dropouts. Much has been written on the nature of permanent dropout, but simply stated, it is any tape phenomena that produces a reduction or loss in signal below a preset level (usually 50%). A temporary dropout has been defined as one that is removed by normal machine recycling. More persistent temporary dropouts sometimes require brushing to remove. There is a distinct difference between permanent dropouts, permanent dropouts of temporary origin, and temporary dropouts. Let's clarify further by classifying and defining again the three categories.

Type one—permanent dropout. This type of error results from the physical deformation of the tape coating, or an imperfection of the backing material. No amount of machine cycling will remove or alter this dropout. This is the familiar nodule, or impurity that is actually coated into the tape during manufacture. Initial testing and all subsequent tests will indicate this as being a dropout.

Type two—permanent dropout. This a "here today, gone tomorrow" dropout. It is usually a bit of dust, lint, or foreign matter lightly adhering to the tape coating. Normal maching recycling will completely remove this error. Actually it merely displaces the foreign matter, and it may occur repeatedly at different tape locations. However, this is not a serious problem because the transport is designed to cope with such errors. It simply shuttles the tape back and forth up to a preset maximum number of times to remove the dropout.

Type three. This is a *temporary dropout* (*type two*) *that has become permanent* (*type one*). This is the type that creates by far the biggest problem. A tape can be checked and certified to be free of type one dropouts. There are no two ways about it. The tape does not have a permanent (type one) dropout throughout its length, and it never shall. However, subsequent tests may reveal what appears to be a "permanent" dropout. In reality, this dropout is a small particle of oxide shed that entered the tape pack sometime after the certifying test, and became so firmly embedded in the coating that it assumed the shape and appearance of a permanent (type one) dropout. A foreign particle may enter the pack long enough to deform the base film of adjacent layers leaving an impression that will also cause dropouts.

The following analogy clearly points out the precise tolerance required for perfect computer tape:

A ½" x 2450′ roll of tape with 1 nodule or surface defect that will cause a dropout at 800 BPI is equivalent to a highway 50′ wide and 557 miles long with one grapefruit sitting on it!

Care and Storage of Tape

The requirements for meticulous housekeeping and perfect handling techniques are definitely justified for they will prevent real problems. Historically, computer facilities were kept clean and modern because they were new and ofen used as show-places. To a certain extent, this concept prevails today, but is greatly overshadowed by the functional requirement of hospital-type cleanliness. Smoking in computer rooms has long been a contested issue. All computer manufacturers and precision tape manufacturers recognize this as a problem; the universal recommendation is to prohibit smoking in the computer environment for optimum operation, but due to the personal inconvenience involved, the non-smoking rule is enforced in only a small percentage of installations. Strict controls of cleanliness not only improve computer performance, but they promote a higher standard of working conditions. This without fail is reflected as an increase in the individual operator's attitude and efficiency. The operator begins to take personal pride in his work, and performance invariably goes up.

Good housekeeping is not only related in a direct manner to the efficiency of a computer operation, but it is an absolute necessity with the high-performance 800 BPI computers. An entirely new standard in cleanliness and maintenance must be established, not to mention the increased emphasis on good operator techniques. Techniques, procedures, and conditions of cleanliness that were acceptable for 556 BPI operation are not adequate for successful 800 BPI operation. A very loose analogy may be made in considering what happens in flight when the speed is increased from 500 miles per hour to 800 miles per hour. Although the increase in speed was about 60%, the related problems increased considerably more than 60% because the sonic barrier was broken and a new set of conditions become effective. In general, this may be linked to updating a computer operation from 556 BPI to 800 BPI—a new set of operating conditions prevail at the much higher packing density. Many slight problem areas occur such as minute dimples in the Mylar backing from small dust particles which will create a dropout at 800 BPI and not at 556 BPI. Creases, pinch roller marks, redeposits, and the presence of any foreign particles become critical at 800 BPI.

Proper control of temperature and humidity in a computer environment is vital for reasons other than maintaining the dimensional stability of the tape and machine components. For example, very low humidity will increase the headwear due to the change in frictional characteristics. Static buildup on the tape surface increases with low humidity. High humidity affects the pinch roller to tape action, and in prolonged, extreme cases may corrode critical guide surfaces. Effects from fluctuating temperatures during storage and use are less subtle. Changes in temperature are highly detrimental to the tape pack. If a tape is wound at normal ambient conditions and subjected to a higher storage or transient temperature, tremendous pressure will be built up within the tape pack as the base film attempts to expand. When the tape returns to normal room temperature, the pack will be loose from uneven contraction. When this tape is then placed on a transport, it may "cinch," rendering the entire reel useless.

Computer tape reel design has been an evolution of a functional design to reach its present configuration. Original design concepts were premised on the fact that the flanges must have windage holes to allow the air to flow out of the pack during winding to assure an even pack. It has been proved, however, that these holes actually "pump" air into the pack. The present trend is toward solid flange reels for a very practical reason: solid flange reels keep fingers away from the tape!

The vast majority of computer tape fails (wears out) due to abuse and mishandling. Accumulated data indicate that less than 20 percent of computer tape actually wears out from normal machine use. The end of tape life is simple to define—it is that point in tape life where excessive dropouts render the tape useless. This could be after 3 passes or 3000 passes depending upon the origin of the dropouts. For example, if all tapes were loaded on a clean, properly adjusted transport once, and never touched again, the tape would perform perfectly for thousands of passes. Unique, long wearing binders have been developed to resist the normal wear effects of heads and guiding components, but it is impossible to develop a tape that is immune to mishandling. A properly adjusted transport will handle tape effortlessly with no adverse wear on the tape. Premature failure of tape is brought about by abuse, mishandling, and improper storage of tape. For example, the tape pack is seldom perfect due to the normal shuttling, stop and start motion dictated by the program, and if the slightly protruding edges of the tape are squeezed by the fingers in loading or unloading, the tape is slightly creased. This distortion often develops into a dropout. Creases and foreign particles introduced by physical tape handling increase the possibility of dropouts. Handling tape and touching the surface will deposit a slight, greasy film which will attract and hold minute dust particles. If it is absolutely necessary to handle tape and touch the surface, it must be done very carefully while wearing rubber gloves. This applies to handling tape between the load points, and excludes normal loading operations.

Tape reels should never be squeezed against the tape pack in handling, as it distorts the tape edges. Reels should be supported lightly with the fingers through the inside diameter of the hub and the thumb against the outer edges of the flanges.

Obviously, tape should *never* touch the floor during loading. Normally, this section of the tape is considered a threading leader and is outside the end of file markers, but if it drags on the floor the chances are excellent that it may pick up foreign particles and deposit them into the tape pack.

With the present day durable binder systems, computer tape rarely "wears out." As perviously pointed out, the vast majority of "worn out" tapes are returned due to excessive dropouts resulting from abuse, mishandling, and physical damage. This does not imply that the tapes are mutilated and shredded. These tapes will contain subtle damages such as minute creases, edge damage, scratches on the oxide surface, greasy film, etc. Once again, the efficiency of computer tape performance is directly proportional to the degree of good housekeeping and skillful operator handling, because it is the only functional computer component that is actually handled by the operators.

Tape Evaluation

What makes one tape acceptable and another tape unacceptable? There are numerous parameters that can be compared to answer this question, but they can all be

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lumped into a simple statement: a computer tape must deliver reliable performance.

The only conclusive evaluation for computer tape is to observe its performance over a period of time under normal programming and operating conditions. From the data presented, it is obvious that tape efficiency is dependent upon many variables. An accelerated test, or test performed on a small quantity of tapes, will not reflect the true picture of performance in a given installation because it will not subject the tapes to all the influencing factors that have a direct bearing on reliable performance.

Future of Computer Tape

By most standards, the computer industry is very young. Within the span of a few short years, the quality and reliability of magnetic tape has improved considerably to keep pace with the increased performance. Computer tape as we presently know it, will, I predict, never become obsolete and be completely replaced by a different medium. For high speed and special applications, however, new media will be developed. Already we see random-access capability incorporated into computers by use of magnetic-coated, easy-to-handle cards with many tracks of recorded data. These cards are used in decks and are fed to the computer individually. Direct recording of an electron beam on exotic media also opens an intriguing and limitless era for the data processing industry. These are just two of the many advances that will mark the changing scene.

Magnetic tape in its role as the data storage unit and data transfer workhorse in the general purpose computer category will remain an active element for a long time to come.

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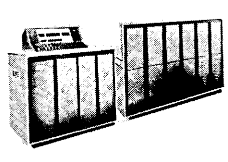

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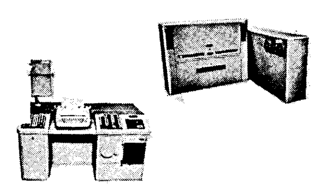

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A COMMAND CONTROL INFORMATION SYSTEM FOR THE FIELD ARMY

David E. Weisberg
Senior Analyst
Charles W. Adams Associates Inc.
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Modern Warfare

The setting is not unfamiliar to most late show TV viewers and is, perhaps, an even more vivid memory to some readers. The Artillery Forward Observer lies crouched in his foxhole. Suddenly, in the distance he notices a cloud of dust which proves to be a group of enemy tanks moving into an attack position. The observer takes several readings on an instrument which appears to be a pair of binoculars. These readings, along with a few other items of information concerning the targets, are quickly entered into a small box-like device.

As soon as this data is entered into the device, a red button on it, marked FM (Fire Mission), is depressed. This device is connected by wire to a small radio. The information is then transmitted several miles to a high-speed digital computer. Here the message is analyzed and calculations necessary for firing on the target are made and sent to a firing battery. At the battery, firing instructions are displayed on a small output device and relayed to the weapon crews. A few quick adjustments and then the heavy crack as the howitzers fire. Over the radio the observer hears the familiar cry of "On the way." Several seconds later the tank concentration virtually disappears in a hail of steel. Time from the observer first sighting the tanks: less than 45 seconds.

Perhaps the above paragraph sounds like a recent Sunday supplement version of Flash Gordon's exploits, but that is not the case. The above incident is only a few short years away from reality with the present rate of change in modern warfare.

Warfare has changed tremendously since the trench fighting days of 1917. The swift slashing movements of the Pattons and the Rommels will become the rule rather than the exception. No longer will a commander have days to plan his next offensive move or even hours to counteract an enemy thrust. Not only has the luxury of sufficient time to plan been removed, but the volume of data to be analyzed in this shorter period of time has increased tremendously. As recently as the Korean conflict, a commander had to consider only conventional ammunition fired from tube artillery or unguided missiles. Today, the commander is faced with utilizing both conventional and nuclear ammunition fired from both tube artillery and guided missiles. With the advent of nuclear warfare, he now has such problems as friendly and enemy fallout on his troops and contamination of areas through which he would like to move. To further complicate the situation, his units are widely scattered as protection against enemy employment of nuclear weapons.

The problem therefore is one of rapidly evaluating tremendous volumes of data to determine key facts upon which to act. Command-Control has become a task which cannot be done in a modern, widely dispersed battlefield without something to aid the commander. For this aid the Army is employing in a number of instances, fast, reliable, mobile digital computers. In an attempt to describe the field use of computer systems, characteristics of such employment are stated below. This article concentrates on the digital computer aspects of the problem and does not concern itself extensively with the operational problems of Command-Control. As well as implementing data processing systems in the field, the Army is thoroughly revising many of its doctrinal concepts to meet the changing requirements of warfare.

Computer Systems in a Field Army— Operational Speed

The speed with which a computer handles an entire problem is the primary criterion by which computers are evaluated today. The problem is often one of having a machine which has an extremely fast cycle time but is still operationally slow due to slow peripheral equipment and, as a consequence does not handle the entire problem efficiently. An effective computer complex is one in which the internal cycle time, input/output speed, and data-handling characteristics are carefully blended together to form a totally efficient machine. Each type of problem will lead to a somewhat different configuration in the aim of reaching fast operational speed.

Data Manipulation

A Command-Control Information System has some of every kind of programming imaginable. The range is from complicated mathematics to information retrieval to business-type data processing. The overwhelming majority of the effort can best be described as data manipulative. This takes the form of message analysis, table constructions, information storage in variable files, generation of graphical displays, preparation of numerous reports, and control of a multitude of hardware. The above characteristics might indicate the use of computers of variable word-length, but this has not been the course taken. The add times of such machines are usually insufficient to operate in real time without a huge increase in equipment complexity. The level of data control often goes below character addressing to the use of individual bits of information.

Communications Orientation

By the very nature of the problem, a command-control system is communication oriented. This is often referred to as "real-time processing," but a distinction should be made. Most real-time systems involve continuous inputs which are periodically digitized for analysis by the computer. An example is telemetry systems presently in operation. But the real time in a Field-Army Command-Control System is more discrete, i.e., at random intervals messages are entered into the computer for evaluation. There may be long lulls between large bursts of messages. In the initial example, within a few seconds of the observer sending his message, several other forward observers may have sent other Fire Missions. This saturation problem is one of the most difficult problems facing the analysts working on Command-Control systems.

Some of the computers of the Army handle communications much as most machines handle multiple buffered input/output. Equipment currently being constructed can be simultaneously sending 30 messages, receiving 30 messages, performing input/output to peripheral equipment, and computing.

Multi-Computers

A Command-Control Information System for use by a Field Army requires a huge number of computers. In a twelve-division Field Army (about 450,000 men) there may well be over one hundred computers from small scale up to large scale communicating with each other through a huge data transmission network.

Together with the primary function that each computer performs, it will provide backup for at least one other computer. This is a vital requirement in a nuclear environment where an entire headquarters can be wiped out in a fraction of a second. A partial solution is to have a highly dispersed and highly mobile organization. As one echelon moves, another portion of the organization must temporarily take over its functions in a sort of leapfrog fashion.

Environment

Everyone concerned with computers is familiar with the antiseptic cleanliness and neat order of most computer installations. Even Command Control systems in fixed plant installations become, to a certain extent, showplaces. Now take these computers and cram them into a shelter mounted on a 2-1/2 ton truck, drive them over potholed roads and cross-country, replace the white shirt and tie operator with a combat dressed soldier complete with muddy boots, and have someone shooting at the computer while it is being maintained under blackout conditions. Obviously, this is no place for fragile electronic circuitry. Some of these computers may have to be airdropped under certain circumstances; they all have to be transportable by air.

The Concept of a Field Army Computer

The U. S. Army is no stranger to electronic digital computer development. In 1946, ENIAC was built for the U. S. Army Ordnance Corps by the Moore School of Electrical Engineering, University of Pennsylvania. Many other advances in the state of the art can be traced back to Army development programs. In the mid-fifties planners began to consider the possibility of using computers in tactical military operations. The break-through in solid-state devices then indicated that it would be possible to build fast, small, and rugged computers.

The Army's initial approach towards developing equipment for tactical operation was to design a large family of computers of varying capacity but sufficiently similar to each other in many respects so that they could be considered compatible. From this concept came the FIELDATA family of computers. The name comes from a standard intercommunication code called FIELDATA which allows computers in the family to communicate directly with each other. Internal compatibility comes from the use of a single set of word formats and the selection of instructions from an over-all single list, which makes programs on all the computers appear quite similar.

The early concept included a number of militarized computers of various sizes and intended purposes. The largest of the family is called MOBIDIC and is mounted in a 30-foot van, and additional peripheral equipment is mounted in several similar vans. Next in size is called the INFORMER; it uses high-reliability magnetic-core logic and includes a 20-million-character disk file and special circuitry for information retrieval. The INFORMER is mounted in a shelter which fits on a 2-1/2 ton truck; additional peripheral equipment is mounted in similar shelters. The BASICPAC is approximately the same size as the INFORMER but has conventional circuitry and does not have the mass storage capabilities. In addition, a number of non-militarized or partially militarized FIELDATA computers have been or are being built to aid in the design and programming of systems for field use. The number of small special-purpose computers in use in the Army is very numerous.

Work on the equipment development program was initiated in 1957 and has since resulted in a number of operational computers. Unfortunately, all these computers were delivered with minimal militarized peripheral equipment. This highlights one of the serious problems facing the Army. It has proved to be a straightforward task to ruggedize central processors; but it has been very difficult to obtain similar ruggedness in the associated peripheral gear. Additional effort in the next several years should produce satisfactory results. Perhaps the toughest product to develop will be a device for mass storage of many million characters.

(Please turn to page 30)

IBM reports to the industry

SYSTEM/360 includes universal code capabilities

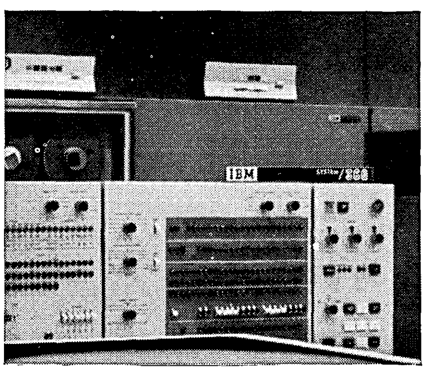
The IBM SYSTEM/360, designed for a specific eight-bit code, also will accept any character code having *fewer* than eight bits.

This eight-bit structure (the extended binary-coded-decimal interchange code, or EBCDIC) is derived from the six-bit BCDIC. One of the most significant advantages of the eight-bit structure is the packing of two four-bit numerics into one eight-bit byte.

The 7-bit ASCII is to be expanded in SYSTEM/360 to a superset of eight bits. It will preserve the relationships and code properties of the seven-bit form.

Input/output equipment that will handle ASCII includes the 2400 Magnetic Tape units, the 2671 Paper Tape Reader, and the 2822 Paper Tape Reader Control. They will be available starting in April, 1965.

SYSTEM/360's central processing unit will handle any eight-bit character-set, although there are certain restrictions in the decimal arithmetic and editing operations.



New Optical Scanner reads cash register tapes

IBM's new 1285 Optical Reader reads data from cash register or adding machine tapes directly into any of these computers—1401, 1440, 1460 or SYSTEM/360 (Model 30 or 40).

For all businesses, especially retailing, the 1285 solves the problem of entering raw sales data into a computer while the facts accurately reflect changing market conditions.

The 1285 features a high reading speed of up to 3,000 lines per minute. One reason for this high speed is its solid-logic circuitry—the same as in SYSTEM/360.

Another is a newly-developed "flying-spot" scanning technique, in which a beam of light from a cathode ray tube automatically scans several lines of print without tape movement.

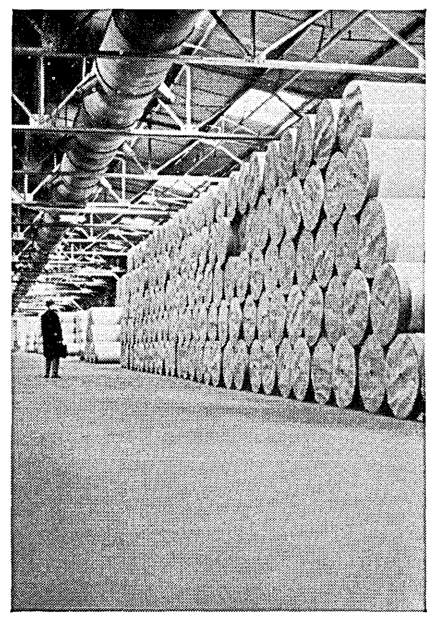
New IMPACT program saves time and money

It's the IBM 1311 IMPACT Computer Program Library for inventory management—an extension of the widely used IMPACT 1401-1405 program.

IMPACT assists the buyer in determining when, what and how much to buy. It helps achieve a more efficient balance between the cost of carrying inventory and the cost of purchasing and receiving. Properly used, it helps improve customer service, while keeping inventory at a minimum.

Library programs include editing, file initialization, estimating and control of joint-replenishment operations.

The IBM IMPACT Program can be used with the IBM 1401/1460-1311 or the 1440-1311 Data Processing Systems.



IBM 1026—new low-cost link to on-line Tele processing

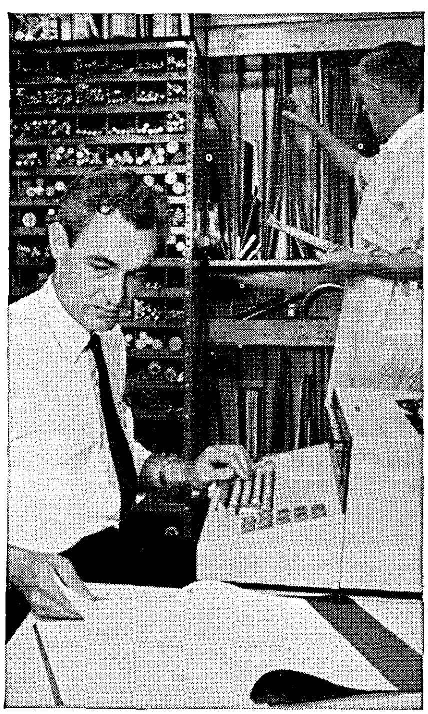
The new IBM 1026 Transmission Control Unit provides any user of a 1240, 1440, 1401 or 1460 with all the advantages of a remote, on-line Tele processing system—at a very low cost.

Large companies can make a modest start toward satisfying their data communications requirements. Expansion to SYSTEM/360 can be made as the need arises.

Smaller companies, too, can use the new 1026 to go on-line now—sooner and more reasonably than ever before.

Each 1026 Control Unit can handle one line, with multiple terminals on that line—either 1030's, 1050's, 1060's or 1070's. Up to four control units may be added to a system.

IOCS support for the IBM 1026 includes polling; addressing and receiving on all lines at the user's discretion; error detection; operation with direct data channel and disk; and time-shared operation of batch jobs with real-time processing.



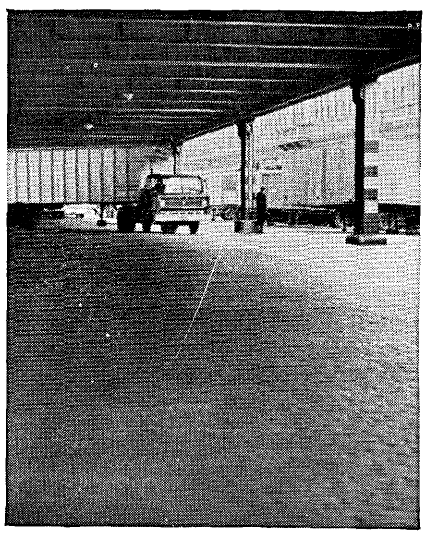
IBM freight program simplifies billing procedures

Revenue-accounting and control in the motor freight industry is now faster and more efficient, through a new IBM 1440 program.

This new Motor Freight Revenue Accounting program edits daily transaction data and prepares the daily transaction register. At the same time, it posts revenue by freight bill number.

It prepares customer statements and simultaneously posts customer accounts-receivable balances. It also edits cash-remittance source data.

Whether the motor-freight carrier uses a centralized statement-and-collection method of billing or a decentralized terminal-level method, doesn't matter. In either case, the program provides effective control of freight bills.



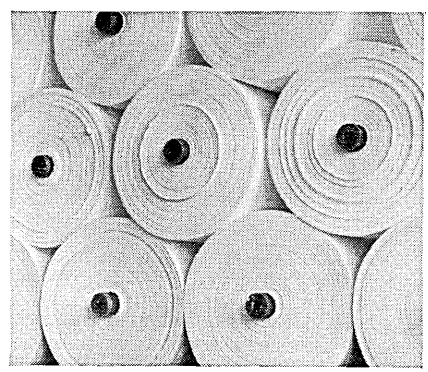
New operating system aids textile finishing

Textile industry managers can now exercise comprehensive control over all of their operations, by employing the new IBM Management Operating System (MOS) for Textile Finishing.

This is a total information system —a step-by-step guide to better management control.

Textile managers can use it to correlate data associated with any or all of the six basic control areas of textile finishing: expanding the finishing order, applying greige inventory, plant loading, raw-materials requirements planning, scheduling, and operations evaluation.

MOS for Textile Finishing can be used with any IBM computer system that has random-access capacity. It can be used by companies involved in the finishing of any cloth—cotton, wool, or synthetic.



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Present development ideas indicate that future computers will be highly modular; all but the smallest will be built up from the same basic units. Entire memory units or banks of communication channels will be able quickly to be added or replaced under field conditions. Equipment will be extremely reliable and will be designed to make maximum use of diagnostic routines for finding faults. These routines will be capable of isolating errors down to a single plug-in card and perhaps to a single module in that card. The computer will take advantage of the latest advances in logical organization and may use some form of micro-miniaturized circuit elements. Peripheral equipment will be designed with a minimum of mechanical parts.

Command-Control Information System of 1970

The Command Control Information System to be implemented by 1970 (CCIS-70) consists of five functional areas: Fire Support, Intelligence, Operations, Logistics, and Personnel & Administration. The main concept of all these subsystems is to get the right information to the right people, at the proper time, and to present it in such a way that it can be assimilated very rapidly.

Fire Support can be divided into two functional areas involving the use of tube artillery and surface-to-surface missiles.

The first function is related to the earlier example of a Fire Mission. This is the detailed control of each weapon so that it will most effectively hit the target. This must be done for both fire observed by a forward observer and unobserved fire. Ballistic calculations are extremely complex and involve a multitude of factors including gun location, target location, wind velocity, and atmospheric conditions at varying altitudes, powder temperature, and projectile weight. These calculations are sufficiently complicated so that, in a manually controlled operation, it is easier to fire several rounds bracketing the target before actually firing on it. This often gives the enemy sufficient time to obtain shelter or to move. Using a digital computer it is possible to go immediately into "Fire for Effect," and achieve a significant increase in tactical surprise and first-round accuracy. Since atmospheric conditions are constantly changing by substantial margins it is common practice to register the guns several times a day in order to be prepared for any eventuality. The savings in ammunition by elimination of registration fire will be considerable.

Fire Plan

The second function is the preparation of the fire plan or the schedule of fire from a number of firing units against a large number of targets. A fire plan is prepared whenever a general attack is planned or a delaying defense is necessary. During the course of normal operation, many potential targets are entered into the computer system and are not fired upon immediately for various reasons. This information may come from forward observers, aerial reconnaissance, the Intelligence subsystem, and electronic means.

When the artillery officer develops a fire plan he must consider such factors as:

Type of target: infantry dug in, tanks, bunkers, etc.
Size of target
Density of target
Location of target
Desired damage: 100% neutralization is usually very uneconomical
Time at which target is to be attacked in relation to other targets
Location of firing units
Ammunition available at each unit and at stock points
Safety lines
Total time of schedule of fires

Obviously a plan which must consider all these factors would be difficult to produce manually; and yet these are not all the items which should be considered. By present methods it takes the Division Artillery Officer and his staff 6 to 8 hours to produce a division fire plan involving several dozen batteries and several hundred targets. Frequently, this amount of time is not available and a less than acceptable plan has to be used, seriously threatening success of the operation. By use of a high-speed computer it is possible to produce a better fire plan in less than 15 minutes. If time is available, a number of different plans may be produced and the best plan chosen by the Commander.

Intelligence

The intelligence subsystem may be described as an information retrieval system where the objective is to have the users communicate with the machine in a language as similar as possible to their own. Early in the design of this subsystem it became obvious that it would not be practical to use natural English and that a somewhat limited version would have to suffice. Tests showed that under the stress of combat individual soldiers and patrol leaders could not be expected to use rigid forms for submitting messages. The system design now envisions intelligence analysts, using flexible formats with mnemonic codes, who are intermediaries between the combat soldiers and the computer.

The activities to be performed by the Intelligence subsystem conform to what is commonly known as the intelligence cycle. This involves planning, collection, evaluation, and use of intelligence which again leads back to planning. The most extensive use of automated equipment will take place in the use phase. A significant amount of clerical effort will be eliminated since it will no longer be necessary to manually record information. In the past, this has taken the form of a message log, where each message is recorded by subject content, and a grease pencil situation map where all units can be shown.

The saving in time will be substantial, and accuracy will be greatly improved. The manual procedure for placing an enemy unit on the situation map is very susceptible to error. In an automated system, after a message concerning a particular unit is received, the proper symbol for the unit can be accurately positioned on an electronic graphical display unit. The use of computer-driven graphical display units will greatly enhance the usefulness of the system. No longer will the Commander be able to view only the extremely cluttered situation map, but will be able to request a display of specifically desired information. This may be all enemy tank units or perhaps all mine fields within a certain area.

One of the largest problems in any intelligence operation is seeing that the proper people get the information that they need and seeing that they get it without wading through a mass of unnecessary data. Using a computer, it is possible for intelligence analysts to enter requests for the information which they desire and then have every incoming message concerning their problem routed to them. In this manner an analyst will be able to request all information concerning the movement of artillery units in a particular area.

Logistics

The third major area under development is the Logistics subsystem. Logistics can be considered to include supply, transportation, rear area damage control, maintenance, civil affairs and administrative planning.

At the present time, activity is being concentrated in the first of these areas, supply. Modern tactical supply, in order to exist in a nuclear environment, involves flexibility, mobility, rapid responses, and selective stockage instead of the previous approach of abundant stockage. Formerly, many items were carried in large quantities and only infrequently used. Because of rear area vulnerability, large numbers of fixed plant depots are no longer practical.

The primary functions being automated are item accounting, requisition processing and stock status reporting. This is quite similar to many commercial inventory control systems; only now it must be performed under tactical conditions. In an effort to increase the response time of supply, a random access mass storage device will be used so that requisitions may be processed as they arrive and by priority.

This area is perhaps the closest to being automated. There is already a MOBIDIC computer in operation at Zweibrucken, Germany, for use by the 7th Army. A second MOBIDIC is installed at Orleans, France. These are both sequential tape systems rather than random-access systems and handle mostly stock control in rear areas.

Personnel and Administration

The fourth area of activity is the Personnel and Administration sub-system. The major effort here is to reduce manual record-keeping at the combat units to a minimum. Effort is being spent in personnel record-keeping, individual replacement, casualty reporting, rotation, and pay.

Under the present method, a complete record is kept on file for each man, and the commander of a small unit sends in a comprehensive daily report concerning personnel in his unit. Under the new concept he will send only change information. He will receive from the computer center serving his unit, a comprehensive report concerning all personnel in his unit with specific mention being made of all situations requiring his action.

The individual replacement function is perhaps one of the most important of all when considering increasing the tactical effectiveness of a unit. The problem exists of assigning the proper people to the proper jobs in both peacetime and wartime. With a computer it will be possible to carry out a more appropriate assignment.

Operations

The last major function to be automated is the Operations subsystem. This is the command post function through which the Division, Corps, or Army Commander controls his units. When automated, it should be able to carry out many staff functions better than the manual methods used at present.

One activity is the maintenance of the Operations Situation Map. This is similar to the situation map in the Intelligence subsystem except that it has more concentration on friendly units. Here again, graphical display equipment will replace the grease pencil. The Commander or his staff will be able to interrogate the computer to determine specific information concerning pertinent events. If the information is not available at this complex, the other subsystems will be interrogated to obtain it.

Besides the information retrieval aspects, a certain amount of computation would be done here. Such functions as fallout prediction, radiological intensity charting, and status of key supply items will be performed. This will also be the center through which coordination with adjacent units and units of the other services or Allied nations will be done.

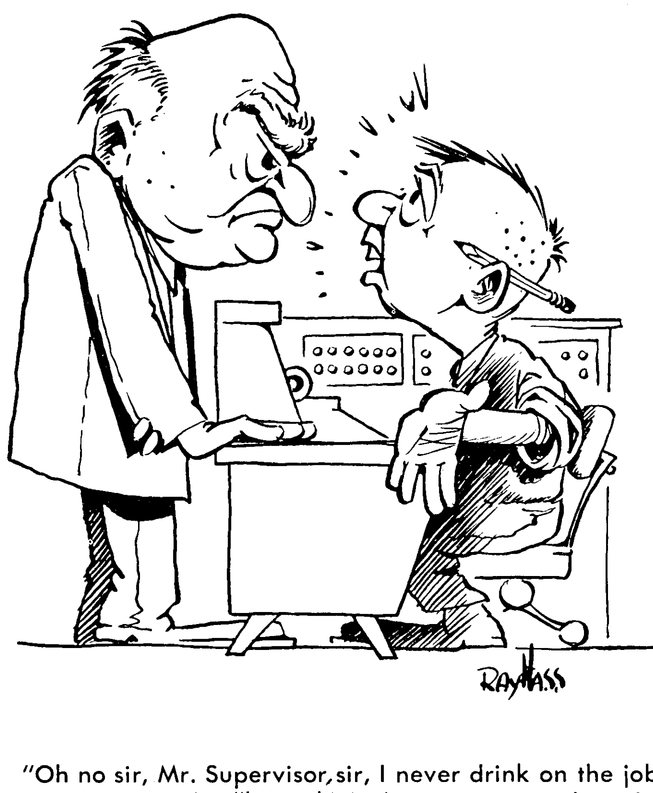
It is quickly obvious that the full power of these subsystems will be achieved when they are all operating together as a single system.

Information concerning targets will flow between the Fire Support and Intelligence subsystems, and the Operations subsystem will receive much of its information directly from other computers. This will reduce the chance of human error considerably. The full advantages of a fully automated system are only beginning to become apparent as the tasks to be performed in each subsystem are becoming more clearly defined.

Many problems still remain to be solved. Not the least of these problems is the development of reliable and rugged equipment, especially peripheral gear. The closer the state of the art comes to all-electronic equipment, the higher it seems are the chances of success. In the system design area, much effort is needed in coordination with the other services and with allied forces so that systems are compatible. Also, care must be exercised that too much "by-the-book" stress is not built into the system. It must be able to adapt to changing situations. Likewise, the programming must be such as to ensure that the programs can be easily maintained and modified when required.

In a world of potential thermonuclear holocaust, maintenance of strong and efficient armed forces discourages attack. The Command-Control Information System for the Field Army is a part of this task.

CIRCULAR PROGRESSION



"Oh no sir, Mr. Supervisor, sir, I never drink on the job sir, you see sir, "looped" is just an expression sir, when I said I was "looped," I meant, oh goodness gracious sir . . ."

THE STANDARDIZATION OF PROGRAMMING LANGUAGES

Franz L. Alt
National Bureau of Standards
Washington, D. C.

The Economics of Standards

Standardization in the computer field has been under discussion for at least ten years; and for the last four or five years, concrete efforts in this direction have been under way, centered in the American Standards Association. Yet even today there is no clear-cut answer to the question whether or when or to what extent standardization in this field is desirable. Work is being done on standardizing of both hardware and software; and in the latter area, it ranges from the smallest units—characters—to the largest —programming languages. Why should there still be so much difference of opinion on the value of standards?

As a staff member of the National Bureau of Standards I know from daily experience that in most fields of technology standardization is an unmixed blessing. Things are not nearly so simple in the field of computer languages. Whatever the advantages of standardizing one or a few computer languages, we pay a heavy price for it. But we also pay a price for failing to standardize, or standardizing too late. And the heaviest penalty of all is for standardizing prematurely or on the wrong language. Between these conflicting tendencies we have to try to reach an optimum compromise. But what is optimum depends on the viewpoint. There are a few persons who are flatly opposed to any standardization of programming languages *at this time.* Many more agree that some amount of standardization is now desirable, but in varying degrees and with varying safeguards. What seems best to the user does not seem best to the producer of computers, and what is best for one particular company may be contrary to the interest of all other companies.

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Objections to Standardization

The languages which exist today are by no means the best possible. We do not yet have a good theory of computer languages, and we are nowhere near the limit of the concepts which can be expressed in such languages. Existing languages are constantly being improved upon. If everyone agreed on using exclusively some standard programming language or languages, the development of new or improved languages would be stifled. Persons with ideas for improving languages would be discouraged by the knowledge that the results of their work would not be used for a long time, and then only after the cumbersome process of revising an existing standard. The situation is quite unlike that in, say, screw threads, where revolutionary new inventions are hardly to be expected. The desire to encourage further development of languages is so strong that it has caused some people to object to any standardization at this time. While this viewpoint seems to me to be too extreme, it does seem necessary to strive to conduct standardization in such a way as to minimize its harmful effect on innovation.

Another point is the great and growing specialization of computer languages. It would be wholly unrealistic to imagine that all computer programmers could agree on using one and the same language. There is an increasing tendency to narrow the fields served by a language, to make the languages more and more specialized. What we need, therefore, is not one standard but a number of different standard languages for different purposes. There will unavoidably be overlaps in some places, and gaps in other places. It is easy to see what a difficult problem it will be to choose a complete, consistent, and non-overlapping set of programming languages.

From what I have said so far, two limitations on our standardization effort emerge: There will not be one standard language but a collection of them, so as to accommodate all areas of widespread machine use. And it seems advisable that the use of the standardized languages be optional and not mandatory, so that nonstandard languages may be used or newly created whenever this appears to be economically justified.

The Case for Standardization— Different Viewpoints

What makes standardization desirable at this time is the proliferation of languages which has begun to set in during the past few years. This threatens to limit the possibilities for interchange of programs between laboratories, and reduces the rate of return on investment in compilers. There is now a bewildering variety of different languages, often differing from each other only in minute detail. Sometimes this comes about merely because programmers insist on their own way of doing things, at other times because of their understandable desire to create a language best suited for their particular brand of problems. Sometimes it is to facilitate the writing of compilers for a specific machine, or to take better advantage of some special feature of a machine.

And here we can discern the germ of disagreement among interested parties: Different languages are best suited for different machines, and if one language is chosen as a standard, this gives an advantage to one kind of machine. True, it is a very temporary advantage, for computers become obsolete very quickly, and new models are introduced every few years. Once a standard language as been agreed upon, manufacturers will usually find it possible to adapt their next model to that language. In a few years everyone would be on an equal footing except for the fact that standardization itself is not standing still, and we may expect new languages to be added to the list of standards from time to time.

There is another way in which standardization affects the competitive position of companies. A computing laboratory which intends to switch to a new machine has a library of programs written in a language adapted to its old machine. Therefore, it has an incentive to acquire a machine of similar characteristics, presumably by the same manufacturer. Also, many laboratories are interested in exchanging programs with other installations; there is, therefore, a tendency to acquire a kind of which numerous others are in use, or may be expected to be in use in the future. Thus, once a manufacturer has acquired a large share of the market, there will be a tendency for his share to grow even more. The only way in which the others can compete at all is by providing compilers for the languages used by the dominant producer. This is made more difficult if there exists a variety of such languages, differing in minor points. Another road open to the small manufacturers is to provide compilers for a language which is common to all of them but different from that of the dominant producer. This may make their combined slice of the market large enough to be competitive. But it forces them to invest in producing still another compiler for each of their machines, and this investment will pay off only slowly.

In any event, those who buy or rent computing equipment have acquired the habit of expecting that the producer will furnish compilers for several popular languages. Since each customer has his own desires, and since even the major languages exist in several slightly different versions or dialects, the manufacturer is hard put to it to satisfy all his customers. A consequence of standardization will be that more customers will be inclined to expect compilers only for those languages which have been adopted as standards, thus reducing the pressure on the manufacturer. This is the reason manufacturers support standardization, and it is also the reason why they will in general favor a small number of standards. In this respect the situation in programming languages is similar to that in many other industries. The customers, in general, will argue for a somewhat greater variety of standard languages, to facilitate programming and the exchange of programs in a greater number of special fields; but even the customers have an interest in holding the number of standards down to some reasonable level, since otherwise opportunities for exchange of programs are too much reduced.

Dangers of Premature Standardization

Matters in this respect can perhaps best be illustrated by comparison with an entirely different field, that of units of measurement. The American economy today is significantly handicapped by its adherence to the English system of units, while most of the world is using the metric system. In the eighteenth century, England was the only nation in which industrialization had gained a foothold. This required relatively precise standards of measurement, and the English units naturally were chosen as standards. At the time of the French revolution the superior metric system, then newly devised, was introduced on the European continent without opposition; but it was rejected in England, where it would have conflicted with the vested interests of the older industry. The American colonies, after independence, switched to a decimal system of money but stayed with the mother country in the matter of the physical units, the foot and the pound. As recently as 1914 the lion's share of world trade fell to countries with English weights and measures, but since then the share of the "metric bloc" has risen rapidly, and now our adherence to English standards constitutes a severe impediment to our export trade. But the enormous investment in our industrial plant makes a changeover extremely expensive.

It is too early to be sure, but we may discern the danger of a similar situation arising in programming languages. In the early years, and even today, computer development in the United States has been far more rapid than in the rest of the world. We were thus the first to develop higher-level programming languages, and we are now saddled with a sizeable investment in computer programs written in the early, and, therefore, less perfect, languages. Some day this may cause us to fall behind in comparison with the rest of the world.

Both producers and users are interested in standards which have international validity. For the producers, the reason is obvious; they wish to compete in the foreign market. For the users, the reason is less obvious, but actually even stronger. Although the volume of computer activity in Europe is small, the technical level of contributions to the theory and practice of programming is very high. The problems which programmers have to solve are, with few exceptions, the same in all countries. Interchange of computer programs across national boundaries, while still small in volume, is a practical thing today.

I have gone into the situation in so much detail in order to give an idea of what conflicting pressures we may expect, and particularly in what ways the field of computer languages differs from other industrial fields in which standardization is being attempted. I now propose to discuss first the form in which the American Standards Association has organized its effort for programming languages, then the present status of specific languages, the contributions of other organizations, and the outlook for future accomplishments.

The Standardization Effort of ASA

Subcommittee X-3.4 of the American Standards Association, charged with the standardization of common programming languages, is less than four years old. Like many other ASA committees, it has set up a number of working groups which deal with detailed technical preparation of various items on the committee's agenda. The full committee meets at intervals of one or two months, considers and discusses the reports of the working groups as well as some items of business coming in from other sources, and recommends items for action to its parent committee X-3. The working group structure, in other words the system of distributing tasks among the working groups, is not based on one logical principle, but is a hybrid of two principles. This situation has come about historically. It was thought originally that different working groups should attend to different aspects of the standardization process, each working group being assigned one aspect for all programming languages. Later on a need was felt for having one working group in charge of all the work on one particular programming language. As a result we now have some working groups concerned with individual languages, some with particular functions, and some with assignments of both kinds.

In addition to the working groups, which are at present eight in number, there is a Membership Committee, which screens applications from individuals who wish to become members, alternates or observers, and a Steering Committee, whose function has been compared to that of the Rules Committee in Congress. The Membership Committee also proposes the general rules which govern the admission of individuals, subject to approval of the main committee.

The voting members of X-3.4 serve as individuals, not as representatives of their companies or agencies. Furthermore, we have a rule that there can never be two or more voting members who are on the staff of the same company or agency. Additional persons from the same organization may, however, be admitted as alternates or observers, and as such take part in the debates, but without voting. Otherwise a person's technical qualifications and legitimate interest in problems of language standards are the only criteria for admission.

Working Group X-3.4.1 is concerned with the theory of languages and language standardization. It is thus a purely functional working group, not concerned with any particular language. It made most of its contributions in the early stages, by specifying the process of standardization, criteria to be applied at different stages, etc. It has produced or stimulated a large number of publications and sponsored or co-sponsored technical meetings. It has made studies of language structure and surveyed the existing organizations concerned with computer languages. At present it acts as a stand-by advisory group which we consult whenever a theoretical question comes up; this happens more often than one might think.

Working Group X-3.4.2 has several functions. First of all it is concerned with language specifications, i.e. with the way in which a language is to be described. This is a major problem, since the description of any one language is likely to fill a book. Next, X-3.4.2 is concerned with establishing criteria for the selection and evaluation of languages. It looks at a number of existing programming languages and decides which ones might make good candidates for standardization. If a language looks at all promising, a subgroup is set up inside X-3.4.2 which examines that language in more detail and arrives at a recommendation as to whether the language should indeed be considered in depth as a possibility for an American standard. If the recommendation is positive and if it is accepted by the parent committee, a new working group of X-3.4 is set up, outside of X-3.4.2, to deal with this language exclusively, and the responsibility of X-3.4.2 for this language ceases. The working group created for the language then concerns itself with all the detailed questions of which features are to be included in the standard and how they are to be described, and comes up with a document intended as a draft standard. This document is referred back to X-3.4.2 for comparison with its own criteria for language specifications. In this way we hope to achieve some uniformity both in the selection of languages for standardization and in their description.

Working Group X-3.4.3 is devoted entirely to one language, FORTRAN. Its accomplishments will be surveyed later in connection with discussion of individual programming languages.

Working Group X-3.4.4 has two assignments, one functional and one concerned with a specific language. This group is charged with the investigation of standards for processor specification, both hard and soft. In addition, as their initial effort, they are pursuing the standardization of COBOL. It is recognized that this in itself is a subset of their major responsibility and it is believed that the experience gained from the COBOL standardization effort will contribute substantially toward subsequent efforts in the general area of processor specification. In fact, this working group has spent most of its efforts on COBOL. Its progress will be discussed below.

Working Group X-3.4.5 is concerned with international matters. This is entirely a functional assignment. It includes (a) relations with the international standards organization (ISO); (b) backing up the American delegation to meetings of ISO Technical Committee 97, Subcommittee 5, which is concerned with programming languages; (c) in effect, Working Group X-3.4.5 has served as the Secretariat of ISO TC97 SC5.

Working Group X-3.4.6 is concerned with nomenclature; this is entirely a functional assignment. The group cooperates with Subcommittee X-3.5 (Glossary) by furnishing suggestions and criticisms on glossary items having to do with programming languages.

Working Groups X-3.4.7 and X-3.4.8 were organized just recently. They are concerned with APT and ALGOL, respectively. Previous to their establishment, a good deal of work on these languages was done by subgroups of X-3.4.2.

The Present Status of Specific Languages

In its almost four years of existence, X-3.4 has not yet produced a single concrete standard. This bald statement may cause some shock, and may further lead to the suspicion that the conflicting pressures to which I have alluded have tended to prevent the selection of any standards. To the best of my belief such a suspicion is entirely unfounded; the true cause for the long time lapse lies in the fact that a programming language is an incredibly complicated thing. It is probable that nothing even approaching it in complexity has ever been standardized. A language is far more than a list of macro-instructions together with a compiler which translates them into machine code. There must be, for each macro-instruction, a description which specifies what output the computer is to produce on receipt of this macro-instruction in all conceivable circumstances. The action which the computer is to take may depend on previous instructions, and there is an unlimited variety of ways in which instructions can be chained together. It is a difficult problem indeed to ascertain that all cases have been provided for and that no contradictions will occur.

In fact, it has been found repeatedly, when a language was being investigated as a candidate for standardization, that no satisfactory description of the language existed, or that the language itself or its implementation was deficient in serious ways. In such cases, development work is needed before standardization can take place. X-3.4 has taken the position that the work of developing computer languages, as distinct from standardizing them, is not its responsibility, nor a responsibility of ASA in general, but should be left primarily to the professional societies and other groups.

But Subcommittee X-3.4 and its working groups are actively cooperating with other groups in such development work, and are furthermore carrying on development work alone in cases where no other organization can be found for it.

To date X-3.4 has concerned itself with four specific languages: ALGOL, FORTRAN, COBOL and APT.

The standardization of FORTRAN is the object of a special working group, X-3.4.3. The group decided early that it would be necessary to standardize two different versions, similar to what is known as FORTRAN II and FORTRAN IV, so that the user will have a choice of two levels of language, one narrow, with few instructions, but easy to implement and compile on computers of moderate capacity, the other more comprehensive, allowing greater power to the programmer but more difficult to implement. The two standards are to be "upward compatible" so that a program written in the narrower language can be used with the compiler intended for the broad one, but not vice versa. Draft documents describing both languages have been prepared, copies of the tentative drafts have been distributed to interested parties, and their comments have been worked into the drafts. We are looking forward to early submission of these documents as proposed American draft standards. Furthermore, on the international level, the International Standards Organization is awaiting a U.S. FORTRAN proposal in the hope that an American standard may be agreed upon, which may be acceptable as an international standard without changes. It now seems likely that they will soon be presented with a recommended draft.

The effort on ALGOL was in the hands of a subgroup of X-3.4.2 until recently, when a separate working group X-3.4.8 was established for this language. There is strong interest in ALGOL in Europe and so the International Standards Organization has taken the lead in working on an international standard for ALGOL, while the American preference has been to wait for this to happen and then perhaps to adopt the international standard for the U. S. without change.

At the time when these strategies crystallized, two or three years ago, the most comprehensive version of the ALGOL language then in existence, known as ALGOL-60, had at least two major faults which, in the opinion of many, made it unsuitable as a standard. First, there appeared to be some unresolved inconsistencies. Second, no input and output instructions were defined; this was left to be done by the compilers. The latter objection was removed when a subcommittee of ACM, with the cooperation of X-3.4.2, developed a set of IO specifications. As a result, it was decided in May of 1964 to draft standards for ALGOL on two levels, with upward compatibility: one being the full ALGOL-60, the other a subset sufficiently restricted to remove the inconsistencies of the former. The standards are also to incorporate two levels of IO specifications, based on the ACM report and on work done by IFIP on the problem. These decisions are so detailed that no more than an editing job is still required to create a document suitable to serve as international standard.

COBOL has been assigned to X-3.4.4 along with the general problem of processor specifications. The difficulty has been that there is as yet no document in existence describing the COBOL language in a manner sufficiently clear and unambiguous for standardization. To accomplish their work in COBOL standardization, X-3.4.4 is subdivided according to four functions: (1) A working group to conduct COBOL implementation surveys. Work on the first survey is nearing completion and reflects the details of all COBOL 1961 implementations in this country. The purpose of the survey was to suggest the largest intersection of language elements to be included in the first level standard. (2) A working group to specify a set of COBOL programs to be used in order to determine whether a given implementation complies with the standard. These programs are initially designed to test the availability of a given language feature and subsequently will determine the validity of the final result. In no way are the programs intended to measure processor efficiency. (3) A working group to publish the X-3.4 COBOL Information Bulletin. The purpose of the CIB is rapid dissemination of information on COBOL standardization activity. To date four bulletins have been published and a fifth is currently being completed. (4) A working group to prepare the proposed draft American COBOL standard and its approved subsets. This group is currently working with the CODASYL COBOL Committee in a cooperative effort to develop and standardize these subsets.

APT is the most recent addition to the list of languages selected for standardization, and the preparatory work is not yet completed. A subgroup of X-3.4.2 had been at work for some time before the recent formation of a separate working group, X-3.4.7, which will now concern itself with the creation of a draft document.

At the same time the committee continues to consider other languages which seem promising for standardization.

Other Standards—Processing Organizations

While the American Standards Association has carried the largest share of the standardization effort, other technical organizations have contributed significantly. Although these organizations have widely differing structures and purposes, there has been a remarkable absence of jurisdictional disputes, overlap or other confusion which one might fear. On the contrary, all has been harmony and cooperation in regard to organization; what disagreements exist pertain to technical or economic matters, as they ought to. This happy state of affairs is due in great part to the fact that the same few individuals serve in all these organizations.

Association for Computing Machinery (ACM)

The Standards Committee of ACM cooperates in every way possible with X-3.4. Many of its members are also members of X-3.4. Its chairman is also editor of the Standards section of Communications of the ACM, which performs a most valuable service by keeping interested parties informed of every step in the standardization process. Various Subgroups of the ACM Computer Languages Committee are active in language development. This activity is of importance to standardization since in many instances the lack of adequate development is what prevents us from standardizing. In particular, the ALGOL subcommittee of this group has worked closely with the ALGOL subgroup of X-3.4.2 in developing input and output specifications for this language.

International Federation for Information Processing (IFIP)

This group (IFIP) and its U. S. adherent (AFIPS) take part in language development and thereby contribute greatly to standardization. AFIPS, or rather its predecessor, the Joint Computer Conference Committee, was probably the first organization in which standardization in the computer field was seriously discussed. IFIP has a number of technical committees, among which TC 2, concerned with programming languages, is of interest to us. In particular, IFIP-TC 2 has a working group for ALGOL, which has been actively engaged in the development of this language and deserves the principal credit for the formulation of the "full ALGOL" standard and one of its IO systems. Close cooperation between IFIP-TC 2 and X-3.4 is assured by overlapping memberships, a number of individuals holding positions in both organizations and contributing decisively to their work. Another technical committee, IFIP-TC 1, is concerned with the standardization of computer terminology.

Business Equipment Manufacturers Association (BEMA)

This organization of American producers of all kinds of office equipment acts as sponsor of ASA Sectional Committee X-3 on computers and information processing, and thereby furnishes some of the indispensable office support for X-3.4 and the other subcommittees of X-3. More importantly, some of the key members and staff of X-3 are BEMA staff members and play a vital role in keeping manufacturers interested in standardization.

European Computer Manufacturers' Association (ECMA)

Unlike BEMA, ECMA activities are almost exclusively concentrated on development and standardization in the computer field. Among its technical committees, TC 2 (General Programming Languages), TC 5 (ALGOL) and TC 6 (COBOL) work in the area of computer languages, ISO (see below) provides a common meeting ground between the ECMA and ASA committees.

International Standards Organization (ISO)

For almost 20 years ISO has served as the focal point for standardization on an international scale for a wide variety of goods and services. Forty-five countries are participating in its work. Among its numerous technical committees is one, TC-97, with the title "Computers and Information Processing." Its scope corresponds closely to that of ASA Sectional Committee X-3 with the same title. Like X-3, ISO TC-97 has set up a number of subcommittees, among which SC 5 (Programming Languages) corresponds to ASA X-3.4.

In few areas is the need for international validity of standards more thoroughly recognized than in computer languages. From the start X-3.4 and TC 97-SC 5 have been keenly aware of the overriding need for the closest cooperation in, and coordination of, all their activities. This has been achieved in several ways. First of all, many individuals hold positions in both organizations, so that there is mutual awareness of activities and motives in more detail than could be accomplished by merely exchanging documents. Secondly, ISO frequently relies on the adherent national groups for its technical work; the United States group, because of the dominant position of the United States in the worldwide computer market, has carried a large share of these responsibilities. Finally, each of the two organizations has shown complete willingness to take the activities of the other into account in planning its own work. Thus, as has been mentioned, the international standardization of FORTRAN and COBOL has been deferred pending action on the national level in the United States, while in the matter of ALGOL standardization, X-3.4 has concentrated on cooperating in the ISO effort in the expectation that its results may later be adopted as American standards.

Outlook

In conclusion, let me point to the two main difficulties which stand in our way and prevent us from progressing as fast as we should like to. One of these, which I have mentioned earlier, is the unusual complexity of the subject, both economic and technical: the multiplicity of interests and effects: the difficulty of describing programming languages and their associate processors: the difficulty of testing them and making sure of their completeness, consistency and compatibility. Another is simply the lack of manpower. X-3.4 has an extremely capable and enthusiastic group of committee members, but the really active ones are few in number and they are volunteers who take time out from their regular duties to work on standardization of programming languages. Because there are so few of them, almost everyone is carrying multiple assignments; and these same individuals also serve in the other organizations discussed in Section 4. We need more help.

A third difficulty has been a lack of funds for travel for participation in committee meetings. This has forced us to look for participants principally in a small geographic area, stretching from New York to Washington, D. C., and it has altogether prevented many capable and interested persons, especially in the academic world, from joining. In both ways it has aggravated the already critical lack of manpower.

By detailing these difficulties, I do not mean to say that I am discouraged. On the contrary, I am confident that despite delays we shall soon reach our objective of an adequate set of standard computer programming languages.

Acknowledgements

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"ACROSS THE EDITOR'S DESK"

Computing and Data Processing Newsletter

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APPLICATIONS

MAJOR U. S. GAS FIELD DEFINED ELECTRONICALLY

West Delta Block 27 Field, which is expected to develop into one of the country's major natural gas fields, has been defined electronically. Sumner B. Irish, President of Graftek, Inc., Princeton, N.J., reported that using custom-engineered programming with a newly developed computer system, the field's reserves were calculated to exceed 5 trillion cubic feet of natural gas. This marks the first time a petroleum reserve has been successfully detailed by a computer system.

The field covers some 14,588 acres in the Gulf of Mexico 70 miles Southeast of New Orleans. It is in lands submerged by the open waters of the Gulf of Mexico with an average depth of 25 feet. Calculations were made down to a depth of 16,000 feet. There were sands or reservoirs proven at various depths ranging from 8200 feet to 16,000 feet. Gulf Oil Corporation is the operator of the jointly owned properties with Humble Oil and Refining Co.

Using the operator's contour maps and empirical volume formula, it was possible to translate the graphics into itemized tabular data. The end result was a great detail of accurate and complete numerical information.

Mr. Irish explained the process: "In making our determinations and processing the graphics into machine language and then to a numerical report, the information was first put on data processing cards. Then the cards were put on a magnetic tape and fed into a computer along with a custom-engineered program. The computer then printed out all the tabular data required by the operator, including: the number of acre-feet of oil sands on each property; the metes and bounds descriptions; the maximum, minimum, and average thickness of each sand by property; and the share or participation in area and volume by each property in major and minor tracts. During the processing, there are several electronic and visual quality control points.

"As a recheck and for permanent records, we redrew with the computer, on a mylar map of all properties located over the field, the contours of the field. Thus the operator received not only all the tabular data required, but also a visual check of accuracy."

These calculations done manually would have required a large staff of engineers and draftsmen working over a period of about 3 months at twice the cost. In this case, the problems were solved within four weeks — with solutions starting to be fed back to the client within two weeks after receipt.

U. S. NAVY REPORTS ON USE OF COMPUTER FOR PRINTING ECONOMIES

The U. S. Navy has successfully used an electronic computer to prepare a 150-page training manual at a substantial savings. The use of an RCA 301 computer in producing the textbook was part of a continuing program being conducted by the U. S. Navy's Bureau of Personnel (BuPers), in cooperation with the Radio Corporation of America and the National Industrial Security Association, to reduce the cost of printing manuals. The production method used was a modified version of the system employed by leading newspapers in the United States.

The manual involved, a textbook for sailors seeking to attain the rating of Instrumentman Third and Second Class, was processed by the computer with a savings in composition costs of some 33 per cent compared with "hot type" composition methods. Only 171 minutes were required to punch and justify the lines for the eleven chapters in the manual. Because of the pilot-program nature of the operation, the tape was fed back into the computer to obtain hard copy, which required an additional 95 minutes.

Tape from the RCA 301 was fed into Merganthaler Elektron linecasters in the Government Printing Office, setting hypenated and justified body text in 10-point Bodoni type; headlines, subheads and captions were set in sanserif Tempo type up to 24 points.

The same technique can be used to produce negatives of positives for photo-offset reproduction, as well as "hot type" for letterpress composition.

RESEARCH ARM-AID, A COMPUTER-GUIDED DEVICE

A research arm-aid that can assist a paralyzed patient in many routine daily activities (such as eating and shaving) has been developed at Case Institute of Technology and Highland View Hospital, Cleveland, Ohio, as part of a joint medical engineering program. Funds for the research were supplied by the Office of Vocational Rehabilitation of the Department of Health, Education and Welfare.

The arm-aid system uses a series of computer programs to guide a splint which, in turn, moves the patient's arm in a variety of functions. In addition, electrodes and amplifiers pick up the bio-electric activity in a patient's shoulder muscle to activate his paralyzed finger muscles to obtain some use of the fingers in grasping. This appears to be the first time a paralyzed muscle has been effectively activated by amplified electrical signals originating in a muscle which is connected to the brain, thus constituting an artificial neural by-pass.

The arm-aid consists of four basic subsystems. One is the externally-powered splint capable of most normal motions which is adapted to the right arm of a paralyzed individual. The splint is powered by a high performance gas system using carbon dioxide under pressure of 600 pounds per square inch.

The second subsystem, the neural by-pass, picks up the weak electrical signals from the trapezius muscle of the shoulder, amplifies and changes them electronically, then applies them through a stimulator to activate the muscles in the lower arm. Thus the patient may grasp objects at will.

The third subsystem involves semi-automatic control and decision-making. Programmed instructions on magnetic tape are converted into signals which guide the movements of the splint. (Programs for the separate daily activities are tape recorded by moving the splint itself through a series of desired motions.) The patient may override the arm-aid voluntarily to make fine adjustments in spatial position.

The fourth subsystem involves a simple set of man-machine communication controls which enable the patient to select any one of the activity programs stored on the tape. A speciall-designed desk, capable of small movements in three dimensions for fine adjustments, has been designed for use with the arm-aid in such complex activities as eating.

Once a program is selected, the activity of the splint can be controlled by four eyebrow movements which activate delicate switches glued to the forehead. These switches directly control the splint. The over-ride system is controlled by beaming an infrared light source toward photo cells mounted on the arm splint. This light source is mounted on spectacle frames which the patient wears.

Using the arm-aid, it has been found that it is possible to eat an average hospital meal in as little as 30 minutes. Tests have been made on normal and quadriplegic patients. These tests have shown that the programmed motions feel normal and natural and the subject is not tired by the function of the arm-aid splint.

In its present form (a prototype used exclusively for research), the device is much too expensive for general patient application. Investigators hope that the research arm-aid will be the forerunner of devices and techniques which eventually will make life easier for the paralyzed and disabled.

COMPUTERS SPEED MIT ENROLLMENT

An old knot in college registration procedures was untied by a new computer system when 7000 students enrolled for the fall term at Massachusetts Institute of Technology, Cambridge, Mass. Processing of the freshmen and sophomores (chosen to test the new program) took place in a few hours instead of the previous two days or longer.

From ten IBM 1050 printers in two locations on campus, students addressed subject or section changes to an IBM 7094 computer in MIT's Computation Center. The computer instantly made the adjustments, and the students received their final schedules within a few minutes.

At the same time, at another location in the main building, a monitor received from the computer a running tabulation of department enrollment. There, heads of departments were able to check on the size and nature of classes within their departments, or a faculty member could ask for and immediately receive a given student's final schedule.

By the end of the day, MIT had complete information on its entire enrollment. The instant registration marked the first time that time-sharing and use of a direct hookup with the computer were applied to a problem of college administration.

BIGGER AND BETTER BEEF CATTLE PRODUCED BY COMPUTER ANALYSIS

The science of beef cattle breeding is being further refined through use of a computer to compare individual animals as well as the performance of each sire and dam in breeding. Performance Registry International (PRI) is using an NCR 315 computer system at National Cash Register's Denver (Colo.) data processing center to develop detailed hereditary records. Cattle producers who use the PRI service report a close connection between animals with high rates of calf production, rapid weight gain and quality of meat.

With the mass breeding of cattle characteristic of today's market, historical records of breeding become so involved that only a high-speed computer can keep track of them. Even the records for a small herd involve a great amount of paperwork. Prior to EDP methods, no one has been able to keep accurate tab on a large herd.

The computer at the center analyzes 14 hereditary traits which can be controlled by selective breeding for each animal, and prepares permanent breeding records for the year for each herd studied. Using the 315 computer, performance and progeny records for every animal in each herd becomes automatic from the time the animal is first weighed in. Producers merely send in to the data center the identification of mating pairs, and the weight records from various stages of growth and test. They receive the computer analyses in return.

Printed reports furnished to cattle breeders include: comparisons of calves over a 205-day period for weight gain; comparison and evaluation of the progeny of sires and dams with the rest of the herd; a history of each dam and sire and an analysis of the history; and an entire herd analysis with each animal listed from maximum production downward.

With the computer analysis, producers are able to cull out low-performing cattle and select superior specimens for herd replacements. By selecting breeding animals with superior traits, genetic improvements are uniformly carried to all succeeding generations, increasing the quality of the beef and the value of each animal. Use of the PRI system has resulted in up to 200 pounds difference in calves at weaning time, and has increased the number of calves in a herd by 10%. PRI officials said that cattle producers are realizing as much as $500 extra per animal when they can show a computer daily gain record as proof of performance.

BIOMETRIC RESEARCH AIDED BY LONG-DISTANCE COMPUTING

A long distance computing service, via customary telephone connections, is assisting the University of Miami's Biometric Laboratory uncover new knowledge about how the human brain works, and suggesting ways in which some baffling mental and physical illnesses can be treated.

The U. of M. laboratory has its own small in-house computer on which some of its analytical work can be accomplished. For the more complex problems an adequate solution can be determined only on a large-scale computer, none of which is currently available in Miami. The difficulty has been resolved through use of a long-distance problem-solving service offered by C-E-I-R, Inc., Washington, D.C. By means of normal long-distance telephone wires and a low-cost data transmission device, the Biometric Laboratory is using the large-scale IBM 7090 computer located 1100 miles away at C-E-I-R's Arlington, Va., research center.

The Biometric Laboratory is using the service on a daily basis. Average elapsed time for transmission of data from Miami to Arlington is from three to ten minutes. Once introduced into the 7090, the information may require from five to thirty minutes' processing time to arrive at the solution, which is then transmitted back to Miami over the wires.

The laboratory, under the direction of Dr. Dean Clyde, is currently involved in analyzing experimental and research data gathered from some fifty hospitals and universities across the nation under a grant from the National Institutes of Health. By employing various computer-based statistical techniques upon this raw data, laboratory staff workers have been able to discover new, significant patterns and symptoms associated with various kinds of diseases.

NEW CONTRACTS

BURROUGHS TO PRODUCE LETTER SORTING MACHINES

Postmaster General John A. Gronouski has announced plans to install 26 high speed letter sorting machines in 13 of the nation's largest cities — two in each city. Burroughs Corporation, Detroit, Mich., will produce the machines under a $2,916,406 contract. Work on the contract will be performed at the Corporation's Control Instrument Div., Paoli, Pa.

The multi-position letter sorters will be capable of distributing letters to 279 destinations at a speed of 43,000 envelopes an hour. The machines will be able to operate with Zip Code optical scanning devices now being developed for the Post Office Department. The scanners will examine the face of each envelope, locate the address, then instruct the letter sorter where to distribute the envelope.

Until zip code reading devices are available, each letter sorter will use 12 keyboard operators. With the aid of the keyboards, operators can sort mail for six times the number of destinations than was possible through use of the old manual pigeon-hole method — and in a fraction of the time.

Cities slated to receive the huge (77½ feet long, 12 feet wide, 9½ feet high) multi-position letter sorters are: Washington, D.C.; Boston, Mass.; Buffalo, N.Y.; Philadelphia, Pa.; Minneapolis, Minn.; St. Paul, Minn.; Portland, Ore.; Omaha, Nebr.; Miami, Fla.; Cincinnati, Ohio; Houston, Texas; St. Louis, Mo., and Los Angeles, Calif.

CDC AWARDED CONTRACT BY WESTERN UNION

Control Data Corporation, Minneapolis, Minn., has been awarded a contract by the Western Union Telegraph Company for delivery of Control Data 9103 Magnetic Tape Stations for use in the domestic expansion of Autodin (Automatic Digital Network). Western Union is the prime contractor and systems manager for Autodin, which serves the Department of Defense.

Autodin's expansion program will add four new switching centers to the existing five and will serve all defense department agencies through approximately 2000 tributary stations. The magnetic tape stations will be installed in the four new locations. The entire purchase price of the magnetic tape stations is in excess of $1.2 million.

MULTI-MILLION CONTRACT AWARDED UNIVAC

A $17 million contract has been awarded the UNIVAC Division of Sperry Rand Corp., St. Paul, Minn., for work on the Army's Nike-X Anti-missile Missile System. The contract with the Bell Telephone Laboratories, Inc., Whippany, N.J., calls for design and development of multi-processor computers and computer memories for the Nike-X data processing subsystems. The new contract increases the dollar amount of UNIVAC input to the Army's anti-missile missile programs over a six-year period to approximately $60 million.

Bell Telephone Laboratories is responsible for Nike-X System design and development. Western Electric Company is system prime contractor under cognizance of the Army Materiel Command.

COMPUTER SYSTEMS, INC. AWARDED CONTRACT FOR HYBRID SYSTEM

Computer Systems, Inc., Richmond, Va., has been awarded a contract for a hybrid computation system for the National Institutes of Health, Bethesda, Md. The equipment, scheduled for installation in the spring of 1965, will be used in biological research programs.

The system will consist of the 3100 general purpose digital computer manufactured by Control Data and the SS-100 analog computer produced by Computer Systems. These two computers will be linked by means of the CSI HL-20 Hybrid Linkage in a system providing computing capabilities particularly suited to handling a wide array of biological research problems.

DOC INC RECEIVES CONTRACT TO CONVERT BALTIMORE COUNTY LIBRARY SYSTEM

The Baltimore County Public Library card catalogs will be converted to reference catalog volumes produced by a computer-driven indexing and printing system under a contract signed recently with Documentation Inc., Bethesda, Md. Under terms of the contract, DOC INC will deliver the converted book catalogs to the library by December 31st of this year. The finished product will be six printed volumes, containing a listing of every title in all branches of the total system.

Each of the system's 13 branches, three bookmobiles, and all county public schools will have complete records of all books available in the entire county public library system. To meet the requirements of the Baltimore County Public Library System 200 copies of each of the six volumes will be supplied by DOC INC.

In addition to the initial conversion, the company will provide on a continuing basis supplements of the library's acquisitions, presently averaging about 1200 titles monthly.

CONTRACT FOR DATA HANDLING SYSTEM

Consolidated Systems Corp., Pomona, Calif., has received a contract for a Data Handling System believed to be the first to use, simultaneously, two large digital computers to control telemetry data acquisition, conversion, and reduction. The contract, in excess of $1,600,000, was awarded by AETRON, a division of Aerojet-General Corp., for installation in the Data Handling Center of the NASA-Mississippi Test Operations in Hancock County, Miss.

INFORMATICS INC. RECEIVES CONTRACT FROM ROME AIR DEVELOPMENT CENTER

Informatics Inc., Sherman Oaks, Calif., has received a contract from the United States Air Force, Rome Air Development Center, to provide additional capabilities for an on-line computational system. Computer programming procedures are eliminated. The system allows direct use of a digital computer by a mathematician or scientist to solve problems in his field of specialization.

CHASE BRASS ORDERS FOXBORO PROCESS CONTROL COMPUTER SYSTEM

A contract award for an on-line digital computer system has been awarded to The Foxboro Co., Foxboro, Mass., by the Chase Brass & Copper Co., a subsidiary of Kennecott Copper Corp. Installation of the process computer will be at Chase's new brass rod mill near Montpelier, Ohio.

The Model 97600 computer system will combine process control with business calculations, making it the first application of its kind in the nonferrous metal industry. Installation of the computer is scheduled for the spring of 1965.

C-E-I-R AWARDED ARMY CONTRACTS

The U. S. Army has awarded two contracts totaling $628,390 for statistical consulting and research services for biological and chemical weapons systems to C-E-I-R, Inc., Washington, D.C. The contracts provide $440,390 for a two-year extension on work performed over the past five years for the U.S. Army Test and Evaluation Command at Dugway Proving Ground, Utah, and $188,000 for services to be performed for the U. S. Army Material Command at Fort Detrick, Md.

A major part of the work on both contracts will be done by C-E-I-R personnel stationed on site, with support from various C-E-I-R research centers.

CONTRACT FROM NASA FOR ANALOG-DIGITAL SYSTEM

Beckman Instruments, Inc. (Richmond, Calif.) and Scientific Data Systems, Inc. (Santa Monica, Calif.) have received a contract in excess of $1 million from the National Aeronautics and Space Administration for an analog-digital computer system to be used for the "real-time" simulation of orbital trajectories, the study of interplanetary space probes and to simulate the physiological reactions of astronauts while traveling in space.

The Beckman/SDS system will include a Beckman 2200 analog computer and SDS 9300 digital computer linked with a standard interface. It will be assembled at Beckman's Richmond facility and is scheduled for delivery to NASA's Manned Spacecraft Center, Houston, Texas, early in 1965

NEW INSTALLATIONS

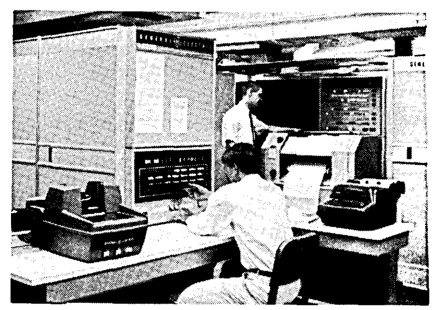
TWO DDP-24 COMPUTERS DELIVERED FOR APOLLO ASTRONAUT TRAINER

Computer Control Compnay, Inc., Framingham, Mass., has delivered the first two of four DDP-24 general purpose digital computers to Decision Systems, Inc., Teaneck, N.J. The computers will help train Apollo program astronauts for their flight to the moon.

Decision Systems is preparing the programs through which 3C's DDP-24 computers (costing a total of $1.4 million) will drive equipment simulating tasks and sensations of an entire Apollo mission. Two simulators are being built by the Link Group of General Precision, Inc., for North American Aviation, the Apollo prime contractor to the National Aeronautics and Space Administration.

COMPUTER AND 16 I/O STATIONS ON CAMPUS AT DARTMOUTH

At Dartmouth College, Hanover, N.H., about 75 per cent of all students from nearly every field of study in the liberal arts curriculum have quick and easy access to a computer system with remote input-output.



The college recently installed a GE 235 medium-range computer connected with 16 input-output stations located at various campus sites. Connections with the computer are by Teletype through a General Electric Datanet-30 which monitors the incoming programs and 16 remote input-output stations.

Shown in the picture is the GE-235 and Datanet-30, along with peripheral equipment, in the central computer room.

PROTOTYPE SYSTEM DELIVERED TO ROME AIR DEVELOPMENT CTR.

A prototype of a computer-centered information storage and retrieval system, developed by the UNIVAC Division of Sperry Rand Corp. for a new Limited Warfare Intelligence Reduction Complex (LWIRC), was delivered recently to the Rome Air Development Center, Rome, N.Y. The computer system is installed in air-transportable shelters which can be air-lifted to remote areas by cargo-type aircraft or helicopters. The system may be expanded quickly and simply by addition of shelters, depending on the level of computational assistance and information storage required at the site.

A UNIVAC M1218 computer is the nerve center of the system which also includes displays, a mass memory subsystem, paper and magnetic tape units. The Air Force calls it the electronic data processing module of the mobile wing reconnaissance technical squadron which forms part of the LWIRC.

The prototype system will be used to evaluate real-time methods of extracting and interpreting data collected and recorded by high-speed, all weather tactical aircraft.

NYU WILL INSTALL PDP-7 IN NEW SCIENCE LABORATORY

New York University, New York, N.Y., has purchased a Programmed Data Processor-7 computer from Digital Equipment Corp., Maynard, Mass. The PDP-7 will act as the nucleus of a systems science laboratory where undergraduate and graduate students can experiment with computer applications and develop new engineering methods. Undergraduates will experiment with known applications for computers and design experimental systems for new applications. Graduate students will gain in the laboratory the experience needed to develop new ways of solving engineering problems.

The PDP-7 is a small, general-purpose computer. It uses 18-bit words and can work with from 4096 to 32,768 words of 1.75-usec. core memory. Peripheral equipment will include a tape reader, tape punch, and incremental cathode ray tube display and four slave displays, light pen, and a data communication subsystem.

ELM FARM FOODS CO. TO INSTALL H200 SYSTEM

Elm Farm Foods Co., Boston, Mass., a leading New England retail grocery chain, is installing a Honeywell 200 computer system to provide purchasing, billing and inventory support for more than 80 regional food stores. The H-200 will control a complex wholesale distribution system (the only one of its type in New England) that Elm Farm maintains for 40 independent retailers and smaller food store chains in Maine, New Hampshire, Massachusetts, and Rhode Island.

The computer, in a management information system, will control the movement of more than 6000 products to the stores and automatically prepare marketing reports, product analyses, manufacturers listings and detailed billing data.

The system will consist of a central processing unit with 12,288 characters of memory, five magnetic tape drives, a high-speed printer and a card-reader punch. It will lease for $6000 a month.

COLORADO STATE INSTALLS IBM 1401

Colorado State University, Fort Collins, Colo., has installed an IBM 1401 computer system which includes in addition to the main console, a card reader and punch, disc file, magnetic tape printer, inquiry station, a printer and teleprocessing unit.

The teleprocessing unit is connected to a large computer at UCLA in Los Angeles, Calif. Anything the 1401 can't handle is referred there for the answer. The teleprocessing system is paid for by a grant from the Western Data Processing Center, of which CSU is a member.

The computer will be used not only by all departments on campus for research, but as a teaching tool. Programs are being offered this year on operating the computer and its programming.

BATTELLE EXPANDING DIGITAL FACILITIES

Battelle Memorial Institute, Columbus, Ohio, is installing a Control Data Corporation 3400 computer. This will replace the Control Data G-20 computer now in the Computation Center at the Institute's Columbus Laboratories. The CDC 3400 is scheduled to be in operation by April 1965.

Expansion of the digital computer facilities were made necessary by increased research demands, particularly in the areas of simulation and mathematical modeling to develop decision-aiding tools for management. Battelle's present computer is being used on approximately 100 research programs a month. Based on the increasing activity of the past few year, this use is expected to double within two years.

RCA COMPUTER INSTALLED TO STREAMLINE FLORIDA SCHOOL SYSTEM

Florida's Department of Education has installed an RCA computer system to obtain up-to-the-minute performance reports on the State's 1900 schools and its thousands of teachers and students. The system is designed to keep track of just how well each school is performing its function, whether teachers are meeting State standards and to electronically evaluate how students are progressing. The computer system, which is built around an RCA 301 computer, uses two RCA 3488 random access memory units with a total storage capacity of more than half a billion characters.

NCR 315 INSTALLED BY ITALIAN APPLIANCE MANUFACTURER

Societa Industria Refrigeranti Ignis (IGNIS), one of the largest manufacturers of refrigerators, washing machines and kitchen ranges in Italy, has installed a National Cash Register 315 computer system.

The system eventually will schedule appliance production for three plants. It now is processing records for 10,000 customer accounts and preparing invoices, sales analyses, tax journals and sales statistics. IGNIS also plans to use the computer system for controlling inventory in 34 warehouses, for cost accounting and for processing the payroll for 2500 employees.

The system includes a central processor, paper tape readers and punch, high-speed printer, and two CRAM (Card Random Access Memory) units. IGNIS purchased the computer system from NCR's Milan offices.

IBM TELE-PROCESSING SYSTEM INSTALLED BY BOSTWICK-BRAUN

Bostwick-Braun Co., Toledo, Ohio, has installed a computer system which controls hardware and industrial supply order processing and inventory. Installation of an IBM 1440 random access computer at the local hardware and industrial supply distribution firm is enabling the company to speed customer orders, minimize out-of-stock items, and reduce inventory costs.

The computer is fed information through IBM 1001 data transmission terminals located at customer outlets. These terminals are linked by ordinary telephone lines directly to headquarters. Customers may send orders directly and at any time to the computer. Once an order processing cycle is started by entry of a punched card, the computer takes over and handles all necessary details without interruption. All customer and inventory information is stored in IBM 1311 disk packs.

B. F. GOODRICH FOOTWEAR ORDERS RCA 3301 SYSTEM

B. F. Goodrich Footwear Co., Watertown, Mass., has ordered an RCA 3301 Realcom system to provide increased speed and flexibility in processing information for management control. The new system will be applied initially to the processing of automatic allocation of inventory to orders, production planning and scheduling, and work ticket preparation.

The system includes the 3301 data processor, 12 magnetic tape units, 2 high-speed printers, a card reader-punch and other equipment and controls. Delivery is scheduled for late this year.

PDP-5 COMPUTER USED BY CARNEGIE TECH PHYSICISTS

Carnegie Institute of Technology, Pittsburgh, Pa., has installed a general-purpose Programmed Data Processor-5 computer purchased from Digital Equipment Corp., Maynard, Mass, for use in the institute's Nuclear Science Laboratories. The computer is expected to help centralize the processing of data from bubble chamber experiments.

In this research, nuclear particles derived from an accelerator mark their passage through a bubble chamber by tracks of bubbles. Photographs of these tracks can then be examined by investigators to detect unusual interactions and their effects. Film readers are used to convert the visual information on the photographs into numerical data for processing on a computer.

PHH TO INSTALL HONEYWELL 200

Peterson, Howell & Heather, Inc. (Baltimore, Md.), one of the nation's largest automobile fleet management and leasing companies, will install a Honeywell 200 business computer in its headquarters next February. PHH handles more than 85,000 vehicles for industrial and commercial organizations.

The H-200 will be used to simplify and expedite billing, statistical, purchasing and quality research activities as well as to calculate and evaluate automobile and travel expenses incurred by client companies.

The system will include a central processor; five magnetic tape units; a high-speed printer; and a card reader/card punch unit.

DDP-24 COMPUTER TO CONTROL TRANSIT SYSTEM

Computer Control Company, Inc., Framingham, Mass., has received an order from the Union Switch and Signal Division of the Westinghouse Air Brake Company (WABCO) for a DDP-24 general purpose digital computer. The computer will be the heart of a mass transit supervisory and control system which electronically surveys traffic conditions and instructs trains where and when they may travel. A stored program in the DDP-24 with daily scheduling information allows train routing to be conducted automatically.

The computer will be used in a demonstration of Automatic Train Operation for the San Francisco Bay Area Rapid Transit District, San Francisco, Calif.

100TH NTDS COMPUTER SHIPPED TO BOSTON NAVY YARD

The 100th Naval Tactical Data System (NTDS) computer has been shipped to the Navy Ship Yard at Boston, Mass., by the UNIVAC Division of Sperry Rand Corporation. Built under contract with the U. S. Navy Bureau of Ships, the Department of Defense designated AN/USQ-20 computers have been installed on board cruisers, destroyers, carriers, and major naval shore-based centers.

NTDS is a multi-computer combat direction system. It automatically coordinates, correlates and evaluates data gathered from sensors and communications links. The information is processed and presented for recommended command action.

FLORIDA TURNPIKE AUTHORITY WILL USE RCA 301 SYSTEM

Toll and service area revenues from the Sunshine State Parkway — one of the nation's largest turnpikes — will be processed by an RCA 301 data system. Basic information for the computer will come from the card a motorist receives as he starts the turnpike portion of his trip and which is returned with the proper toll payment as he leaves the Parkway. Use of the system will put the Turnpike Authority's toll auditing function on a daily basis.

The RCA system also will be used to: update and make readily accessible records on the Turnpike right-of-way, which has been declared a federal game preserve; prepare the pay checks for the Turnpike Authority's personnel; and provide a current breakdown for each department in the Authority on such details as operating expenses, maintenance costs, and personnel requirements.

M.I.T. SCIENCE LAB INSTALLS SECOND PDP-1

The Laboratory of Nuclear Science at Massachusetts Institute of Technology has installed a Programmed Data Processor-1 computer (Built by Digital Equipment Corp., Maynard, Mass.) to control the laboratory's Precision Encoding and Pattern Recognition (PEPR) system.

PEPR is an electro-optical system under development at the laboratory for use in classifying data obtained by photographing subatomic particle paths in a bubble chamber. It is expected to be in operation late this year. If it performs as expected, it will have a marked impact on existing methods of processing nuclear physics data.

EDUCATION NEWS

NEW COMPUTER STUDY OFFERED AT CSU

A Manpower Development Training Act (MDTA) class in computer programming is now underway in the department of business at Colorado State University, Fort Collins, Colo. The program is made possible under the MDTA of 1962. Contracts to provide training are made with the Department of Health, Education and Welfare through the State Board of Vocational Education. Once the funds are made available, the Department of Labor — through the State Employment Security Service — tests, interviews and selects participants.

The program, covering a period of 50 consecutive weeks, is designed to prepare those successfully completing the work for job entrance as computer programmers. A class of 25 begin each 8-hour day of instruction and labs at 7 a.m.

The course of study, developed by members of the CSU department of business, includes some training in: mathematics, statistics, accounting unit record equipment system analysis, business data processing applications, computer programming, office management, business communications and human relations. Approximately 60 hours of on-hand instruction will be given on IBM unit record machines. Extensive training in actually programming the IBM 1401 also will be given each participant.

NEW PRODUCTS

Digital

EDUCATIONAL DIGITAL COMPUTER

A low-cost, solid-state digital computer, designed specifically for teaching digital computer programming, applications and computer maintenance, has been developed by Digital Electronics Inc., Westbury, L.I., N.Y.

The new educational digital computer, known as the Digiac 3080, is designed to teach the high school, vocational school or college student all aspects of computer programming, problem-solving and maintenance techniques. It will prepare him for either a job in industry as a programmer or with a background that will enable him to use the tools available to him in industry.

Digiac 3080 is a complete teaching system which includes its own IBM Selectric typewriter for direct input-output, a paper tape punch and reader, and a control console. The computer has a magnetic drum memory for internal storage with a capacity of either 1024 or 4096 words. A FORTRAN compiler, especially designed for training, will be available.

There are 105 instruction operations including addition, subtraction, multiplication, division, logical multiply, shift (left and right) and punch. Typical operation times are: 1½ milliseconds for add/subtract; 8 milliseconds for multiplication; 8 milliseconds for division and an average access time of 9 milliseconds.

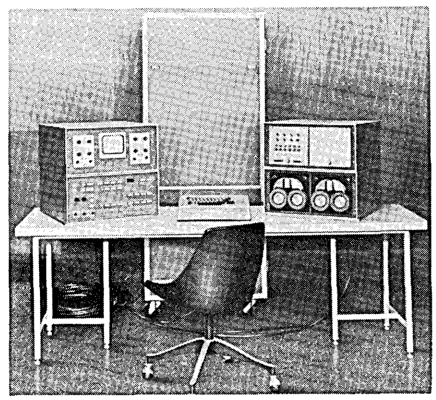
When used for training purposes, the Digiac 3080 will enable the student to learn computer logic, understand computer circuits and perform basic trouble-shooting. In the final instruction phases of the program, the student will actually perform malfunction analysis problems which will enable him to repair the computer.

The new educational computer is a full size computer which (because of its low initial cost of under $15,000) will find many applications in almost every industry ranging from small accounting departments to individual scientists or engineers with only a part-time requirement for the services of a digital computer. (For more information, circle 30 on the Readers Service Card.)

MIT's LINC COMPUTER OFFERED BY DIGITAL

Digital Equipment Corp., Maynard, Mass., has announced that it is building and selling the first commercially available version of LINC, the digital computer designed at Massachusetts Institute of Technology for biomedical research. The LINC (for Laboratory INstrument Computer), built to specifications recently made public by M.I.T., has all the features of the original machine, and can use all existing LINC programs. More than two dozen machines, constructed earlier in the development program under M.I.T. guidance, have been in use for a year or more at laboratories throughout the country.

LINC is small enough for the individual researcher to operate, program, maintain, and administer. Amplifiers, timers, plotters, and many other laboratory instruments can be connected directly to LINC'S built-in conversion equipment. It is fast enough to do simple data processing operations while actually gathering data during an experiment. Its logic structure permits its user to perform complex calculations on the data afterward.



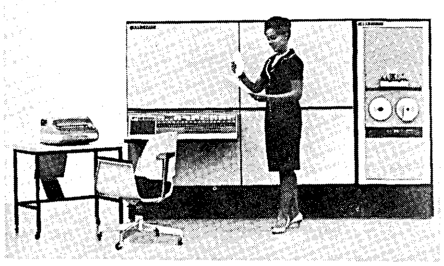
The LINC has front-mounted controls, indicator lights, and connector panels; a built-in cathode ray tube display, magnetic tape system, analog-to-digital converters, and keyboard input. It's random access, core memory of 2048 12-bit words cycles in 8 microseconds. The 16 analog input channels accept up to 30,000 signals per second, convert them into 8-bit digital numbers, and store them in memory. The 48 instructions in its order code perform high-speed multiplications, half-word manipulations, tape operations and other functions.

Basic system programs including an assembler, will be included with the system. Programs generated by present LINC users are shared through a pool administered by the LINC development group. (For more information, circle 31 on the Readers Service Card.)

ASI INTRODUCES NEW FAMILY OF COMPUTERS

A new line of digital computers for scientific, engineering and on-line systems applications has been announced by Advanced Scientific Instruments (ASI), Minneapolis, Minn. The new systems have characteristics which specially suit them to design, systems analysis, and on-line computation in the aerospace, nuclear, and general scientific and engineering fields.

The ADVANCE 6020, a small scale system, and the ADVANCE 6040, a larger high-performance machine, are the first two members of the new family. Both computers have a 1.9 usec memory cycle time and a word length of 24 bits plus parity. The 6040 contains a high-speed arithmetic section which allows 9.5 usec multiply, and 11.5 usec divide instructions.



— ADVANCE 6020

Both systems have a complete line of peripheral equipment comprising high and low density magnetic tape units, card readers and punches, paper tape system, input/output typewriter, line printers and incremental plotting systems. Both systems also have a new package of tested programming aids which includes a one-pass Fortran compiler and a one-pass symbolic assembler.

All computer systems of the ADVANCE Series are upward compatible in both hardware and software.
(For more information, circle 32 on the Readers Service Card.)

Memories

FABRI-TEK PREMIERES NEW MEMORY CONCEPTS AT FJCC

Fabri-Tek Incorporated, Minneapolis, Minn., has shown a new mass memory concept, a plug-in integrated memory system, and a modular thin-film design concept at the Fall Joint Computer Conference held last month. Also developed by Fabri-Tek is the Series MF one-microsecond, coincident-current memory system which was introduced at the SJCC.

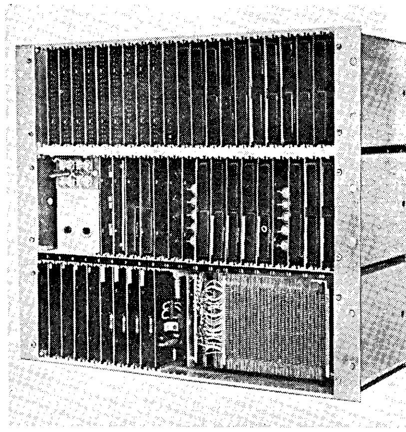
The new mass memory concept provides 18.9 million bits arranged in a "window-frame" stack of 64 planes. Each plane measures approximately 5 feet long by 13 inches wide with 72-64 x 64-bit sub-plane insets. Cores used are 30 x 18 mils, strung on 40 mil centers. The entire system is approximately 6' square by 24" deep with "Y" selection circuits stacked on boards adjacent to the memory planes and "X" selection plus power supply mounted in the middle of the "window-frame" design.

The plug-in, integrated memory system uses integrated circuits in memory logic to take maximum advantage of their low cost, low power consumption, and space saving capabilities. This new memory concept is available as a plug-in unit to provide the basic "heart" of a memory system with memory stack, drivers, selection circuits, and sense amplifiers packaged in one compact unit. The necessity of level changing circuits is eliminated by selecting integrated circuits to match the same components used in the rest of the customer's equipment.

The thin film modular design concept gives freedom of choice to the systems designer as to the level of thin-film memory equipment complexity he is able to purchase. To do this, Fabri-Tek has divided the FFM202, 150 nanosecond access-time, thin-film memory system into three modules, offering: a stack alone; a stack with driver, selection, and sensing circuits; or a complete system with power supply, address and output registers, indicators and self-test circuits.
(For more information, circle 33 on the Readers Service Card.)

THE 52.02 MEMORY SYSTEM BY FERROXCUBE

The newest addition to Ferroxcube Corporation of America's (Saugerties, N.Y.) line of coincident current, random access memory systems is the 52.02 Memory System, with a read/write cycle time of 2 microseconds and an access time of less than 1 microsecond. The 52.02 is available with capacities up to 16,384 words, each 52 bits long. It has low temperature coefficient cores and silicon semiconductors to provide an operating temperature range from 0°C to +65°C. All logic circuitry is hermetically sealed. Logic functions are performed by diode-transistor NAND circuitry with levels of 0 and +6 volts.



The device is capable of operating in a variety of modes: read/restore, clear/write, and split-cycle. Input/output circuitry, capacity, and power requirements are available to meet virtually all memory system applications.
(For more information, circle 34 on the Readers Service Card.)

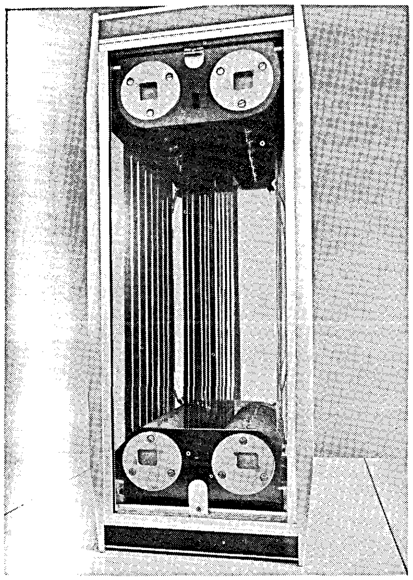
RANDOM ACCESS MEMORY BY POTTER

Potter Instrument Co., Inc., Plainview, L.I., N.Y., has developed a new random access memory system. The Potter RAM®, a random-access cartridge-loading storage device, has a storage capacity in excess of 50 million alphanumeric characters. It is reputed to be 50% faster in all modes of operation than any presently used system.

The Potter RAM, identified as Model TLM-4505, is the first random-access memory system to provide a check-read-after-write capability. Addressing at random with this capability averages under 100 milliseconds, 20% faster than presently available systems.

Continuous loops of standard computer-grade magnetic tape form the basic storage element. Tape loops are assembled in a new TAPE-PACK® Cartridge (Model AC-8606) supplied by Potter. Cartridges are interchangeable permitting processing of many different files on one machine. Files can be interchanged in approximately 17 seconds.

Long machine and cartridge life is achieved by using air-floated techniques for the tape loops. The recording medium never makes contact with any solid material. The storage medium flies over the head, thus avoiding the difficulties of flying head techniques and a rigid recording surface. The loops are driven by a non-slip capstan and all other parts of the loop are air-floated.



— Tape cartridge, showing 16 loops totaling 50 million bits of information.

Information is recorded serially, in a multiplicity of tracks on each loop, and any information located can be written or read at random by transmitting address information to the machine.

Cartridge-loading random-access memory systems are for use with medium and low-cost digital computer systems wherever rapid access to a volume of information, too large to be accommodated economically by ferrite core memory devices, is required.

Following are some pictures showing the construction and operation of this memory device, which bridges between the magnetic tape reel and the magnetic drum.

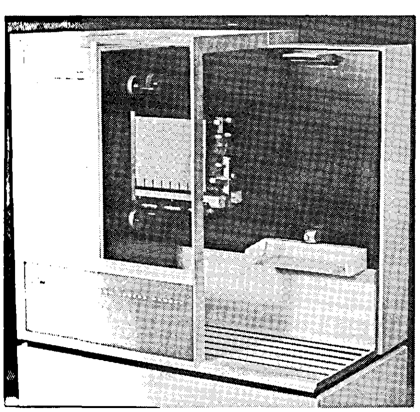


Fig. 1. The random access memory unit ready to accept the interchangeable tape-cartridge.

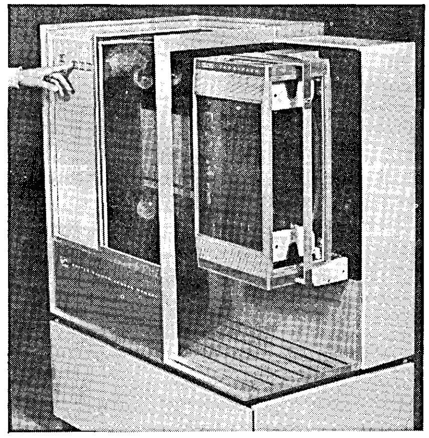


Fig. 2. When the button is pressed, automatic loading proceeds — the tape cartridge and the drive assembly being brought together.

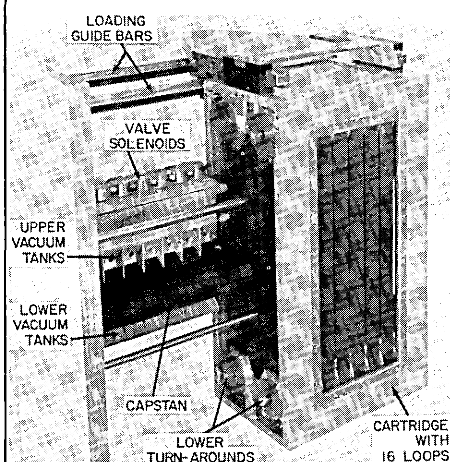


Fig. 3. The mechanical eouipment that mates with the tape cartridge.

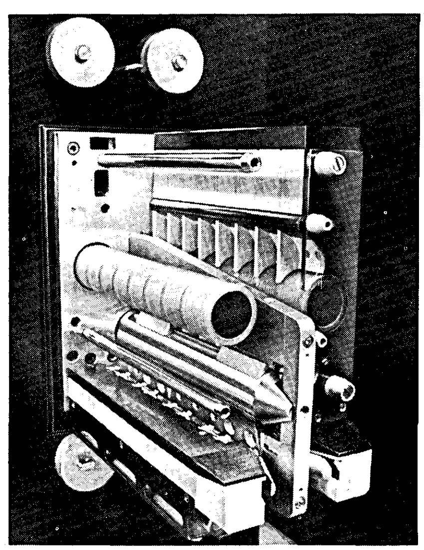


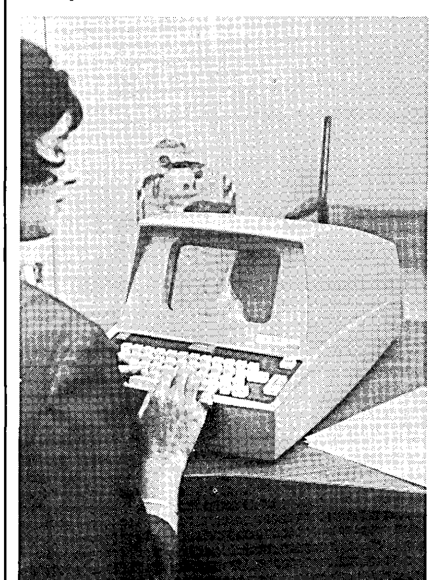
Fig. 4. This shows the multiple drive block assembly in detail. The dark cylinders are two capstans, which drive all the tape loops at the same time. The long, fluted, metal cylinder below them is the write/read head post assembly. It moves in or out longitudinaly.

Typically, the tape is two inches wide and has 48 tracks serially recorded at 1000 bits per inch; the total length of each of the 16 loops is 38 inches.
(For more information, circle 35 on the Readers Service Card.)

Data Transmitters and A/D Converters

TWO-WAY, MAN-MACHINE DATA COMMUNICATIONS SYSTEM

A long-distance, two-way, man-machine data communications system has been developed by Information Products Corp., subsidiary of Renwell Industries, Inc., South Hadley Falls, Mass. The system, called BuCom, consists of a compact, desk-top interrogator-display unit and a long-distance, high-speed Data phone link with any computer where business data is centrally stored and processed.



The system was demonstrated in New York by officials of IPC and of Renwell, who asked questions of a Univac 490 computer in Pittsburgh and received instantaneous answers visible on the display screen. The long-distance communication capability provided by the BuCom system permits companies with widespread operations to have the advantages of high-speed random access data processing and still have all records instantly accessible to operational and management personnel.

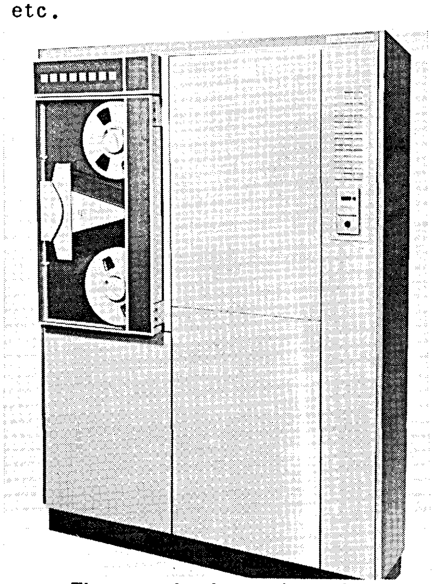
Renwell President Henry L. Shensky reported that BuCom techniques also are being applied to inventory control, production scheduling, traffic scheduling and control, and financial and management reporting.
(For more information, circle 37 on the Readers Service Card.)

MODULAR TERMINAL FOR MAGNETIC-TAPE DATA TRANSMISSION

Digitronics Corporation, Albertson, N.Y., has developed a new modular Magnetic Tape Terminal, called D522.

This terminal allows the user to select initially those modules which meet his current requirements and to add, in the field, at low cost, any additional modules needed as the needs appear, or drop those modules he no longer needs.

The terminal is a solid-state data-communications device that transmits or receives on computer-compatible magnetic tape using ordinary voice-grade telephone facilities. It can transmit bi-directionally, magnetic-tape-to-magnetic-tape, magentic-tape-to-paper tape, magnetic-tape-to-punch-cards, and magnetic-tape-to-printer. There are no code restrictions on the customer's data. It can convert paper-tape-to-magnetic-tape, etc.



The standard terminal includes a magnetic-tape handler, a 1024-character core memory buffer, a coupler for Reverse Channel or "turn-around" subsets, two visual block counters, and a control panel. Modules which can be added after installation give the device the ability to handle paper tape, punch cards, hard copy, and other off-line functions.
(For more information, circle 38 on the Readers Service Card.)

IBM 1026 TRANSMISSION CONTROL DEVICE

A new low-cost communications device has been developed by IBM Corporation, White Plains, N.Y. It has been designed to bring the cost of on-line data transmission and computer processing within the range of smaller users. The new IBM 1026 transmission control unit provides, on a smaller scale, the same Tele-processing capability already available to users with more extensive data processing systems and more powerful control units.

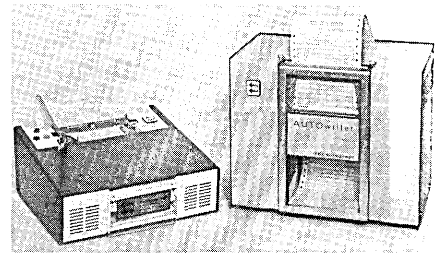
Linked to IBM's 1401, 1440, 1460 or 1240 data processing systems, it enables the computer to exchange data with: IBM 1030 data collection systems; IBM 1050 data communications systems; IBM 1062 teller terminals; and IBM 1070 process communications systems. The 1026 can accept information from remote terminals, enter it into a centrally-located computer for processing and transmit information or computer responses back to the originating location seconds later.

The device translates incoming data from communications code to computer language, checks for transmission errors, and uses its 210-character buffer to assemble incoming and outgoing messages. Terminals can communicate with the 1026 over leased communications lines as well as conventional facilities. Up to four 1026s can be attached to a computer, each with one line capable of handling several terminals.
(For more information, circle 39 on the Readers Service Card.)

MESSAGE WRITING AT A DISTANCE

In the Autowriter made by Telautograph Corp., Los Angeles, Calif., a ballpoint pen:

— turns on the transmitter and all connected receivers;
— turns them off at the end of the message;
— copies the message — words, sketch, or diagram — directly



on paper at the receiving station while the message is written at the transmitting station;
— provides audible signals when the message is urgent.
(For more information, circle 40 on the Readers Service Card.)

Numerical Control

DIRECT DIGITAL CONTROLLERS FROM 3M

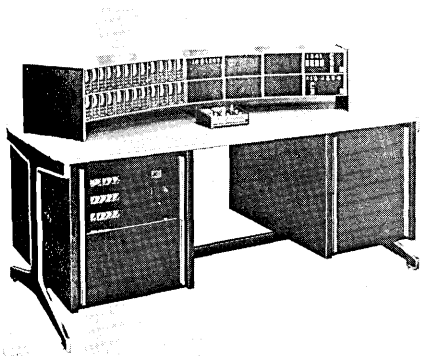
Two direct digital control systems, for economical application of digital techniques to process control, are available from 3M Company, St. Paul, Minn. The 3M Direct Digital Controllers, under the brand name DigiTele, are time-shared digital process controllers offered as complete units designed for industrial applications. They are used to control process variables — such as temperature, pressure and flow — to desired values and to regulate them despite upsets which cause variables to deviate from the desired set point.

The desk console computer/controller is one compact device providing 24 loops of direct digital indicating control, computer capability for data formatting, logging and set point calculation, alarming and convenient manual operation of all controls, readouts and adjustments.

Direct digital controllers from 3M accept digital or analog inputs, including millivolt signals and provide 1-5, 4-20 or 10-50 M.A. output control signals. The controllers link any computer and the process to be controlled. Overall accuracy is plus or minus 0.25% and resolution is plus or minus 0.1% of full scale.

The DigiTele system uses individual output modules, each of which accepts the digital error signal and develops its own Reset or Reset plus Proportional signal.

In addition to use as controllers, the DigiTele DDC systems are directly applicable to Multiple Indicator and Data Logging applications. All systems also are optionally available with interface

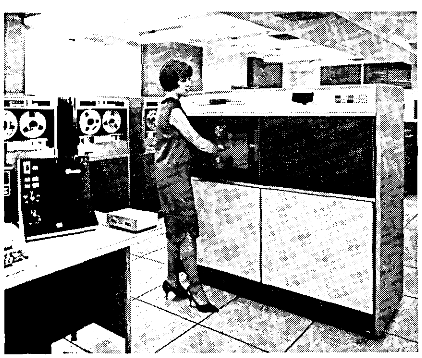


logic for operation with central data processing computers, remote readouts and telemetering equipment. (For more information, circle 41 on the Reader Service Card.)

Input-Output

S-C 4400 — MICROFILM PRINTER

Stromberg-Carlson, a division of General Dynamics, San Diego, Calif., has developed a computer microfilm printer which speeds record retrieval and saves several data handling steps. The new printer, the S-C 4400, is capable of printing speeds of 62,500 alphanumeric characters per second.



The S-C 4400, operating directly from a computer or from computer-generated magnetic tapes, translates digital signals into words, numbers and symbols. Output is recorded automatically, a page at a time, on either 16mm or 35mm microfilm.

The printer, developed as a new link between computers and film storage and retrieval systems, saves these steps in the process of converting computer data into microfilm:

1. When operating on-line with the computer, there is no need to produce magnetic tape.

2. The need for paper output from the computer is eliminated in many operations since selected pages can be produced on paper from the 4400's film output.

3. The tasks of manually handling paper and magnetic tapes also are eliminated.

4. In addition, the job of microfilming and coding the documents for retrieval purposes is performed automatically by the S-C 4400.
(For more information, circle 42 on the Readers Service Card.)

ELECTRIC TAPE WINDER, CENTER-FEED TAPE UNWINDER

Two new punched paper tape accessories are available from Data-link Corporation, Los Altos, Calif.

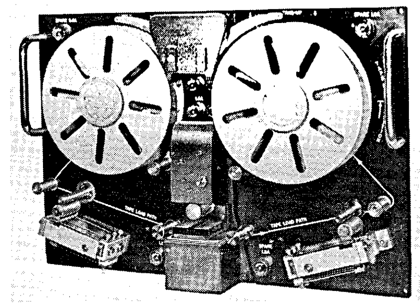
The new Electric Tape Winder has a special friction clutch mechanism within the continuous duty motor which maintains tension (adjustable) consistently within plus or minus one ounce. The consistency of the driving force eliminates improper code registration. Impact-resistant durable plastic winding reels are used instead of metal reels to lessen the possibility of erratic winding drag and tearing of the tape. The standard winder operates at 35 codes per second. It is fully portable and can be used with paper tape up to one inch in width.

The new Center-Feed Tape Unwinder is made of impact-resistant plastic which resists bending or breaking. Although designed like most conventional tape unwinders, its lightweight construction makes possible the use of a special low-friction bearing for smoother operation.
(For more information, circle 43 on the Readers Service Card.)

MILITARIZED PERFORATED TAPE READER/SPOOLER

Potter Instrument Company, Inc., Plainview, N.Y., has introduced a new militarized perforated tape reader and spooler that operates bidirectionally at 200 characters per second. Rewind speed is 300 characters per second (minimum); rewind time is less than 3 minutes for 500 feet.

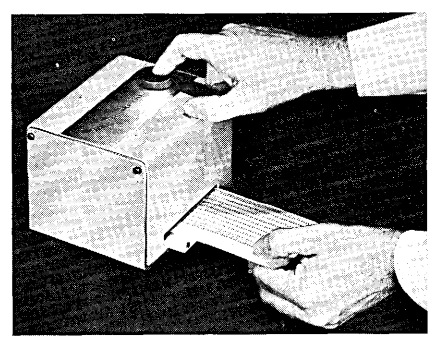
Regulated power supplies, amplifiers and start/stop circuits are completely transistorized. Semiconductors are silicon. Information and sprocket channel amplifiers contain individual sensitivity adjustments. All operations are externally controlled.



The device is easily adaptable to system requirements. Applications include field computer programming, ground checkout systems for aircraft and space vehicles.
(For more information, circle 44 on the Readers Service Card.)

PUNCHED CARD READER FOR COMMERCIAL AND INDUSTRIAL CARD AUTOMATED SYSTEMS

A new punched card reader designed for commercial and industrial card automated systems has been developed by Drexel Dynamics Corp., Horsham, Pa. This device, known as Drexamatic Model 2900 Card Reader, has varied applications including process control programming, remote data entry, machine dispensing, material weighing, numerical machine control, and in general, all automated systems capable of accepting digital commands.



The reader is available for use with either IBM or Remington Rand cards. It operates equally well with either regular or pre-perforated stock cards. The 2900, suitable for either desk or panel mounting, has electric push button operation and wiping gold contacts. A maximum of 240 inputs are provided which is equivalent to 20 columns on an IBM card.
(For more information, circle 45 on the Readers Service Card.)

ELECTRONIC RETINA CHARACTER READER

High speed optical scanning equipment, capable of "reading" airline tickets at the rate of 600 per minute and of transferring accounting information automatically to computers, has been purchased by United Air Lines and installed at its headquarters offices near O'Hare International Airport, Chicago, Ill. The equipment, called an Electronic Retina Character Reader, was developed by Recognition Equipment Inc., Dallas, Texas. It is capable of transporting and sorting paper which is as light as nine pounds and carbon backed.

Information including such items as the routing, fare, tax, totals, carrier code and fare basis are correlated with a route code, read from the ticket and transferred to magnetic tape by the new machine. The device also performs various sorting operations including sequential sorting of tickets or air bills by number and/or by carrier. The machine sorts as rapidly as it reads.

The new equipment includes three basic units consisting of a document carrier, a recognition device, and a control and output device. It is comparable in size to existing computers.

The document carrier was built to airline specifications. Although intended to process documents prepared and handled with reasonable care, the transport system permits the device to process and read papers which have been torn, crumpled or stapled.

The reader recognizes preprinted or matrix-applied numerals through an optical system and Electronic Retina as each numeral or figure passes in front of the retina. Scanning time per character is measured in millionths of a second.

The control unit, in addition to programming the system and recording data read by the scanner, can be used as an off-line scientific computer. It can read from or record data on magnetic tape, punch-paper tape, or a typewriter.
(For more information, circle 46 on the Readers Service Card.)

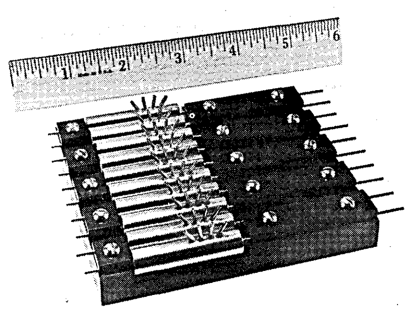
Components

TURBULENCE AMPLIFIERS

The turbulence amplifier, manufactured by Fluid Logic Division, H & H Machine Co., Norristown, Pa., is a new concept in logic and control components. It is one of the first fluid logic devices to be successfully used in the control of industrial equipment. Systems using over 100 turbulence amplifiers have been in actual plant operation for more than a year without a single breakdown or failure.

To understand its operation, it is helpful to consider the turbulence amplifiers as a "pneumatic transistor". Turbulence amplifiers will do almost anything a transistor will do — not as fast, but with a simpler design and at less cost. Operating speed for the turbulence amplifier is in the millisecond range which is not fast enough for a large computing system, but more than fast enough for most industrial logic and control applications.

Turbulence amplifiers have no moving parts and therefore nothing to wear out. They use the properties of long laminar air streams for their operation. No biasing is required for the amplifiers. There is complete isolation between individual control jets on a single amplifier and also from one amplifier to another.



— A ten unit turbulence amplifier rack for industrial logic and control systems.

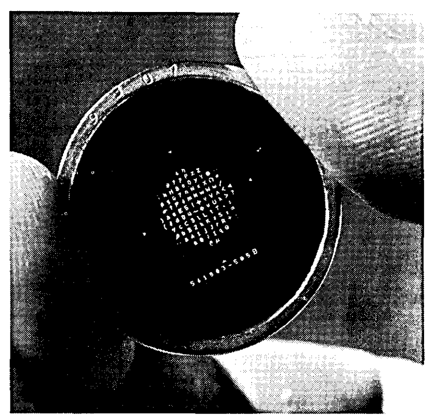
Turbulence amplifiers can be interconnected to provide all conventional logic functions (OR, NOR, AND, NOT and MEMORY). They can be used to make counters, programmers, sequence checkers, adders, or any logic or arithmetic circuit. They are being used in industry for process control, machine control, contactless sensing and gauging and in many other applications.
(For more information, circle 47 on the Readers Service Card.)

NEW COMPONENT EXPANDS VERSATILITY OF COMPUTER DISPLAYS

Stromberg-Carlson Division of General Dynamics Corp., San Diego, Calif., has developed a new matrix containing 96 different characters and symbols instead of the usual 64 available in the CHARACTRON® Shaped Beam Tube. The new component is being used in computer display systems produced by the company at their West Coast facility.

The CHARACTRON tube is a proprietary cathode ray tube used to translate computer codes into understandable information on its face. The matrix is the key component. In a standard matrix array there are 64 characters, arranged eight rows horizontally by eight rows vertically. All alphabetic characters are upper case.

The newly developed matrix is capable of presenting both upper and lower case letters, plus a variety of symbols and Greek letters.



— New matrix (above) containing 96 different characters and symbols.

The tube also has a spot writing capability, producing an .008 inch spot at four microamps. Characters size is variable at a ratio of five-to-one, ranging from .200 inch down to .040 inch. Symbols are typically repeated at a 30-times-per-second flicker-free rate.

In their initial application, the matrices are being used with 7 inch CHARACTRON tubes in 64 different consoles which Stromberg-Carlson is manufacturing for the National Aeronautics and Space

Administration's Mission Control Center at Houston, Texas. (For more information, circle 48 on the Readers Service Card.)

PEOPLE OF NOTE

HONEYWELL ENLARGES EDP MARKETING STAFF

Honeywell has disclosed the promotion of three key executives to new posts in the marketing organization and the establishment of two new divisions.

Myron A. Angier, formerly coordinator of Honeywell's Industry Council (a computer specialist group supporting 11 key industries), has been promoted to the newly-established position of assistant to the vice president-marketing.

Dr. William L. Gordon, who had headed the applications engineering group, has been named director of Applications and Systems, a new division consisting of five departments.

Robert J. Koch, formerly director of administrative services, has been promoted to the new position of director of the Customer Support and Administration division. Koch will be responsible for administrative services, marketing administration, Honeywell users group liaison, systems service and operation of 10 Honeywell service centers throughout the United States.

All three appointees will report directly to Claude H. Smith, vice president-marketing, for Honeywell EDP.

INFORMATICS INC. ELECTS COHEN

The Board of Directors of Informatics Inc., Sherman Oaks, Calif., has elected Irving Cohen to the position of Vice President, Command and Control Systems. Mr. Cohen will have responsibility for the firm's work in command and control systems — part of which will be the direction of the contract with the Office of Naval Research for the development of system design technology and methodology for future improved Naval Tactical Command and Control Systems. He also will have responsibility for the ONR contract to develop system design concepts for the new generation Marine Tactical Command and Control Systems.

ENGEL NAMED TO NEW POST AT HONEYWELL

Frank Engel, Jr., formerly manager of the computing center at Harvard University, has joined Honeywell's electronic data processing division as manager of the newly-formed Applied Science Department. He will direct Honeywell's technical support program for its recently-introduced line of scientific computer systems.

PAUL HACHIGIAN ELECTED VP

Paul Hachigian has been elected vice president of the Data and Information Systems Division of International Telephone and Telegraph Corporation, it was announced by Dr. Norman E. Friedmann, president of ITT/DISD. Mr. Hachigian is also ITT/DISD's chief engineer and director of communication data products. He began his career with ITT in 1951 and has been with the division since 1959.

BUSINESS NEWS

AUDIO DEVICES HALF YEAR SALES UP 15%

Total sales of Audio Devices, Inc., New York, manufacturers of magnetic tapes, for the first half of 1964 were $4,600,837, an increase of 14.9% over the first six months of 1963. Net profits for the period dropped to $40,620 after taxes, equivalent to 5 cents per share compared with 27 cents per share for the same period in 1963.

The loss was attributed to three adverse factors in manufacturing which occurred simultaneously: 1. a temporary low in production yield due to the introduction of a substantial improvement in the company's computer tape; 2. a drift from standard in the quality of certain incoming raw materials; and 3. a need for physical modifications of the plant during this period. The company commented that these changes are now complete and production is back to normal.

ITT SALES SET RECORD

Sales and net income of International Telephone and Telegraph Corp. set all-time highs in the first half of 1964, the company reports.

Net income for the first half of 1964 was $27,753,000, an increase of 17 per cent over the $23,693,000 in the corresponding period of 1963.

Sales and revenues for the first six months of 1964 were $728,284,000, or 11 per cent above the $657,680,000 for the first half of 1963. Orders on hand at mid-year were a record $968,000,000, as compared with $868,000,000 at the same time a year ago.

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 OCTOBER 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	21	1
	ASI 2100	Y	$3000	12/63	5	2
	ASI 6020	Y	$2200	4/65	0	0
	ASI 6040	Y	$2800	7/65	0	0
Autonetics	RECOMP II	Y	$2495	11/58	64	X
	RECOMP III	Y	$1495	6/61	20	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	10	18
	TRW-530	Y	$6000	8/61	23	3
Burroughs	205	N	$4600	1/54	62	X
	220	N	$14,000	10/58	42	X
	E101-103	N	$875	1/56	125	X
	E2100	Y	$535	8/64	30	990
	B100	Y	$2800	8/64	8	30
	B250	Y	$4200	11/61	94	17
	B260	Y	$3750	11/62	66	170
	B270	Y	$7000	7/62	84	30
	B280	Y	$6500	7/62	93	41
	B370	Y	$8400	7/65	0	16
	B5000	Y	$16,200	3/63	36	22
	B5500	Y	$35,000	3/65	0	3
Clary	DE-60/DE-60M	Y	$525	2/60	255	0
Computer Control Co.	DDP-19	Y	$2800	6/61	3	X
	DDP-24	Y	$2500	5/63	37	22
	DDP-116	Y	$900	2/65	0	2
	DDP-224	Y	$3300	12/64	0	5
Control Data Corporation	G-15	N	$1000	7/55	320	X
	G-20	Y	$15,500	4/61	26	X
	160*/160A/160G	Y	$1750/$3500/$12,000	5/60;7/61;3/64	381	23
	924/924A	Y	$11,000	8/61	28	3
	1604/1604A	Y	$38,000	1/60	60	X
	3200	Y	$12,000	5/64	13	60
	3400	Y	$25,000	11/64	0	18
	3600	Y	$58,000	6/63	25	32
	6600	Y	$110,000	8/64	1	4
Digital Equipment Corp.	PDP-1	Y	Sold only about $120,000	11/60	54	2
	PDP-4	Y	Sold only about $60,000	8/62	45	10
	PDP-5	Y	Sold only about $25,000	9/63	61	8
	PDP-6	Y	Sold only about $300,000	10/64	1	8
	PDP-7	Y	Sold only about $88,000	11/64	0	10
El-tronics, Inc.	ALWAC IIIE	N	$1820	2/54	24	X
Friden	6010	Y	$600	6/63	197	110
General Electric	205	Y	$2900	10/64	1	14
	210	Y	$16,000	7/59	60	X
	215	Y	$5500	11/63	28	15
	225	Y	$7000	1/61	122	3
	235	Y	$10,900	12/63	20	16
	415	Y	$5500	5/64	12	110
	425	Y	$7500	7/64	5	45
	435	Y	$12,000	10/64	0	22
	455	Y	$18,000	6/65	0	9
	465	Y	$24,000	6/65	0	6
	625	Y	$50,000	2/65	0	7
	635	Y	$65,000	12/64	0	9
General Precision	LGP-21	Y	$725	12/62	130	50
	LGP-30	semi	$1300	9/56	435	5
	RPC-4000	Y	$1875	1/61	98	1
Honeywell Electronic Data Processing	H-200	Y	$4200	3/64	75	590
	H-300	Y	$3900	7/65	0	6
	H-400	Y	$5000	12/61	101	8
	H-800	Y	$22,000	12/60	62	7
	H-1400	Y	$14,000	1/64	9	5

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	4	7
	H-2200	Y	$11,000	10/65	0	11
	DATAmatic 1000	N	---	12/57	4	X
H-W Electronics, Inc.	HW-15K	Y	$490	6/63	3	4
IBM	305	N	$3600	12/57	505	X
	360/30	Y	$4800	7/65	0	1600
	360/40	Y	$9600	7/65	0	460
	360/50	Y	$18,000	9/65	0	370
	360/60	Y	$35,000	10/65	0	320
	360/62	Y	$50,000	11/65	0	80
	360/70	Y	$80,000	10/65	0	180
	650-card	N	$4000	11/54	385	X
	650-RAMAC	N	$9000	11/54	72	X
	1401	Y	$4500	9/60	7450	750
	1401-G	Y	$1900	5/64	250	780
	1410	Y	$12,000	11/61	440	145
	1440	Y	$1800	4/63	1125	650
	1460	Y	$9800	10/63	425	600
	1620 I, II	Y	$2500	9/60	1510	25
	701	N	$5000	4/53	1	X
	7010	Y	$19,175	10/63	50	38
	702	N	$6900	2/55	3	X
	7030	Y	$160,000	5/61	6	X
	704	N	$32,000	12/55	41	X
	7040	Y	$14,000	6/63	50	38
	7044	Y	$26,000	6/63	43	14
	705	N	$30,000	11/55	84	X
	7070, 2, 4	Y	$24,000	3/60	525	40
	7080	Y	$55,000	8/61	70	3
	709	N	$40,000	8/58	11	X
	7090	Y	$64,000	11/59	45	3
	7094	Y	$70,000	9/62	255	18
	7094 II	Y	$76,000	4/64	50	52
ITT	7300 ADX	Y	$18,000	7/62	9	6
Monroe Calculating Machine Co.	Monrobot IX	N	Sold only - $5800	3/58	158	X
	Monrobot XI	Y	$700	12/60	430	170
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	230	125
	NCR - 390	Y	$1850	5/61	680	180
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	3	X
	RCA 301	Y	$6000	2/61	515	130
	RCA 3301	Y	$11,500	7/64	4	33
	RCA 501	Y	$14,000	6/59	96	4
	RCA 601	Y	$35,000	11/62	4	1
Raytheon ***	PB 250	Y	$1200	12/60	154	8
	PB 440	Y	$3500	3/64	5	8
Scientific Data Systems Inc.	SDS-92	Y	$900	12/64	0	10
	SDS-910	Y	$2000	8/62	80	55
	SDS-920	Y	$2700	9/62	62	7
	SDS-925	Y	$2500	12/64	0	4
	SDS-930	Y	$4000	6/64	6	24
	SDS-9300	Y	$7000	10/64	0	5
UNIVAC	I & II	N	$25,000	3/51 & 11/57	32	X
	III	Y	$20,000	8/62	76	32
	File Computers	N	$15,000	8/56	24	X
	Solid-State 80, 90, & Step	Y	$8000	8/58	332	X
	Solid-State II	Y	$8500	9/62	43	3
	418	Y	$11,000	6/63	6	8
	490	Y	$26,000	12/61	36	20
	1004	Y	$1900	2/63	2000	650
	1050	Y	$8000	9/63	74	250
	1100 Series (except 1107)	N	$35,000	12/50	14	X
	1107	Y	$45,000	10/62	20	7
	1108	Y	$50,000	7/65	0	8
	LARC	Y	$135,000	5/60	2	X
				TOTALS	22,177	10,541

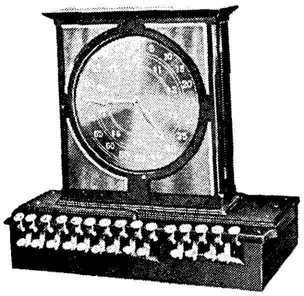
X = no longer in production.

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

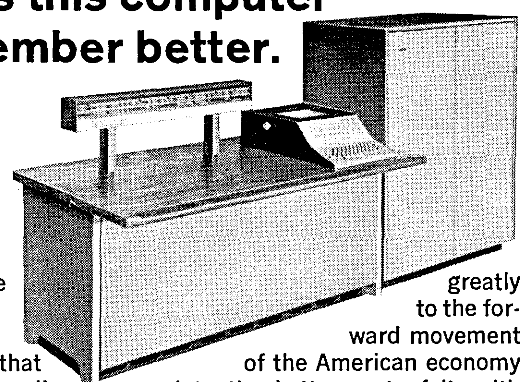
** Some of the unfilled order figures are verified by the respective manufacturers; others are estimated and then reviewed by a group of computer industry authorities.

*** Formerly Packard-Bell Computer Division

80 years ago the first cash register helped shopkeepers remember.



Today NCR's new thin-film rod memory helps this computer remember better.



NCR's job for 80 years has been to make things easier and more profitable for businesses of all kinds and sizes. How? By producing the most complete and efficient line of record keeping and data processing equipment obtainable. We began by marketing the first cash register—the first automated system for handling sales and cash! Today NCR continues to make things easier for government, industry, business and banking with a full line of equipment to handle everything from original entry to final report. Latest is a rod memory computer that cycles in billionths of a second!

Equally as important as the development of the total system concept of record keeping are the many research and development programs which NCR has in progress. Important advances in encapsulation, photochromism, thin-film and laser technology have contributed greatly to the forward movement of the American economy and to the betterment of its citizens. If you would like to be considered for positions that are now opening for qualified persons at NCR, write to T. F. Wade, Technical Placement, NCR, Dayton, Ohio 45409. All correspondence will be treated confidentially. An equal opportunity employer.

N C R

BE SURE TO VISIT THE NCR PAVILION AT THE N.Y. WORLD'S FAIR.

THE NATIONAL CASH REGISTER COMPANY ®

Circle No. 27 on Readers Service Card

CALENDAR OF COMING EVENTS

Nov. 3-5, 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 Elec. Res. & Engineering Meeting), Commonwealth Armory and Somerset Hotel, 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.

Nov. 16-18, 1964: 17th Annual Conference on Engineering in Medicine and Biology, Cleveland-Sheraton Hotel, Cleveland, Ohio; contact Dr. D. G. Fleming, Case Inst. of Techn., Cleveland 6, Ohio.

Nov. 16-19, 1964: 10th Conference on Magnetism & Magnetic Materials, Raddison Hotel, Minneapolis, Minn.; contact J. T. Elder, 3 M Co., 400 McKnight Rd., St. Paul 19, Minn.

Jan., 1965: 11th National Symposium on Reliability & Quality Control, Fontainebleu Hotel, Miami, Fla.

Feb. 17-19, 1965: International Solid State Circuits Conference, Philadelphia, Pa.

Mar. 22-25, 1965: IEEE International Convention, Coliseum and New York Hilton Hotel, New York, N. Y.; contact IEEE Headquarters, E. K. Gannett, 345 E. 47 St., New York, N. Y.

April 21-23, 1965: Southwestern IEEE Conference and Elec. Show (SWIEECO), Dallas Memorial Auditorium, Dallas, Tex.

May, 1965: National Telemetering Conference, El Paso, Tex. (Tentative)

May 11-13, 1965: Electronic Components Conference (ECC), Washington, D. C.

May 24-29, 1965: IFIP Congress '65, New York Hilton Hotel, New York, N. Y.; contact Evan Herbert, Conover Mast Publ., 205 E. 42 St., New York 17, N. Y.

June, 1965: Automatic Control in the Peaceful Uses of Space, Oslo, Norway; contact Dr. John A. Aseltine, Aerospace Corp., P. O. Box 95085, Los Angeles 45, Calif.

June 22-25, 1965: Sixth Joint Automatic Control Conference (JACC), Rennselaer Polytechnic Institute, Troy, N. Y.; contact Prof. James W. Moore, Dept. of Mechanical Engineering, Univ. of Va., Charlotteville, Va.

Oct. 10-16, 1965: 1965 Congress of the International Federation of Documentation (FID), Sheraton Park Hotel, Washington, D. C.; contact Secretariat, 1965 FID Congress, 9650 Wisconsin Ave., Washington, D. C. 20014

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, Washing ton 25, D. C., at a cost of 25 cents each.

June 30, 1964 (Continued)

3,139,609 / Hewitt D. Crane, Palo Alto and William K. MacCurdy, Menlo Park, Calif. / AMP Inc., Harrisburg, Pa., a corp. of New Jersey / Magnetic-Core Shift Register.

3,139,610 / Lionel Crown, Santa Monica, Seymour Markowitz, Los Angeles and David Slotnick, Sherman Oaks, Calif., a corp. of California / Magnetic-Core Memory Construction.

July 7, 1964

3,140,402 / Douglas C. Engelbart, Palo Alto, Calif. / AMP Inc., Harrisburg, Pa., a corp. of N. J. / Magnetic-Core Logic Circuits.

3,140,403 / Josef Morwald, Dachau, near Munich, Germany / Kienzle Apparate G.m.b.H., Villingen, Black Forest, Germany / Matrix Type Switch Arrangement.

3,140,404 / Robert Mauduech, Paris and Raymond Gouttebel, Clamart, France / Automatic Electric Labs., Inc. / Eccles-Jordan Flip-Flop With Closed Ferrite Cores In The Cross-Coupling Paths.

3,140,471 / Harrison W. Fuller, Needham Heights, Mass. / by Mesme assignments to Laboratory for Electronics, Inc., Boston, Mass., a corp. of Delaware / High Capacity Data Processing Techniques.

3,140,472 / Lester R. Adams, Endwell, and Edward H. Sommerfield, Endicott, New York / International Business Machines Corp., N. Y. / Data Transfer Apparatus.

3,140,473 / John E. Gaffney, Jr., Poughkeepsie, N. Y. / IBM, N. Y. / Information Storage System.

3,140,474 / Ervin Leshner, Philadelphia, Pa. / Burroughs Corp., Detroit, Mich. / Magnetic Memory Drum.

July 14, 1964

3,141,154 / Ralph Anthony Hall, London, England / International Standard Electric Corp., N. Y. / Intelligence Storage Equipment.

3,141,155 / Albert W. Vinal, Owego, N. Y. / IBM, New York / Magnetic Memory System.

3,141,159 / Edwin S. Lee III, San Gabriel, Calif. / Burroughs Corp., Detroit, Michigan / Digital Magnetic Code Converter.

July 21, 1964

3,141,961 / Roy W. Reach, Jr., Sudbury, Mass. / Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., a corp. of Delaware / Information Handling Apparatus.

3,141,963 / Werner Zuhlsdorf, Berlin, Germany / VEB Wissenschaftlich-Technisches Buro fur Geratebau, Berlin, Germany / Circuits and Control for Mantissa Devices In Binary Computing Machines.

3,141,964 / Harold Fleisher, Poughkeepsie and Robert I. Roth, Briarcliff Manor, N. Y. / International Business Machines Corp., N. Y. / Calculating Memory.
3,141,967 / William H. Meiklejohn, Scotia, N. Y. / General Electric Co., a corp. of N. Y. / Information Storage Apparatus.
3,141,980 / Nathaniel Rochester, Mount Kisco, N. Y. / IBM, N. Y. / Memory System.
3,142,048 / James I. Smith, Basking Ridge, N. J. / Bell Telephone Labs., Inc., N. Y. / Magnetic Memory Circuit.
3,142,049 / David J. Crawford, Poughkeepsie, N. Y. / IBM Corp., N. Y. / Memory Array Sensing.

July 28, 1964

3,142,818 / Arthur W. Holt, Silver Spring, Md. / by Mesme assignments to Control Data Corp., Minneapolis, Minn., a corp. of Minnesota / Character Recognition Using Curve Tracing.
3,142,822 / Gregory L. Martin, Phoenix, Ariz. / Goodyear Aerospace Corp., a corp. of Delaware / Apparatus For Sampling, Storing and Summing Signals.
3,142,828 / Edmunde E. Newhall, Brookside, N. J. / Bell Telephone Labs., Inc., N. Y. / Magnetic Memory Array.

August 4, 1964

3,143,725 / Robert A. Henle, Hyde Park, N. Y. / IBM Corp., New York, a corp. of New York / Negative Resistance Memory Systems.
3,143,728 / Norman C. Loeber, San Jose, Calif. / IBM Corp., N. Y., a corp. of New York / Core Storage Configuration.

August 11, 1964

3,144,640 / Wilhelm Grooteboer, Duisdorf, Bonn, Germany / Int. Standard Electric Corp., N. Y., a corp. of Delaware / Ferrite Matrix Storage.
3,144,641 / Jack I. Raffel, Groton, Mass. / Mass. Institute of Technology, Cambridge, Mass., a corp. of Mass. / Balanced Sense Line Memory.

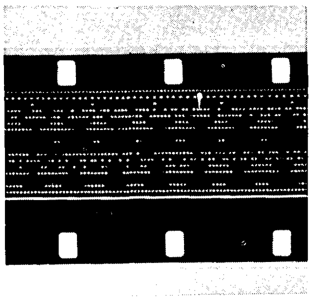
August 18, 1964

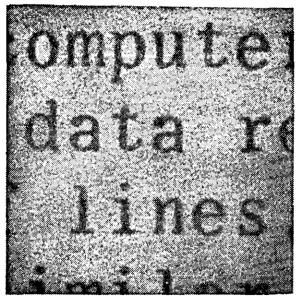
3,145,307 / Salvadore J. Zuccaro, Los Angeles, Calif. / Ampex Corp., Culver City, Calif., a corp. of California / Logical Circuits.
3,145,342 / Howard H. Hill, Northboro, Mass. / Computer Control Co., Inc., a corp. of Delaware / Universal Logical Element.
3,145,343 / William P. Horton, Natick, Mass. / Computer Control Co., Inc., a corp. of Delaware / Universal Logical Element Having Means Preventing Pulse Splitting.

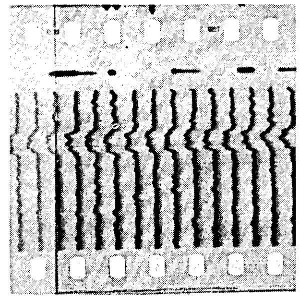
August 25, 1964

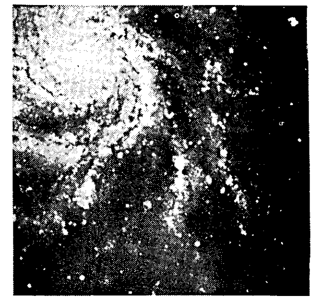
3,146,353 / Arthur V. Pohm, Ames, Iowa / Sperry Rand Corp., New York, a corp. of Delaware / Magnetic Thin Film Logic Circuits.
3,146,354 / Shintaro Oshima, Tokyo-to, Hajime, Enomoto, Ichikawashi and Saburo Shirai and Yasuo Koseki, Tokyo-to, Japan / Kokusai Denshin Denwa Kabushiki Kaisha, Tokyo-to, Japan, a joint stock company of Japan / System of Logical Operation Including Magnetic Core Circuit.
3,146,425 / Robert E. Benn, Broomall and Douglas C. Wendell, Jr., Malvern, Pa. / Burroughs Corp., Detroit, Mich., a corp. of Michigan / Data Storage Device.
3,146,426 / Michel Agon, Courbevoie and Jacques Jeanniot and Yves Poupon, Paris, France / IBM Corp., New York, a corp. of New York / Memory system.
3,146,428 / John C. F. Walker III, Dayton, Ohio / The National Cash Register Company, Dayton, Ohio, a corp. of Maryland / Data Storage System.

5000 POINTS PER SECOND









Information International, Inc., Cambridge, Mass., has developed a fully automatic Programmable Film Reader to read scientific or engineering data recorded on photographic film, paper, or similar media. Readout can be had on IBM-compatible magnetic tape, or in the form of numerical print-outs, graphs or plots, or visual CRT displays. This article describes the system and its applications.

THE FILM READING SYSTEM Using 16 or 35 mm. film as a medium for recording scientific data has many advantages. Because of the small input power and limited storage space that are required, it is particularly suitable for recording data produced by recording devices in space vehicles or aircraft; by wind and current measuring devices; and by other devices of similar nature.

However, reading or transcribing the data from film once it has been recorded has presented many problems in the past. It has generally been necessary for an analyst or researcher to read the data visually from the film and transcribe it by hand. This has been found to be a time-consuming, laborious and relatively expensive operation. In some cases, semi-automatic film reading devices are available. However, these can read only about 5000 points per day and require a human operator.

Information International, Inc., of Cambridge, Mass., has now developed a completely automatic computer film reading system which can read film at the rate of approximately 5000 points per second. Scientific data recorded on 16 or 35 mm film can be read completely automatically and printed out in the form of numerical listings or recorded on magnetic tape for further processing and analysis. The film reading system is based on three major elements: A general purpose digital computer, together with a visual display scope; a film reading device; and computer programs for using the computer and film reader.

THE FILM READING PROCESS The film reading process involves the scanning of film by a rapidly moving light point on the visual display scope. The output of this scanning operation is detected by a photo-sensitive device in the film reader and relayed to the digital computer for further processing and analysis. In addition to translating the data itself into a more desirable format, the film reading system can also furnish additional summaries and analyses of the data as may be required.

EXTREMELY FLEXIBLE SYSTEM The flexibility of the film reading system in two respects should be emphasized. First, almost any format of data on film can be read, with appropriate modifications to the basic computer program. This includes data represented in the form of lines, graphs (e.g., radar pulses), points, and other similar forms of data. Second, almost any type of desired output may be obtained once the basic data is obtained from the film. Forms of output which are available include the following:

(i) A print-out or listing of data on paper.
(ii) A record of the data on magnetic tape.
(iii) Visual representations of data. These may take the form of a continuous graph (using a digital x-y plotting device). Or they may take the form of photographs — still or motion — of scope displays.

In addition to data recorded on film, data recorded on paper can also be read by means of the film reading system.

SYSTEM APPLICATIONS

(i) Analysis of data produced by oscillographs or other types of graphic recorders
(ii) Tracking and analysis of objects for which motion pictures are available (e.g., missile tracking studies)
(iii) Reading of astronomical or astrophysical data recorded on film (e.g., analysis of stellar configurations)
(iv) Reading photographs of cloud chambers, bubble chambers, and spark chambers
(v) Counting of particles (such as blood cells or bacteria) in photographs
(vi) Character recognition

To the best of our knowledge, Information International is the only commercial firm supplying fully automatic computer film reading systems. We do essentially two things. We develop and manufacture film reading systems for clients to use at their own facilities (as, for example, in the case of radar film reading systems we have developed for Lincoln Laboratory and the U. S. Air Force). And we furnish services for reading films which are sent to us for processing (as in the case of oceanographic current meter film).

III is able to supply equipment to satisfy a variety of customer needs. Customer options include transmittive or reflective input media, binary density decision, multiple level density measurement, local contrast measurement, and various degrees of system resolution.

We can supply a completely set-up, ready-to-run "turnkey" film reading system (including a medium price, general purpose computer). Or we can provide the basic film reading device, appropriate computer programs, or technical consulting to those planning to develop their own film reading systems. The film reading device itself may be used with specialized film reading computer programs, such as those we have developed, which make use of highly sophisticated filtering techniques to minimize the effect of "noise" (dirt, scratches, general illegibility) on the film. As a result, the film reading system is capable of reading film in relatively poor condition. Or, where the quantity of data on film is not great enough to justify investment in a film reading system, I.I.I. can furnish services for reading film and transcribing data on a production basis. A brochure describing the film reader and film reading systems we have developed is available on request.

INFORMATION INTERNATIONAL INCORPORATED
200 SIXTH ST., CAMBRIDGE, MASS.

ANNOUNCING

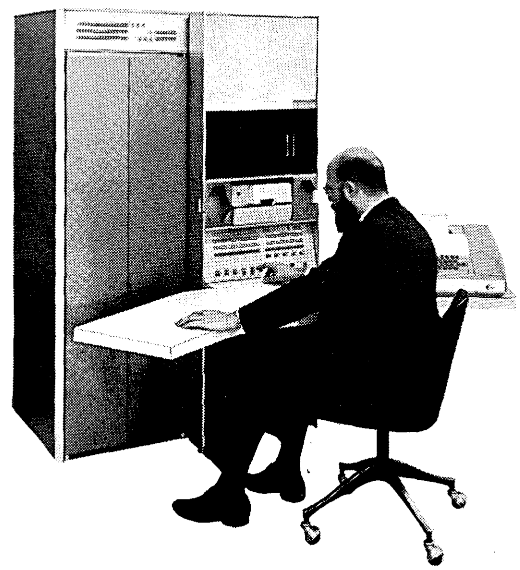
TWO NEW COMPUTERS
WITH FLIP CHIP™ INTEGRATED CIRCUITS

PDP-8

- 1.6 μsec cycle time
- 3.2 μsec add time
- 12 bit word length
- 4096 word memory (expandable to 32,768 words)
- Fortran
- Field tested software
- 570,000 words/sec maximum transfer rate
- Reader punch and typewriter included

$18,000

PDP-7



- 1.75 μsec cycle time
- 3.50 μsec add time
- 18 bit word length
- 4096 word memory (8,192 words directly addressable, expandable to 32,768 words)
- Field tested software including Fortran II
- 570,000 words/sec maximum transfer rate
- 300 cps paper tape reader
- 63.3 cps paper tape punch

$45,000

OPTIONAL EQUIPMENT AVAILABLE

IBM compatible tape
DEC tape
CRT displays with light pen
Card equipment
Analog I/O
Data communication equipment
Bulk storage drums
Printers and plotters

digital
EQUIPMENT CORPORATION
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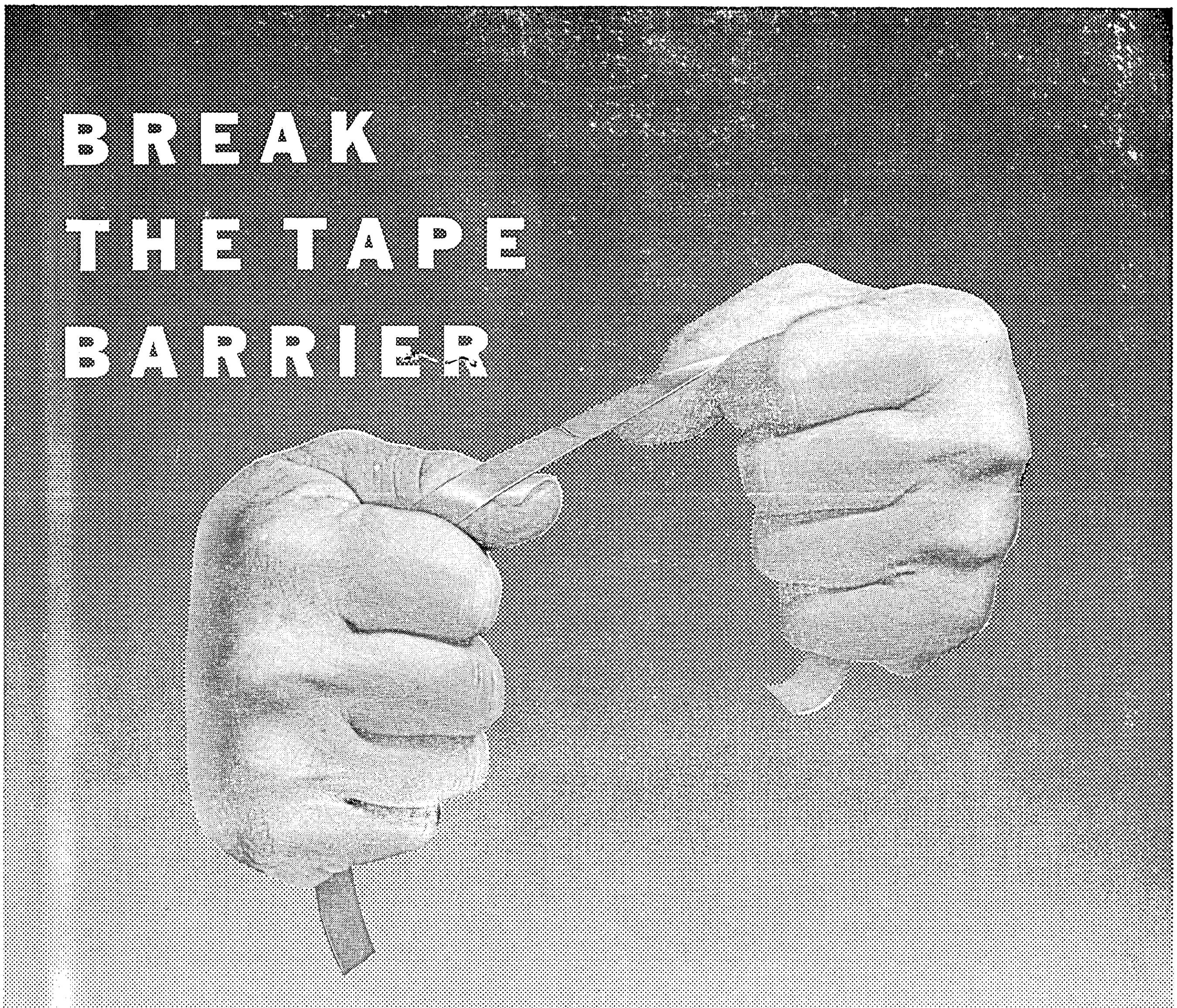
FLIP CHIP IS A TRADE MARK OF DIGITAL EQUIPMENT CORPORATION

Circle No. 4 on Readers Service Card

ADVERTISING INDEX

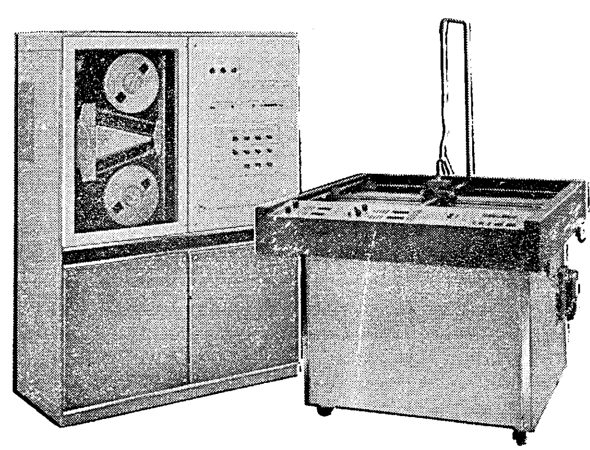
Following is the index of advertisements. Each item contains: Name and address of the advertiser / page number where the advertisement appears / name of agency if any.



Let benson lehner show you how.

Most computer prepared digital plotting tapes require a ¾" record gap to separate the data points. But, not at Benson-Lehner. They have found a way to take the gap out of the tape. By using this gapless method, the computer write time is shortened to 1/14 of the time previously required. This means that you can write 14 times more information on the same length of tape! Or if you prefer, have some tape left over. And when you think of what it cost for computer time, the gapless way is the least expensive way to travel across a tape transport.

The Magnetic Tape Plotting System shown is capable of performing multi-color point-to-point plotting and line drawings, with scale markings, curve identification and alpha-numeric symbol printing.

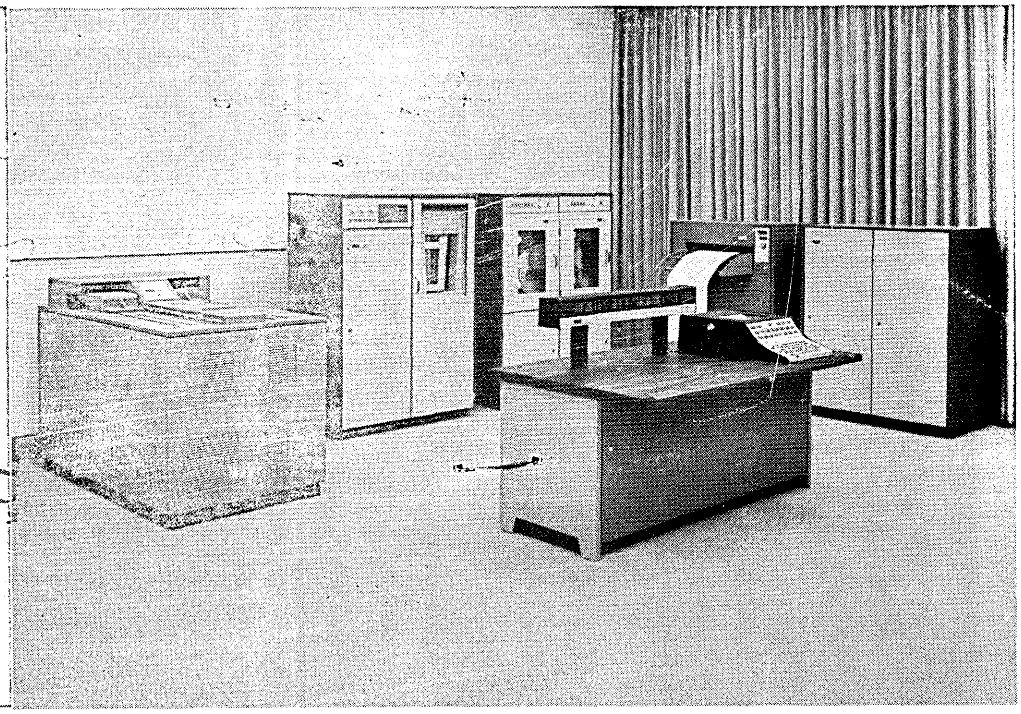


benson-lehner corporation

14761 CALIFA STREET • VAN NUYS, CALIFORNIA

Circle No. 26 on Readers Service Card

ACROSS-THE-BOARD OPPORTUNITIES IN DIGITAL SYSTEMS AT NCR, LOS ANGELES



Move ahead in digital systems with NCR. Developments such as the newly announced NCR 315 RMC Rod Memory Computer with the first commercially available all-thin-film main memory tell you that EDP technology is moving fast at NCR Electronics Division. Opportunity is in the present tense. If you can make original contributions in any of the areas listed here...if you would like to combine a good living with the good Southern California life... investigate NCR now.

SYSTEMS ANALYST ENGINEERS

Central and Advanced Systems—All Levels

Experience in analyzing requirements to prepare functional specifications for processors, controllers, buffers, peripheral equipment, random access memories, etc. Knowledge of logical design and programming helpful, essential at higher levels, where candidates should also have heavy experience in advanced system design—multiprogramming, list processing machines, complex on-line systems, or other specialties.

On-Line—Intermediate and Senior

Experience in analyzing requirements and preparing functional specifications for on-line systems and selected devices. Should have good knowledge of data transmission techniques, and be able to carry out studies of traffic loads, scanning and polling schemes, etc. Knowledge of programming and elementary logical design essential.

Evaluation—All Levels

Experience in preparing comparative analyses of data processing system, using analytic techniques including queuing theory and simulation. Knowledge of programming essential.

PROGRAMMERS

Software—All Levels

Requires experience in designing and writing compilers, operating system, generators, etc.

Research—Senior Level

Must have extensive experience in advanced programming techniques and applications such as list processing systems, syntax-directed compiling, information retrieval system, and natural language processing.

Design Automation Programmer

This position requires a man who has had previous experience in programming, for design automation. Requires an understanding of engineering and hardware problems. Bachelor's degree in math, engineering, or related fields required.

Advanced Mechanisms Specialist

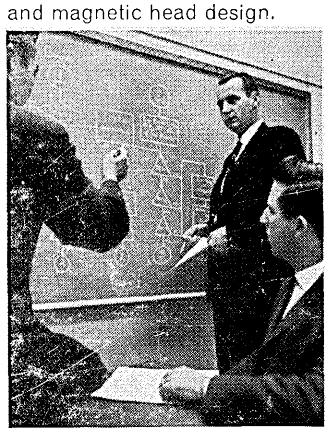
Position will entail analysis and advanced design of complex mechanisms and applied mechanics problems. Experience highly desirable in design of computer peripheral equipment, such as disc files, drums and drum memories; floating-head background helpful. Should be equally skilled in mathematical analysis and laboratory measurements. PhD preferred.

Systems/Communications Designer

This senior position will involve analysis and advanced design of on-line, real-time systems. Requires BSEE, MSEE desired, with good knowledge of digital computer technology.

Advanced Magnetic Recording Specialist

Intermediate to senior engineer with BS degree, MS desired, with 3-4 years' experience in advanced magnetic recording techniques. Requires detailed knowledge of media, circuitry and magnetic head design.



Senior Display Engineer

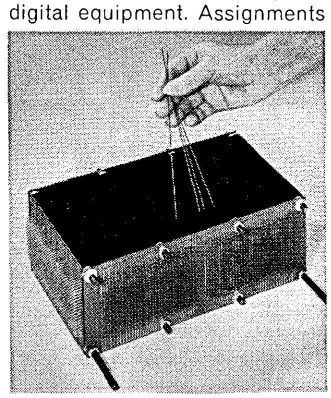
We are seeking an engineer with 1 to 3 years' experience in display technology, with emphasis on the electronic design of commercial and military display devices. Requires BSEE or related degree.

Senior Research Engineer

Research in advanced computer techniques, stressing state-of-the-art hardware and experimental system work. Requires BS in engineering or physics and 5 years' experience in thin films or magnetics.

Intermediate and Jr. Computer Engineers

Experienced graduate EE's with 3 to 5 years in logic design and transistorized circuit design of digital equipment. Assignments



will entail logic and circuit design of buffer storage units and digital peripheral equipment.

INTERVIEWS AT THE FALL JOINT COMPUTER CONFERENCE, SAN FRANCISCO, OCT. 27-29

To arrange an appointment, call Ed Free during FJCC at the conference hotel, 362-3021. If you are not attending FJCC, please send resume immediately, including training, experience and salary history, to Bill Holloway, Personnel Department, or telephone collect.

The National Cash Register Company

NCR

ELECTRONICS DIVISION
2815 W. El Segundo Blvd.
Hawthorne, Calif.
Telephone: Area Code 213-757-5111

an equal-opportunity employer