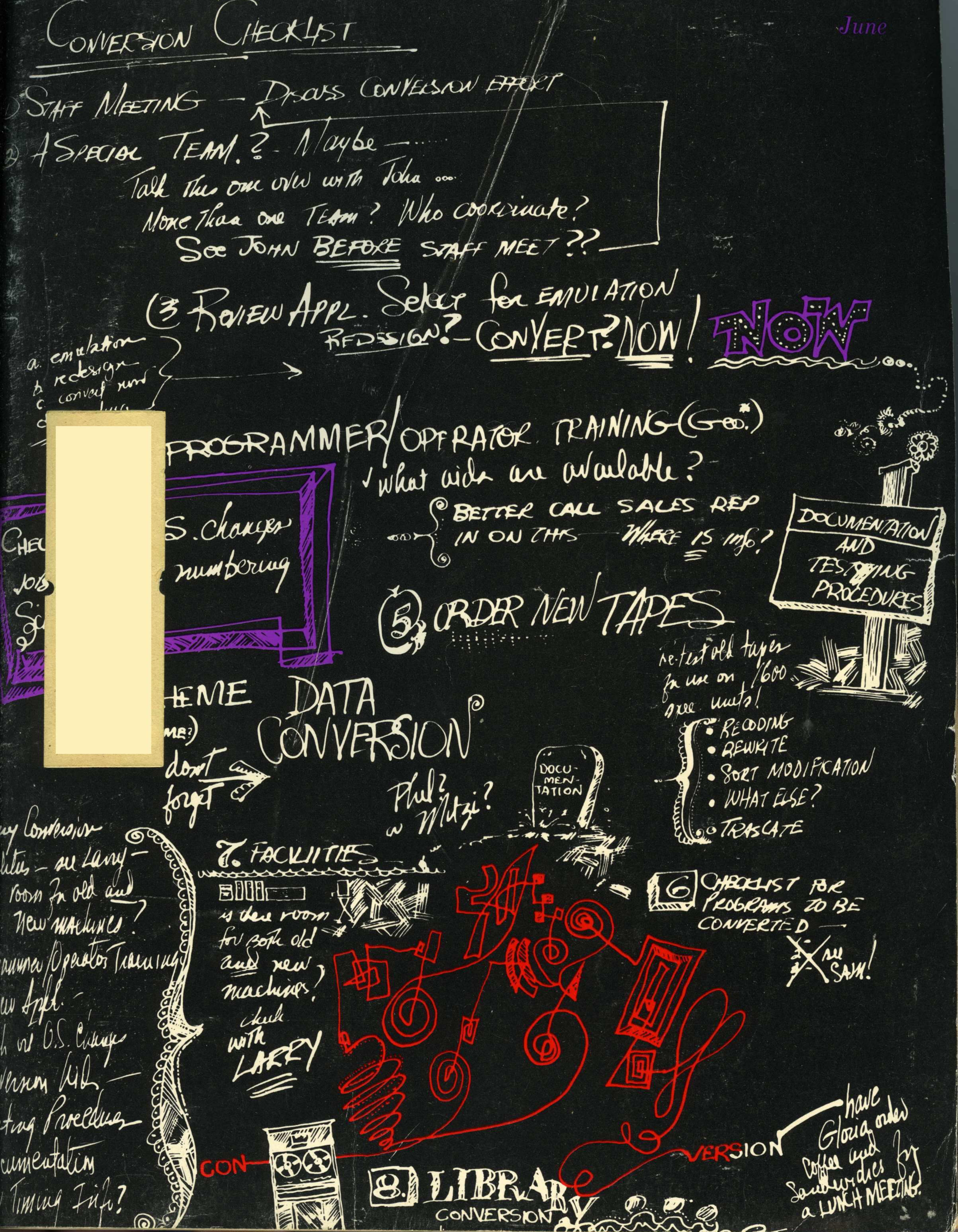
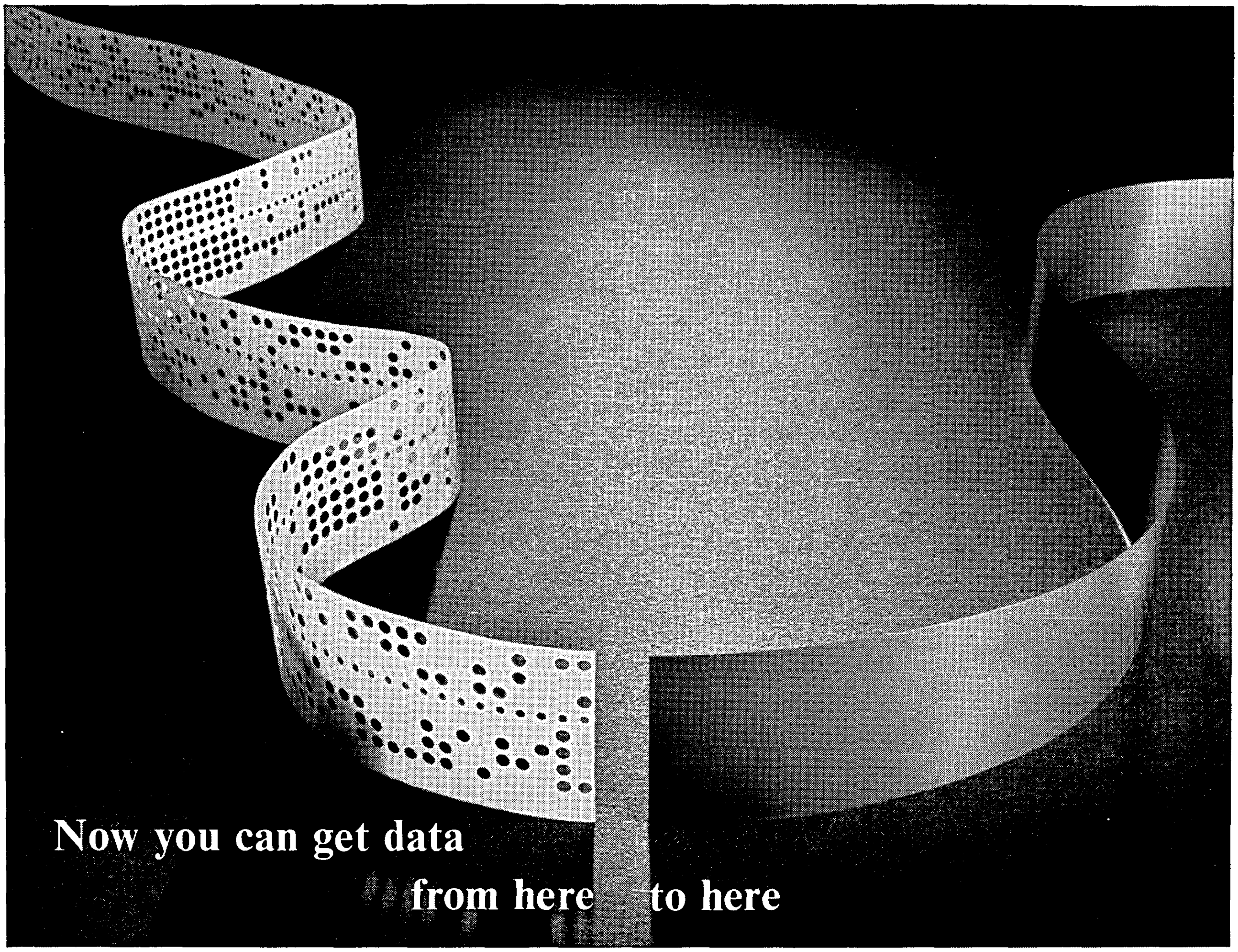
DATAMATION

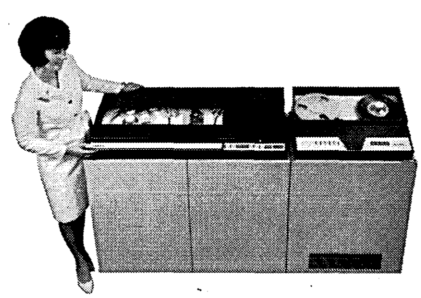
June





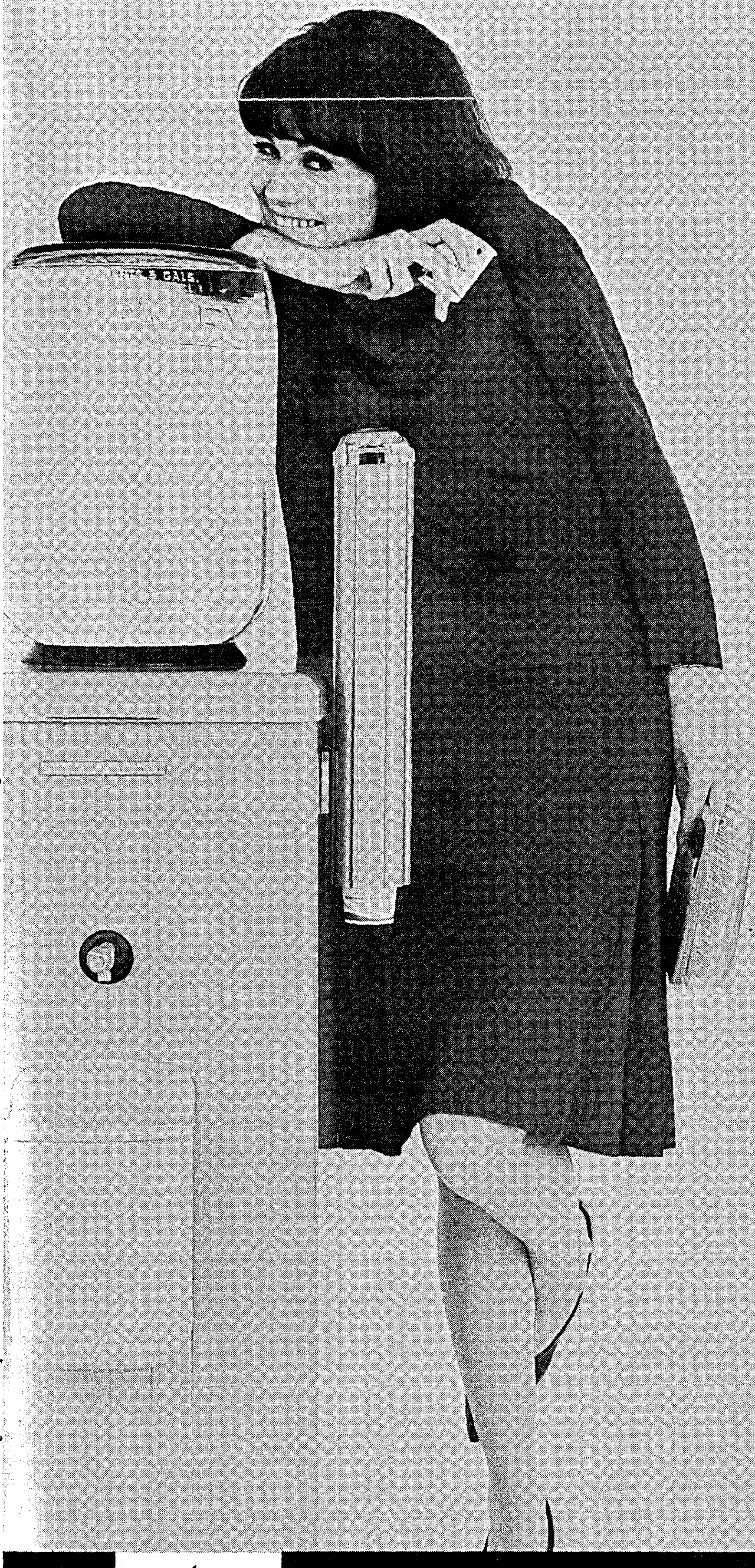
at twice the speed, one-fourth the cost.

Ampex punches more holes in current media conversion methods. You can put your computer back to full time computing. New Ampex *OFF-LINE* paper tape to magnetic tape conversion system saves you more time and money than any other method on high volume conversion requirements—and gives you error-free output tapes. The economical PTS helps you obtain maximum computer throughput while reducing your total processing costs.
PTS Speed: Reads 5 to 8 level punched paper tape at 1,000 cps, converts data to computer ready 7 or 9 track IBM/ASCII compatible magnetic tape with density up to 800 cpi.
PTS added features: Operates off-line as an inexpensive, rugged work horse. Simple, unitized control panel requires only one operator. Programmable memory for any code to any code conversion. Manual or automatic block length setting. Automatic editing of special characters.
PTS reliability: Extensive automatic system crosschecks assure that final data written on tape is error-free. Proven reliable paper tape reader and "no pinch roller" Ampex Single Capstan tape drive.
PTS by Ampex: Direct sale for less than $25,000—or your choice of lease plans. Write for information on the PTS. From Ampex, a world leader in magnetic tape recording. Write Ampex Corporation, Redwood City, California.



AMPEX

CIRCLE 1 ON READER CARD



Our optical reader can do anything your keypunch operators do.

(Well, almost.)

It can't goof off at the water cooler. Or file its nails. Or eat lunch. But it *can* read. And gobble data at the rate of 2400 typewritten characters a second. And compute while it reads. And reduce errors from a keypunch operator's one in a thousand to an efficient one in a *hundred* thousand.

Our machine reads upper and lower case characters in intermixed, standard type fonts. Handles intermixed sizes and weights of paper, including carbon-backed sheets.

An ordinary computer program tells our reader what to do . . . to add, subtract, edit, check, and verify while it reads. Lets you forget format restrictions, leading and trailing zeros, skipped fields, and fixed record lengths. And our reader will not obsolete any of your present hardware because it speaks the same output language as your computer.

Our Electronic Retina Computing Reader can replace all—or almost all—of your keypunch operators. At least that's what it is doing for the Chicago Board of Education.

If you have a volume input application, it can do the same for you. Tell us your problem and we'll tell you how.

CIRCLE 4 ON READER CARD

RECOGNITION EQUIPMENT Incorporated

U. S. Headquarters: Dallas, Texas 214-823-8194

Offices in principal U. S. cities and Frankfurt, London, Milan, Paris and Stockholm

Compu

The gap between the computer and you. Univac® closes it

The first of these computer communications systems is the UNIVAC DCT-2000.

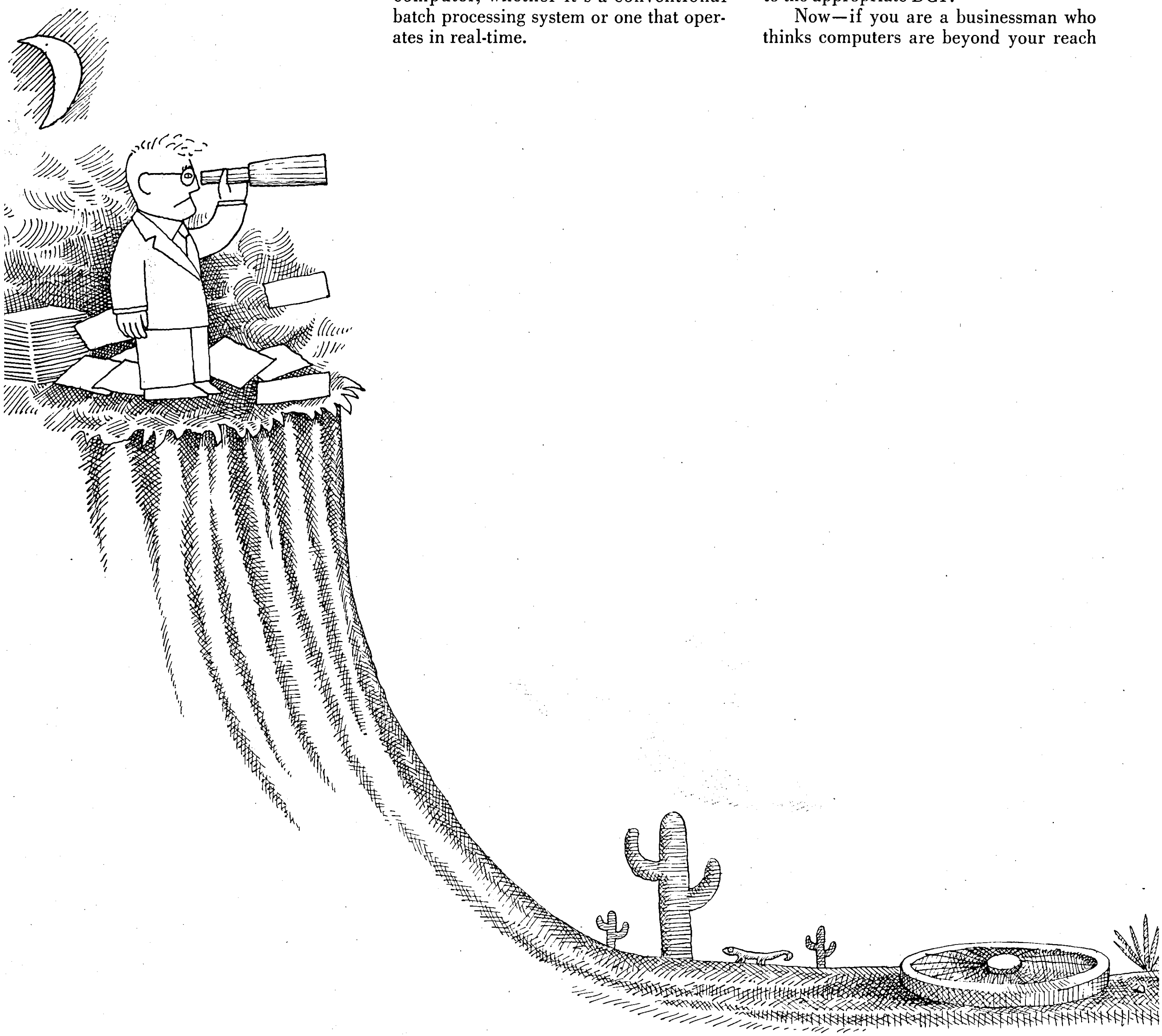
Prior to these flexible new data terminals, emphasis has been on either low or high speed terminal equipment. But for most business requirements low speed is too slow. High speed is too expensive.

Now you can get more out of your computer, whether it's a conventional batch processing system or one that operates in real-time.

With conventional systems, the DCT-2000 sends accumulated data on a scheduled basis.

In a real-time mode the UNIVAC DCT-2000 sends data to the computer at any time. Or a network of DCT's can send data simultaneously. All of it will be processed and returned almost immediately to the appropriate DCT.

Now—if you are a businessman who thinks computers are beyond your reach



june
1966
volume 12 number 6

Publisher	**GARDNER F. LANDON**
Editor	**ROBERT B. FOREST**
Managing Editor & Art Director	**CLEVE MARIE BOUTELL**
Associate Editors	**EDWARD K. YASAKI**
	WILLIAM J. ROLPH
Assistant Editor	**HEIDE E. HESS**
Eastern Editor	**ANGELINE PANTAGES**
European Editor	**CHARLES WHITE**
Contributing Editors	**HOWARD BROMBERG**
	ROBERT V. HEAD
Washington Reporter	**PHIL HIRSCH**
Editorial Adviser	**ROBERT L. PATRICK**
Technical Consultants	**DANIEL D. McCRACKEN**
	LOWELL AMDAHL
Production Manager	**MARILEE PITMAN**
Circulation Mgr.	**ALGENE TRAINA**

Eastern District Managers — **JAMES M. MORRIS**, **WARREN A. TIBBETTS**
141 E. 44th St., New York N.Y. 10017
[212] MUrray Hill 7-5180

New England District Manager & Vice President — **WARREN A. TIBBETTS**
112 West Haven Rd., Manchester, N.H., [603] NAtional 5-9498

Midwest District Manager — **JOHN BRENNAN**
205 West Wacker Drive, Chicago, Ill. 60606
[312] Financial 6-1026

Western District Manager & Vice President — **HAMILTON S. STYRON**
1830 W. Olympic Blvd., Los Angeles, Cal., 90006
[213] 385-0474

EDITORIAL OFFICES
1830 WEST OLYMPIC BLVD.
LOS ANGELES, CALIF. 90006

BPA
Circulation audited by
Business Publications Audit

ABP
Member,
American Business Press, Inc.

DATAMATION is published monthly on or about the tenth day of every month by F. D. Thompson Publications, Inc., Frank D. Thompson, Chairman; Gardner F. Landon, President; Gilbert Thayer, Senior Vice President. Executive, Circulation and Advertising offices, 141 East 44th Street, New York, New York 10017 (Murray Hill 7-5180). Editorial offices, 1830 W. Olympic Blvd., Los Angeles, California 90006. Published at Chicago, Ill.
DATAMATION is circulated without charge by name and title to individuals who qualify by our standards and are employed by manufacturers or users of automatic information-handling equipment in all branches of business, industry, government and the military. Available to others by subscription at the rate of $15.00 annually; single issues (when available) $1.50. Reduced rate for qualified students. Foreign subscriptions are on a paid basis only at a rate of $25.00 annually. No subscription agency is authorized by us to solicit or take orders for subscriptions. Controlled circulation paid at Columbus, O. and Chicago, Ill. Form 3579 to be sent to F. D. Thompson Publications, Inc., 205 W. Wacker Dr., Chicago, Ill. 60606. Copyright 1966, F. D. Thompson Publications, Inc. Microfilm copies of **DATAMATION** may be obtained from University Microfilms, Inc.; 313 No. First St., Ann Arbor, Michigan.
Printed by Beslow Associates, Inc.

This issue 62,618 copies

NASA's new Raytheon 520 Computer and Hybrid Linkage System beats specs by 33%

CHAN. NO.	ADC VALUE	DAC VALUE	PER CENT DIFFERENCE	CHAN. NO.	ADC VALUE	DAC VALUE	PER CENT DIFFERENCE
0000515							
00	+17777	+17777	+.000	01	+17777	+17777	+.000
02	+17777	+17777	+.000	03	+17774	+17777	-.037
04	+17777	+17777	+.000	05	+17775	+17777	-.025
06	+17777	+17777	+.000	07	+17777	+17777	+.000
08	+17776	+17777	-.013	09	+17775	+17777	-.025
10	+17777	+17777	+.000	11	+17777	+17777	+.000

Typical test results for 520 Hybrid Conversion Sub-system.
Test loop includes attenuators, multiplexer, parallel sample and hold, A-D/D-A converters and 100 volt amplifier output.

test 0000515 proves it

So did all the other tests performed on this digital computer and hybrid linkage system before it was shipped on schedule to NASA's Marshall Space Flight Center facility at Slidell, Louisiana for simulation of space vehicle control systems, structure and fluid thrust coupling, trajectory optimization and lateral-load and wind-profile studies.

Procurement specs called for maximum analog loop error of ±0.055%. But test after test showed actual errors much lower, ranging from 0.000% to a high of ±0.037%, 33% better than required. Average error for 12 channels was ±0.008%.

This kind of performance is gratifying, but not entirely unexpected. The conversion sub-system linking the Raytheon 520 with an existing 231RV analog computer was designed to be accurate, providing 13 bits plus sign, parallel sample and hold and buffered digital-to-analog converters to eliminate skew in sampling and desampling.

NASA's system includes Raytheon's new Multiverter®, a single unit combining integrated circuit multiplexing, a sample and hold amplifier with an aperture time under 50 nanoseconds and 4 microseconds settling time to 0.01% accuracy, and a 0.01% analog-digital converter.

Other features of the 520 hybrid system include readout of all points accessible to the 231RV addressing system, 520 control of servoset potentiometers, and sensing and control of 231RV computer modes such as Static Check, Rate Test, Pot Set, Reset, Hold and Operate. Up to nine analog computer consoles can be handled. A 1200-hole supplemental logic patch panel is provided with a complement of logic elements.

Raytheon's hybrid computing software includes Real-Time FORTRAN IV, FLEXTRAN (a macro assembler) and the BOSS monitor. Hybrid programs provide mode control, pot setting, readout, conversion, sense and control line activation and priority interrupt operation.

The Raytheon 520 is a 24-bit small/medium scale computer for hybrid computing, real-time systems and general purpose scientific and engineering applications. It's now being specified for installations in the $100,000 to $300,000 range. New capabilities include a 1 μsec main memory, Keyboard CRT, Disk Pack, Direct Memory Access and Drum. All the facts are in Data File C-127.

RAYTHEON COMPUTER
2700 South Fairview Street
Santa Ana, California 92704

RAYTHEON

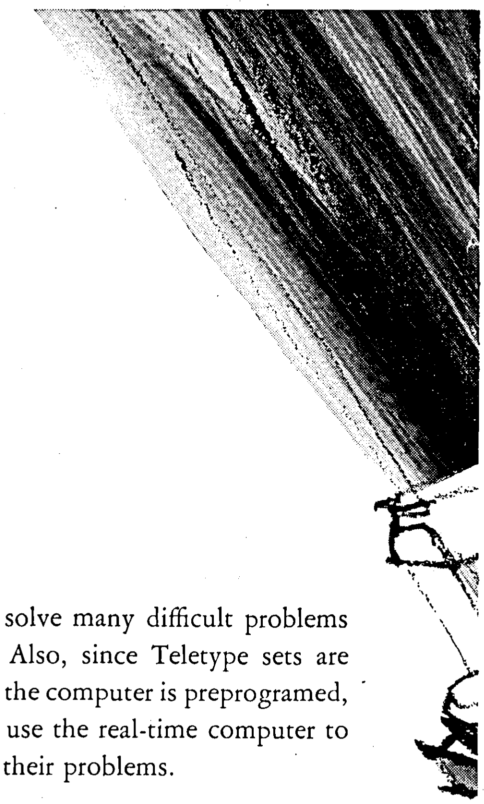
DATAMATION®

june
1966

volume 12 number 6

automatic information processing for business industry & science

datamation departments



calendar

● National symposium of the Federal Government Accountants Assn. featuring edp papers and exhibits will meet June 15-17, Radisson Hotel, Minneapolis, Minn.

● Congress of the International Federation of Automatic Control will be held in London June 20-25. Sponsors are U.K. Automation Council and Secretariat of the IFAC and National Member Organizations. Fees: delegates, \$60; authors of papers, \$50.

● International conference of the Data Processing Management Assn. is scheduled for June 21-24, Hilton Hotel, Chicago, Ill.

● Symposium on mathematical and computational methods in the social sciences will be held at the International Computation Center in Rome, July 4-8. Fee: \$25.

● Institute in technical and industrial communications will be held July 5-9, Colorado State Univ., Fort Collins, Colo. National Center of Communication Arts and Sciences is a co-sponsor with the university.

● The users group for small IBM computers, COMMON, will meet July 6-8, Denver Hilton Hotel, Denver, Colo.

● Conference on data acquisition and processing in biology and medicine is scheduled for July 25-27, Univ. of Rochester Medical School, Rochester, N.Y.

● Colloquium on computers and language will be held July 28, The RAND Corp., Santa Monica, Calif.

● "Time-Sharing" will be the theme of the Northwest Computing Assn. conference to be held August 11-13, Seattle, Wash.

● SHARE XXVII will meet August 15-19, Royal York Hotel, Toronto, Ontario, Canada.

COURSES:

June 27-July 1, Modern Methods in Analog Simulation, Illinois Institute of Technology, Chicago. Sponsor: Electronic Associates Inc. $250.

June 27-July 1, Computer Graphics, Ohio State Univ., School of Engineering, Columbus, O. $150.

June 29, Data Link Seminar, IIT Research Institute, Chicago, Ill.

July 11-15, Dynamics and Control of Process Systems, Princeton (N.J.) Computation Center. Sponsor: Electronic Associates Inc. $200.

July 11-22, Modern Theory of Communication, Ohio State Univ., School of Engineering, Columbus, O. $275.

July 11-22, Computerized Simulation of Market and Competitor Response, Sloan School of Management, MIT, Cambridge, Mass.

July 12-14, Information Retrieval: Today and Tomorrow, Sheraton Eastland Motor Hotel, Portland, Me. Sponsor: Computer Usage Education Inc. $195.

July 18-22 SIMSCRIPT, Modeling and Simulation, Southern Simulation Service, Tampa, Fla.

July 18-22, Analog Simulation and Computation, Princeton Computing Center, N.J. Sponsor: Electronic Associates Inc. $200.

July 18-29, Analysis and Design for Automatic Control, Hobart and William Smith Colleges, Geneva, N.Y. Sponsor: Instrument Society of America. Application deadline is July 7. $385.

July 18-29, Real-Time Information Systems, Univ. of California Extension, Los Angeles. $300.

July 25-29, 8800 Operation, Princeton Computing Center, N.J. Sponsor: Electronic Associates Inc. $200.

July 25-August 5, Computer Control Systems Technology, Univ. of California Extension, Los Angeles, Calif.

July 26-28, The Reprogramming Problem, Jack Tar Hotel, San Francisco, Calif. Sponsor: Computer Usage Education Inc. $195.

August 8-12, Urban and Regional Information Systems, Univ. of California Extension, Los Angeles, Calif.

August 9-11, IBM System/360 Software, Sheraton Eastland Motor Hotel, Portland, Me. Sponsor: Computer Usage Education Inc. $195.

August 18-19, Introduction to Symbolic Control, IIT Research Institute, Chicago, Ill.

August 23-25, Time-Sharing, Jack Tar Hotel, San Francisco, Calif. Sponsor: Computer Usage Education Inc. $195.

letters

standards & software

Sir:

The editorial, "The Missing Data Base," (Mar., p. 21), concerns two subjects which should be of vital concern to the entire industry—software costs and standards. Yet we find a large segment of the using public insensitive or unaware of these problem areas. This irresponsibility is apparent in the user comment made at the recent SHARE meeting concerning PL/I, to the effect, "Let IBM go ahead with it. We want a PL/I compiler now." At this same meeting, Mr. Watson of IBM pointed out that 360 software costs ($60 million for '66) will exceed those for hardware. Do users believe they are getting software free of charge? It is distressing that such attitudes persist.

The process of developing standards is agonizingly slow but can be considerably improved by increased industry awareness of the entire standards activity and by determined participation on the part of users and equipment suppliers.

A. J. WHITMORE
Westinghouse Electric Corp.
Pittsburgh, Pennsylvania

Sir:

World Report (April, p. 149), mentions that the European Computer Manufacturers Assn. (ECMA) has formed a technical working committee on PL/I. This information is more interesting when it is realized that the formation of this TC 10 was decided in November '64, and the first meeting was held in January '65. The committee—the first international group dealing with PL/I—has been extremely active since then, working hard on a hard subject. All available updated information has been provided for the members.

During this time, the U.S. edp community tried "to achieve coherence in their own ranks" as General Sarnoff would say. In August '65, I attended a meeting of manufacturers and users in New York, and proposed the full cooperation of ECMA to an American PL/I committee, if formed. Almost all attendees gave definite reasons against such a committee. However, in the meantime, X3.4.2 has been born, trailing TC 10 by over a year. I am happy to re-state here our full readiness for close cooperation. National edp standards are of little value unless they are compatible with internationally accepted and implemented standards, because only these can ensure improvement of information interchange.

D. HEKIMI
Secretary General
European Computers Manufacturers Assn.
Geneva, Switzerland

the pushbutton telephone

Sir:

Dr. Leon Davidson's article, "A Pushbutton Telephone for Alphanumeric Input" (April, p. 27), proposes that the special characters *lambda* and *rho* be suffixed to numeric digits in order to encode letters of the alphabet. I can think of at least one good reason for making them prefixes: the computer receiving the codes should be capable of immediately generating a voice equivalent and "speaking" it so that the button-pusher can verify that he has entered the right combination. The method suggested in the article requires the computer to wait for the next transmitted character before it can decide what the last character really meant.

Furthermore, if *lambda* and *rho* are treated as binary zero and binary one, and if the digit zero is assumed to be a delimiter, then the user can enter any character using a six-bit or eight-bit code, or some special code. This facility makes immediate computer voice response imperative. The entry of *lambda* and *rho* twice could be taken to mean "change mode" and "stay in this mode." To the extent that successive letters belong to the same mode, this could reduce entry times appreciably.

ARTHUR L. DE MUNITIZ
Los Angeles, California

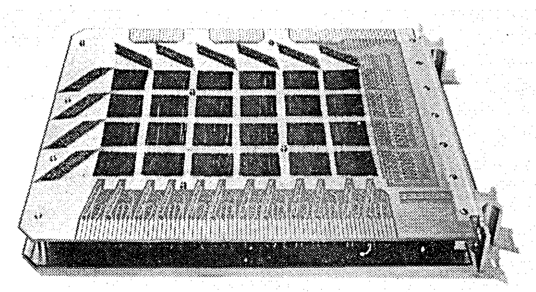
Sir:

I suggest that Dr. Davidson has not given alphanumeric input serious consideration from the user's point of view. Is there a need to provide alpha input from telephones? I remain unconvinced.

The explanation of the mechanics of this input uses 12 keys. Why 12? Elsewhere the article mentions that capability has already been provided for 16. This reduction in key capacity certainly makes the author's answer more difficult and contrived.

And then the solution! Alpha input by anybody with a touch-tone telephone and a simple knowledge of our alphabet . . . the letter "A", that's Key 2, followed by Key*, and so on for the whole alphabet. Incredible! At least, if the alphabet had to be divided into three sub-sets, couldn't

When you ask for Fairchild's new 2.5D Planar Arrayed Coincident Expandable memory stack, with cam lock connectors, 30% fewer connections, and all-welded terminations, including diode modules, just ask for PACER[T.M.] memory stack.



It's faster.

FAIRCHILD
MEMORY PRODUCTS

Department of Fairchild Camera and Instrumentation Corporation, 2525 Charleston Road, Mountain View, California 94040. Telephone: 415-962-2917 TWX: 910-379-6949

CIRCLE 13 ON READER CARD

he divide the alphabet into thirds and arrange them accordingly so that the ordinary user could have *some* basis for remembering if a character needs just one or another or both of two other character keys for proper encoding?

Obviously alphabetic input, regardless of machine capability, will not become feasible for humans without a full alphabet keyboard (or with minor deletions in certain languages—"C" for example, is fully replaceable in English by either "K" or "S") with a minimum matrix size of 3 x 9 or 4 x 7 etc.

ELI NADEL
Miami, Florida

The author replies: these letters illustrate the problem of introducing a new technology without an actual "hands-on" demonstration. Mr. de Munitiz would possibly recant his first paragraph if he could try out, himself, the procedure he recommends, using a real system. For one thing, he would not be willing to wait for a speak-back of each character before hitting the next character (even if the system designer allowed loading down the system by giving each input character the full "input message/response message" treatment). Furthermore, using the 11th and 12th buttons as suffixes allows the user to obtain visual clues from the position of the desired character on its digit button (left, middle, or right) *before* he as to select the function button (11 to 12). This, by the way, also answers Mr. Nadel—since there is no need to *remember* the layout or the encoding, one can *look* at the buttons every time, if one wishes.

As for Mr. de Munitz's excellent suggestion that binary bit strings be allowed as input, this can be handled by the numeric-entry mode described in my article, without use of the "left" or "right" buttons. Merely use the regular "1" and "0", and use any other digit (say "9") as the delimiter. There is no need to sacrifice the flexibility of function of the "left" and "right" buttons for this purpose.

To respond briefly to Mr. Nadel's remark: "Why 12 keys?" Because 12-button sets are in mass production, and 16-button sets are not.

Mr. Nadel's opinions about full alphabetic keyboards, and his doubt as to the need for alpha input, are matters of opinion. This area is best left to market researchers for evaluation. IBM's press demonstration in April, of a 12-button phone input system for high-school students' homework, shows that the future of the system which I described can't be as dismal as Mr. Nadel believes.

Sir:

There might be several advantages to arranging the alphanumerics in accordance with Hollerith (see Fig. 1), thus enabling more direct input to the computer or easy reading of undecoded hard copy. Such inputs would be convenient for updating the data base and management information systems, without the necessity for special devices at a few hotels or corporate branches throughout the country. To one side of the telephone keyboard, a list of special characters could be printed. Since these would each be coded with more than two buttons, such characters could be designated preceding the entry with a double slash. Although cumbersome, this would allow an enormous number of

Fig. 1

1 AJ/	2 BKS	3 CLT
4 DMU	5 ENV	6 FOW
7 GPX	8 HQY	9 IRZ
Left Zone 12	Mid Zone 11	Right Zone Zero

special symbols to be entered, thus suiting every user.

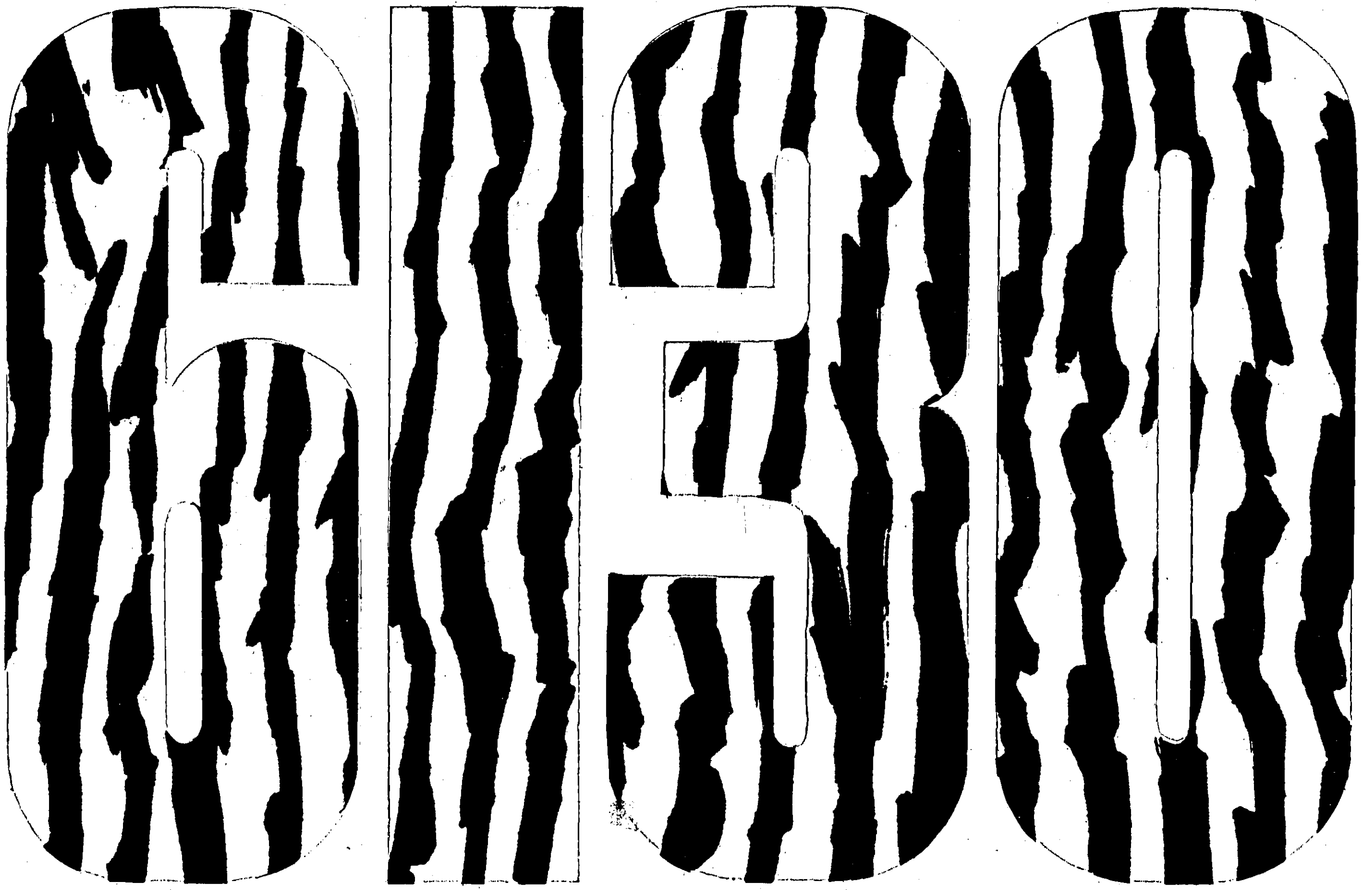
One human factor that is needed is single-character cancellation. Most of us discover a dialing error (if we discover it at all) just after making it. A mark could be placed after the mistake by pressing the three Zone buttons. Thus, if the dialer hit the "9" button instead of the "8", cancellation could be indicated by adding the three zones, or in the case of the "R" (9 + Middle), by adding the Left and Right buttons. The actual cancellation would be accomplished by the computer at the receiving end. For visibility checks lights behind the button could go on when the corresponding code was pressed—e.g., pressing button "1" would light the "1" on the button and addition of Zone 12 would shift on the light for "A" behind the button.

A. K. EMRICH
Kensington, Maryland

The author replies: This letter typifies the many possible variations which can be developed on keyboard layouts. However, his arrangement would be of use chiefly to certain small groups such as programmers, and might therefore best be provided by use of an overlay, rather than by expecting that some telephone sets be manufactured to this special pattern. He also calls attention to the need for a "cancel" code. I found that alternate strokes of "left" and "right" buttons (four or more in total) served this purpose unambiguously.

Datamation welcomes your correspondence concerning articles or items appearing in this magazine. Letters should be double spaced . . . and the briefer the better. We reserve the right to edit letters submitted to us.

ASI Computer Division-EMR, announces the first in the ADVANCE 6100 Computer Series



the paper tiger with teeth...

The new 6130 computer system from the ASI Computer Division of Electro-Mechanical Research, Inc. is not available for immediate delivery. Some will call it a "paper tiger." This computer, however, is a formidable one, fully equipped for data acquisition systems and other industrial applications. It's designed to out-perform <u>all</u> competitive machines in the low-cost area.

Check some of the features of the ADVANCE 6130 and you'll see it's worth waiting for—

- 16-bit data word plus parity and memory protect bits.
- 0.9 microsecond memory cycle time.
- Monolithic integrated circuitry.
- Multiple bus system of organization which allows parallel communication and control between central processors, I/O channels, peripheral units, and/or various memory modules.
- Low price, $34,000.

For more information, contact any of our sales offices or our Marketing Department in Minneapolis directly.

ASI COMPUTER DIVISION EMR

8001 Bloomington Freeway, Minneapolis, Minn. 55420

CIRCLE 16 ON READER CARD

look ahead

A STANDARD SOLUTION
TO CONVERSION PROBLEMS?
Newest entry into the hectic computer sweepstakes is Standard Computer Corp. of Phoenix. Not to be confused with Standard Computers, Inc. (Philly leasing firm), SCC will shortly announce a third generation computer (Fairchild CTL monolithic integrated circuits) which will handle second generation software (e.g., 7094 programs will run in machine language). Several cpu's will be available, featuring main storage of 196K six-bit bytes or 131K eight-bit bytes. Internal data handling speeds will range from 350 nanoseconds to 3.5 usec. Tape channels will be able to handle 30, 60, or 90 KC (800 bpi) tape units.

The company, formed in March '65, says that system rentals will range from $6,500 to $18K/month. The first two systems will be shipped next month; firm orders for six more to be shipped this year are in house. The new gear might offer an interesting solution to the conversion problem (see this month's cover feature articles), and the cries of "I like IBSYS now" heard at SHARE a few months back.

AIR FORCE RELEASES CAPTIVE
A report by an ad hoc Congressional committee recommending that System Development Corp. be treated by the Air Force Systems Command as an independent contractor has won official AF approval.

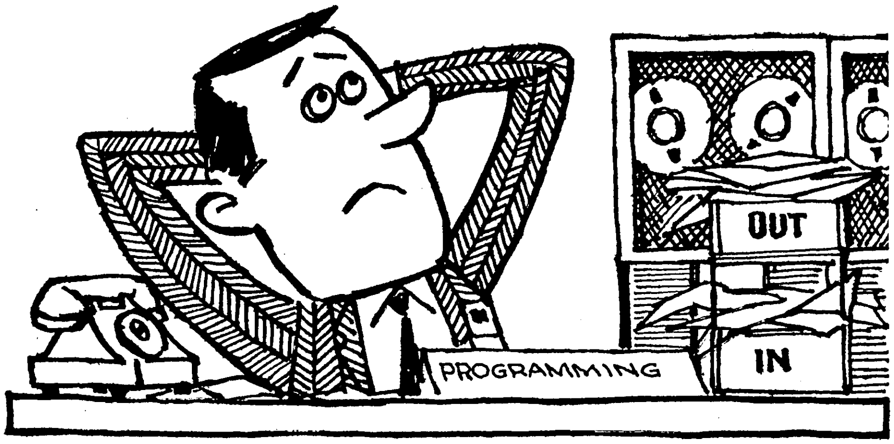
Thus the company will henceforth bid on AF work; there will be no more sole-source procurements. Right now, about 82% of SDC's work comes from the Air Force. That figure may drop. SDC says it will continue to offer its service to "public-serving organizations," which in the past has included a CPA institute and a state hospital association, as well as state and local governments, universities, etc.

SDC says it will continue to take about a 6% "profit" margin, which is earmarked for research. But such research in the past has included loaning, for free, technical people to, say, a local gov't agency. The resulting expertise is used to pursue contracts for similar work at other agencies. Whether SDC can continue such practices and still compete with lean, hungry commercial software houses is the big question.

THE HARD LIFE OF SOFTWARE
Some uncertainty about the delivery date of the PL/I H compiler is indicated by the April IBM OS/360 delivery schedule. The H was to have been coded in PL/I and compiled by the F (44K?) compiler, but now it won't be: the F has run into some snags and slipped to an August 31 delivery. COBOL F storage requirement has increased from 44K to 64K, meaning users will need 128K of core storage to accommodate it. Though IBM is trying to decrease this.

Big systems users feel hardest hit by the slip of the control program for multiprogramming (variable number of tasks) from Nov. '66 to second quarter of '67. Too, model 67's delivered before then will have to deal with pre-tested versions of this program and of the time-sharing operating system which is promised for June '67.

Don't read about AUTOFLOW* unless you need documentation help



If you are that one-out-of 31,391 computer users without documentation problems—you don't need AUTOFLOW.

AUTOFLOW, is ADR's Computer Documentation System designed to assist programmers produce accurate flowcharts, automatically, from assembly language input.

The only programmers who need (or recommend) AUTOFLOW are those who want an easy to use, easy to learn, no-extra-effort documentation system. With AUTOFLOW, the programmer doesn't worry about any graphic considerations. AUTOFLOW produces the flowchart, allocates symbols, edits, rearranges coding, allocates pages and columns, and draws connecting lines.

And because AUTOFLOW reduces documentation, maintenance, and reprogramming costs—management likes it too. (We'll supply 7 more reasons if you ask.)

Operational since early '65, AUTOFLOW has been acclaimed both as the significant tool for controlling documentation quality and accuracy, and a superior method of establishing program documentation standards and rules.

The AUTOFLOW—Computer Documentation System is available for IBM 1401, 1410, 1460 and System/360; RCA 501 and SPECTRA 70, and Honeywell 200.

Request detailed operational information and modest prices on leasing arrangement by completing the attached form.

You can get out of the documentation doldrums—discover AUTOFLOW today!

APPLIED DATA RESEARCH, INC.
206 Center, Route 206 Princeton, New Jersey 609-921-8850
Offices in Princeton, Washington, New York and Los Angeles.

*Trademark Patent Pending

☐ **Yes.** Prove that AUTOFLOW can help me.

☐ **No.** Don't help! I prefer tedious, expensive, inaccurate documentation

I am also interested in:

- ☐ Management Sciences
- ☐ Software Development
- ☐ Applications Programming
- ☐ Research
- ☐ Equal Opportunity Employment at ADR

Name__________

Title__________

Co.__________

Address__________

City_____ State_____ Zip_____

CIRCLE 17 ON READER CARD

NCR operates in one of the most challenging and constructive of all business fields. Our chief effort is directed toward helping business operate more effectively. This is accomplished through providing better and complete data processing systems.

NCR's new product releases during the past year averaged more than one a month, and ranged from a major new computer family to a new line of cash registers. The development of NCR's "Total Systems" concept has contributed substantially to the companies growth.

As worldwide sales continue to increase, many different skills are presently in demand at NCR for the installation of total data processing systems. Current requirements are in Dayton and other locations mentioned below.*

In the communications area, latest availability dates for the telecommunications (queued) control programs and I/O support for the 2311 data cell drive are supposed to be announced this month. In the meantime, the interim measure -- the Communications Control Application Program, which is independent of OS 360 -- is just now in its final test state, and most users are finding they have to modify it. Result: a new user's group of about 30 companies has been formed; one purpose: to nudge IBM into giving CCAP full support and possibly into developing an improved version.

Other software delays since December: 44K Assembler -- 4 months to Sept. '66; 200K FORTRAN IV -- 6 months to Dec. '66. On the bright side, a two-man SHARE team allegedly reports F assembler offers 10-20 times the speed of the E, although one 50 user says it's more like 5 times.

UCLA ALMOST DROPS THE BALL

Alumni and friends of UCLA are disturbed at the computing situation there. A complex chain of events almost led to the loss of a $1.4-million ARPA-sponsored computer network study. One UCLA spokesman blames slow government funding, although dough from a previous ARPA contract kept the project nominally alive for awhile. Then four key programmers left, another six were dropped or re-assigned. An order for $400K-worth of high-speed communicating gear was cancelled, but the remaining megabuck will probably be re-assigned to a modified, reduced network study, headed by Clay Sprowls (he goes on sabbatical July 1); and to the School of Engineering, which will instrument computers in an attempt to measure hardware, system and user program performance.

I.C.-COMMUNICATIONS BREAKTHROUGH BATTLE LOOMS

One far-out hardware designer who labels himself a conservative says that the latest integrated circuits will make such a big cost breakthrough in the next 3-5 years that it could spell doom for time-sharing and multiprocessing. Says he, the new i.c.'s, with an entire register on a single chip, could bring about a cheap, small computer ($100/month) to be attached to a peripheral device. The combo would offer more capability than a 1401.

Another hardware expert doubts things will happen that fast, points out that reductions in data transmission rates could offset such effects of i.c. breakthroughs. It's conceivable, says the second man, that with your own satellite, you might be able to achieve coast-to-coast transmission rates of 5¢/hr.

THE NEW LOOK AT AEROFLEX

A simple inexpensive photographic system that uses one negative to store up to 400 high-resolution images all the same size as the negative. The equipment and techniques for such a system have been developed by Aeroflex Laboratories, Inc., Plainview, N.Y., and manufacturers from all over the computer, crt display, document retrieval, camera and other industries have been sending their scouts there to find out if and how they can use it. The method of the Multiplex Recording Technique, developed last October, is not disclosed, as nine patents are pending.

MRP inventor Clayton Houghton notes that the modular system, using a projector which can display more than one image from a negative at a time, could replace tape units and crt displays in some

(Continued on page 135)

You'd have to be crazy to publish a firm software delivery schedule. Here's one for Sigma 7:

Fourth quarter 1966. Stand-alone package, operating without a monitor in minimum storage. Includes SDS standard FORTRAN IV, a standard Assembler, a Library of Mathematical and Utility Routines, and a program debug package. This package permits you to operate one job at a time—either a real-time or a general-purpose job.

First quarter 1967. The first level of SDS monitors, called Basic Control Monitor. All the stand-alone software is available under the monitor, and you can now do two things simultaneously—a real-time job in the foreground, and a general-purpose job in the background.

Second quarter 1967. You step up to Batch Processing Monitor, a much more comprehensive monitor, plus this additional software:

SDS Extended FORTRAN IV, debug version, oriented toward program checkout.

High-Efficiency Extended FORTRAN IV, oriented toward efficient object programs.

Extended assembler (Meta-Symbol).

ADAPT, an application-oriented package for numerical control of machine tools.

Third quarter 1967. Debug version of PL/I.

Fourth quarter 1967. Conversational versions of FORTRAN IV and PL/I; standard version of the Universal Time-Sharing Monitor; High-Efficiency version of PL/I.

Soon thereafter we will deliver the Extended version of the Universal Time-Sharing Monitor; MANAGE, a management information system which includes a Report Generator; a generalized Sort/Merge program, and other applications packages.

We're not promising to deliver a great big musclebound mass of all-purpose software all at once.

And we're not going to let you sit and wait for software after your Sigma 7 is installed.

We're going to deliver successive levels of software on a firm schedule. Every level is compatible with the next one, so that you'll move up to greater capability with each new package.

Sigma 7 software gives you a choice of three compilation modes—debug, high-efficiency, conversation.

All Sigma 7 software is reentrant.

Sigma 7 software is multi-use. It looks the same regardless of the mode of use of the hardware.

All Sigma 7 software has very low overhead. The muscle is where it counts.

All of the delivery dates are firm. We'll be glad to put them in writing. In an order.

Scientific Data Systems
1649 Seventeenth Street, Santa Monica, California
Offices in principal cities throughout the world

SDS

CIRCLE 18 ON READER CARD

editor's readout

HIS MASTER'S VOICE

For those of you old enough, the title above immediately calls forth an image of a dog sitting, head cocked in thoughtful attention, before the horn of a gramophone.

But let's talk about user groups. In the beginning, a user group was four guys with a bottle sitting in a room saying, "They can't do this to us." The fact that "they" did do that to "them" shouldn't obscure the fact that user groups have been, at times, highly useful and productive organizations. User groups saved FORTRAN, shaped PL/I, sniped at COBOL. They've served as audiences to stirring confessions about hardware and software slippages (in time and performance). They've tended to keep manufacturers a bit more honest than they might otherwise have been.

But it's doubtful that user groups have accomplished as much as they should have. And it's increasingly doubtful that they'll be as effective in the future as they have been. For one thing,, they're getting just too darned big. (COMMON is said to have 1000 members.) A subtle psychology of size makes it harder for a man to sound off in front of hundreds than it would be before a small group. And the bigger the crowd, the easier it is for the manufacturer to gain acceptance of ideas which might be hacked to pieces by a handful.

Too, user groups are tending to broaden the scope of their machine coverage. COMMON, formerly a 1620 user group, looks as if it will offer haven to 1620, 1130, and 1700 users, plus any 360 users who can't find a home in SHARE or GUIDE. Whether any user organization can effectively serve such a broad variety of interests is doubtful.

The fact that user groups (as now constituted) are tied to one computer manufacturer inhibits their devotion to problems which cross and rise above one company's line of equipment. The costly crimp placed on conversion by machine-dependent languages is one example.

So what about JUG (Joint User Group), which is supposed to pay attention to such lofty matters? Well, JUG is an organization of organizations. Which means that it's one level removed from the workers, the doers. Square the confusion and lethargy inherent in any group of part-time workers who meet occasionally, and you get the picture. We're not criticizing JUG; we're merely saying "that's human nature."

Standards, you want? JUG, the voice of the individual user (as distinguished from the user as a member of a trade association), has one vote on the American Standards Association information processing committee. BEMA, the voice of the manufacturer, has 12.

Still, JUG is trying. With a prod and an assist from the DEC user group, they conducted an administrative workshop for user group executives just prior to the '66 SJCC. Termed by those who attended as useful, the meeting produced a committee to investigate the possibility of a common program catalog, an idea introduced at JUG over a year ago. Another workshop is being planned for November.

Some folks argue that ACM could be the voice of the user. But why ACM should start now to do something it's avoided so far isn't clear. Besides ACM doesn't represent small, unsophisticated users. And, points out one man, the manufacturer supports user groups . . . might be more responsive to their wishes than to a professional society.

Others have tried to introduce the idea of manufacturer-independent user groups, conforming to application interests, not particular machines. One such idea was shot down last year by SHARE.

We don't know the answer. But we do feel that it is time for user groups to review and measure themselves against their goals: Are we really putting effective pressure on the manufacturer? Are we working toward establishing common means of measuring system performance, for instance? Are we tackling the important problems which go beyond any one manufacturer's equipment?

The need is clear. The talent and energy are available. All we have to do is stop listening to that damn gramophone and get to work.

PROGRAM AND FILE CONVERSION

plan your change and change your plan

by W. J. CARTLEDGE, JR.

The prospect of disturbing the status of hundreds of well-running programs and data files is not a welcome one for those who have never experienced a computer conversion, and it is even more fearsome to those who have been through such an effort. Careful study of the conversion problem for a given installation will usually lead to this conclusion—it's going to be even worse than you thought!

However, conversion can be tackled like any other large systems job: break it into pieces and deal with them one at a time. Perhaps the following suggestions for dealing with these "pieces" will be too idealistic in some cases, and may have to be compromised with real life. But if they at least provoke managers to serious thinking about the details of conversion, they will have served their purpose.

organization of resources

When does conversion begin and end? It may be said that conversion begins when people are assigned to work specifically in this area. Conversion is completed when people are no longer working with old programs. This implies, then, that people must be organized to begin work on conversion problems. People are needed to define the conversion problems peculiar to the installation; to design the standards and policies of conversion; to perform the actual recoding and testing; and, of course, to supervise the general conversion effort.

The particular organization of manpower depends on the degree of conversion problems for the installation. If the installation is largely using COBOL and has data files that need little or no conversion, then it is quite possible that the existing staff within the current organization structure may be all that is needed to perform the conversion.

On the other hand, an installation with more complex problems may require the manufacturer's assistance or outside contract programming services, as well as reorganization of the programming staff.

In any case, a specific organization should be set up: either the conversion will be accomplished by the programmers currently responsible for each program, or by a conversion team; both approaches have their advantages. Conversion by an assigned team provides better control over the conversion effort and certainly enables more uniform conversion, testing, and documentation practices with the responsibility placed upon one group. Also, a team will usually be better motivated to keep the conversion effort on schedule, or even ahead of schedule if present documentation is up to date and complete. A side effect of the team approach is that the converted programs will be understood by persons other than the currently responsible programmers, thus providing an alternate source for future maintenance.

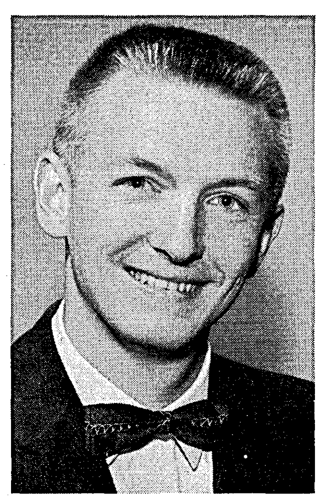
The team approach also allows the best utilization of conversion experience because these specialists will become quite familiar with the inevitable "unwritten" procedures that are pertinent only to the conversion process. Many stop-gap measures will be worked out as conversion progresses, in order to keep pace with changes in policy, equipment configuration, and available software. A small group working closely together would recognize frequently recurring conversion problems that could be solved or minimized by a special aid or procedure.

Conversion by the responsible programmers within the present organization has certain advantages as well. For one thing, a heavily patched program which needs to be cleaned up during conversion can best be handled by one who knows the program well. There would also be less confusion, since there would be no need for communicating undocumented program functions between programmers. Thus fewer man-hours would probably be needed to convert each program, although this time might be spread over a longer period due to the many interruptions for current program maintenance, etc., that compete for the programmer's attention. A by-product of this type of organization is the experience of coding and testing in the new language gained by the programmer so that he can handle maintenance more directly and with a better understanding of the over-all effects of future changes within his programs.

conversion planning and control

Planning the conversion effort is essential to success. The main considerations include:

1. Knowledge of available conversion aids
2. Priority schedule of applications to be converted
3. Conversion policies and standards



Mr. Cartledge heads the Technical Support section at Hughes Aircraft Co., Fullerton, Calif. The treasurer of GUIDE International, he has served as chairman of the S/360 conversion committee and was a representative to the IBM/GUIDE/SHARE joint conversion committee.

4. Cost accounting procedure

The user should review the literature on conversion aids available from the manufacturer and determine very carefully whether the aids are really useful or will possibly waste more time than they save.

Many installations have discovered that the generalized nature of some conversion aids has defeated their usefulness when applied to a specific installation. The user may determine that it would benefit him more to write his own programmed conversion aids. It may also be desirable to write some special programs to research any available machine-readable files used by the installation for scheduling or operating. These programs could be useful in developing statistics on machine usage and file usage, information which could be valuable in preparing a priority schedule of program conversion.

The next step in conversion planning is to segregate the current applications into:

1. Those to be emulated and left unconverted
2. Those to be redesigned
3. Those applications in which sorts could easily be converted now, and the rest of the program series redesigned later
4. Those to be converted by recoding or translation

Those systems which could operate indefinitely under emulation should include any programs that are rarely used—such as quarterly and annual jobs—and any systems which are expected to phase out in the foreseeable future. When most of the installation workload has been converted it may be more economical to discontinue the use of the emulator and execute any remaining old programs with a programmed simulator. This would only be economical when the additional machine time cost for running with the slower simulator is less than the rental of the hardware emulator feature.

Applications that would benefit significantly by taking advantage of advanced hardware features and I/O devices on the new equipment should be redesigned rather than just recoded. Others that might be included in this category are programs which are heavily patched or which require excessive program maintenance due to obsolete design.

Other applications which include many programs to be emulated, but which perform a great amount of sorting, would benefit considerably by direct conversion of only the sort runs, particularly if fast direct access devices will be used on the new equipment. At a later time, when it is more convenient, the rest of the programs related to those sorts could be converted.

Applications that are classified as convertible should be scheduled on a priority basis, taking into consideration several factors:

1. Does the application have to be ready to go when the new computer comes in, to meet management or contractual demands?
2. Will conversion of the application be relatively easy; is it essentially isolated from other programs, with few interfaces?
3. Do the application programs regularly use a large amount of machine time?
4. Does the application contain a large number of sort runs, either modified or unmodified?

Certainly any programs that must be ready when the hardware arrives should be scheduled early in the conversion effort. Those applications that currently use much machine time would be profitable to convert in time to build up a minimum work load on the new equipment. However, it is suggested that programs that will convert easily should be done first to give the conversion programmers an opportunity to develop a systematic approach and gain confidence in their new tools.

It may be practical for some users to automatically translate current sort control cards to the new format by a special utility program. But there are obstacles to this approach. First, it implies that the sort input/output files must remain in their current form and, therefore, should be essentially compatible. Secondly, if disc drives are used as sort work files, the size of the input file must be known, to be sure it will fit. If the form and size of these files are not known, then an early investigation should be started to gather this information.

A successful conversion plan should include a schedule of activities and target dates and a check list of conversion tasks. Even though the schedule dates will be subject to frequent revision, it is still quite important in order to enable management to make adjustments in their plans. Besides itemizing the convertible applications and programs, the schedule should include:

1. Training classes for programmers and operators in the use of the hardware concepts, programming languages, and operating systems
2. Special conversion utility routines
3. Detail information required from the manufacturer regarding equipment and software timing figures, specific operating system features to be used, emulation functions, etc.
4. Implementation of the operating system as tailored to the installation, which may require major adjustments to the installation's job and file numbering procedure
5. Arrangements for use of remote testing and tape conversion facilities prior to equipment delivery
6. Procurement of tapes, disc packs, and data cells; and re-testing of older tapes to be used on higher density tape units
7. Conversion of current files to new media, either by converted application or en masse (e.g., 7-track to 9-track tapes via tape copy, or tape to direct-access device via utility routine)

A check list for each application and each program within the application can help to avoid overlooking minor steps in the conversion process, and should be developed during the first few programs that are converted. It could include such tasks as:

1. Review of present documentation package
2. Updating of source deck
3. Re-assembly of source deck
4. Program conversion steps
5. Preparation of file conversion control cards
6. File conversion test
7. File conversion operation
8. Program test
9. Final documentation steps
10. Final review

The user should be sure to provide guide lines for the conversion programmers so they may know what conversion aids are available for use, what procedure should be used in conversion testing and documentation, and what policies apply for file conversion and the use of the new hardware (such as main storage limitations, input/output device configuration, and integration with other systems).

The installation standards that are established are greatly influenced by the particular operating system to be used with the new equipment. Therefore, those who are responsible for developing programming standards must become thoroughly familiar with all of the options and alternatives of the operating system. They should also become acquainted with the particular programming languages expected to be used in the installation. Standards should be implemented by indoctrination and enforced by auditing of the completed conversion packages. Without some type of audit procedure, standards may be useless and the converted programs may be just as tangled as the old ones, or even more so.

Finally, good management requires an accounting of the manpower and machine time utilized in achieving conversion. It may be possible to adjust the installation's present accounting procedures to accommodate special conversion categories, or it may be sufficient to simply provide a manual system. Some users are receiving credit from the manufacturer for any computer time used to assist in conversion.

program conversion procedure

When it has been determined which applications are to be converted, then the documentation can be gathered for those programs requiring immediate attention.

The documentation to be compiled should include:

1. Program description
2. Application and program flow charts
3. Program listings
4. Record layouts
5. Test case material
6. Operating instructions
7. Symbolic decks
8. Object program decks
9. Any on-line card reader program packets

Of course, in order to continue production on the current equipment it may be necessary to leave the object program decks and card reader packets in Operations. In this case a listing of these cards (or program tapes) should be obtained and all future patches must be carefully controlled so that the equivalent functions can be included in the converted programs.

The program functions, interfaces, and data file compositions should be reviewed with a knowledgeable programmer so the conversion approach for each program may be determined.

Some useful information that may assist in conversion would include:

1. Current schedule and running time of each program
2. Current size of data files
3. Complexity of interfaces with other applications
4. Functions of peripheral computer programs (such as 1401) that should be incorporated
5. Essential refinements desired in the converted programs

Having determined that the application is to be converted by a recoding approach, the conversion procedure for each program may be one of the following:

1. *Translate* the current program by means of a Language Conversion Program (provided by the manufacturer or written by the user) if the current program is written in a high-level language such as COBOL or FORTRAN.
2. Manually *rewrite* the current program if the program language is mainly machine-oriented. If the new computer has enough main storage, it may also be possible to combine two or more programs and integrate their functions in the rewriting process.
3. Write *sort modifications* for the new computer system in some cases, a single modified sort program could replace two or three current programs, particularly where the only output of a program currently feeds a sort and/or the only input to a succeeding program comes from a sort.

The translation approach has certain prerequisites. First, the current source deck must be available and up to date and should be essentially free of machine dependent functions or data descriptions. Secondly, the data file formats must be acceptable to the new equipment. To verify the completeness and accuracy of the current source deck, it may be necessary to analyze the object program for any patches and then update the symbolic deck accordingly. In the case of extensive patching it may be advisable to re-assemble and test the updated deck to assure agreement with the patched object deck. It may also be desirable to adjust the data division for more efficient record layout, utilizing special features of the new equipment such as packed decimal or binary modes. After the translation by machine has been completed, any further refinements to the procedure division or adjustments to the data division can be added. Then it is ready for compiling and testing on the new system.

The rewrite approach requires a similar procedure to insure the integrity of the current documentation, but requires much more manual effort to complete. However, it also permits more flexibility in handling the program functions. Although it is presumed that the data file requirements are already defined, it may be possible or even necessary to specify a different type of I/O device for some of the files, such as using high speed disc storage instead of tape for small work files or using a master table available in mass storage and common to several programs, rather than an individual table designed solely for that program.

In some installations the existing record formats may have to be perpetuated, but other users may choose to take advantage of special packing features available on the new computer system and will prefer to redesign the record layout. Some current computer systems generate word-oriented tape files which would not be acceptable to the new computer system anyway. So, there would be nothing to lose in redesigning the record layouts for the most efficient usage. Extra caution must be used in formatting master files that are referenced by several programs: it may be necessary to perform file maintenance on *both* old and new files for an extended period, until all related programs are converted.

After the source deck and record layouts have been updated, the program flowchart should also be updated, or written anew if necessary. It may be convenient to use some of the documentation aids provided by the manufacturer for generating automatic flowcharts and cross-reference listings. However, if the current program language is mostly one-for-one symbolic instructions, it is doubtful that any but the most simple programs can be effectively and meaningfully flowcharted by machine. Since the purpose of the flowchart is to convey intent (which is obscure to a computer), this function is best performed by a good programmer. On the other hand, even a good programmer can appreciate the value of cross-reference and analysis listings. Some current assemblers already provide this documentation but, if not, a programmed documentation aid may be useful in obtaining it.

When the old program is brought up to date, the new program may be written in the language provided for the new equipment. A point to be considered here is the desirability of including all report functions within the new program. Whereas it may have been more practical in the past to write an unformatted report tape, the new equipment and new software can handle report writing functions quite easily. In some cases, though, as a matter of expediency, it may be possible to convert some programs in a shorter period of time if the report data is written in exactly its current form so that current system peripheral programs may still print the report under emulation, without any immediate report conversion effort involved. This is especially true if the program generates several report files.

Writing modifications in COBOL for the new sort software will enable some installations to make significant throughput gains. In the past, there have been two prevailing schools of thought concerning sort modifications. Some installations feel that sort modifications are too serious a hindrance to inevitable conversions. Other users have proved to their satisfaction that the machine time saved during the life of their current system was worth far more than the extra cost incurred during conversion. Now, with the ability to code sort modifications in COBOL, either by separate linkage to the sort or by use of the COBOL SORT verb, the needs of both philosophies can be met.

Since the I/O device configuration of the new equipment may be quite different from the current computer system, the effective capacity of the new sort package must be matched against the required record volumes to be sorted. Two potentially troublesome situations occur on System/360: if the user elects to remain in 7-track mode he cannot sort variable length records on tape; also, the capacity of the 2311 disc drives may severely limit the size of acceptable sort input files.

Program testing may become quite involved where file conversion must also be considered. Since actual record format conversion must be tailored to each specific program and file, it is almost a separate programming effort. Therefore, the most straightforward method of testing would suggest that the newly coded programs be tested independently with their own manually prepared test data. Then the effects of file conversion can be tested later when the functions of the converted program are known to work properly. A separate check list of steps for each program is particularly valuable during the program testing and data conversion procedure.

data conversion procedure

Current installation practices, hardware configuration, and conversion policies will determine the complexity of data file conversion. Installations currently using character-oriented machines (e.g., the IBM 1410 and 7080), will probably have less difficulty in utilizing their current files on new equipment such as System/360. But if they desire to implement a labeled file environment or make use of the packed decimal or binary word features, then they too will have file conversion problems. Even if these users prefer to retain their existing formats, they will be paying for conversion continuously on System/360, since a "computational" usage of any input data, like amount fields, will require internal conversion from zoned decimal to packed decimal format, and back again for output.

Machines like the IBM 7070 usually generate word-oriented files. Even certain types of 7070 fixed length records will be unacceptable, as is, to System/360. Since fixed length on a 7070 refers only to a fixed number of words, a change in mode from alphanumeric to numeric in any given word from one record to the next will change the character length of the record, and will therefore not be considered "fixed-length" by System/360. Also the occurrence of change-mode characters (deltas) *between* records may affect the record length. Similarly, load-mode records with word marks created by the 1410/7010 may be unacceptable to System/360, because of the variance in record lengths.

There are several reasons for file conversion besides the need to provide a compatible format. The files may require the new volume labels or they may require character translation to be acceptable to the character set of the new computer. The user may also wish to put the files on disc or mass storage. It may be desirable to rearrange certain data fields to group them for more efficient movement within the computer. Re-formatting to take advantage of packed decimal fields may be advisable if the file is to be stored or sorted on disc, since the effectively shorter length will permit a greater capacity.

The actual format conversion may be accomplished by a utility conversion program, or even a specially coded program where necessary for an original conversion of existing files, such as a one-time interface between a converted program and an unconverted program. If an interface file will be generated repeatedly and converted indefinitely, then "dynamic" subroutines performing the conversion "on-line" within the converted programs would be more efficient. However, the use of such subroutines

may increase the running time and complicate the testing procedure. Such a hybrid program will require attention later to remove the subroutines when the unconverted interface program is converted.

Each data conversion task must be as thoroughly tested as a converted program. Whether a utility program or tailored conversion routine is used, manually prepared test data should be used to check the conversion program. The test output then ought to be used in a test on the receiving program, whether it is a new converted program or an old program which will be emulated.

Adequate control checks are important in any data conversion procedure. Record counts, at least, and perhaps control totals by record type should be a required output of the conversion program. One rule to keep in mind in data conversion is this: if anything can go wrong, it probably will.

library conversion

Many installations that are planning to emulate current programs indefinitely will choose to copy their active library files into 9-track mode. This is a challenging task, but will be necessary to permit efficient use of the packed decimal mode in re-formatted files. Also, System/360 Sort requires 9-track drives to write checkpoint records and to handle variable length records on tape. Although this kind of record form could be sorted on disc, the input file size is much more restricted: a 6-tape (1600 bpi) sort can handle four times as large a file as a 2311 disc sort.

Since several hundred hours of machine time would be consumed in duplicating all of the tapes in a large library, a more practical procedure would involve selection of those files that will be scheduled to be read shortly after installation of the new computer, and duplication of them anytime after their last use on the old equipment, but before actually needed on the new. Careful analysis of the operating schedule would thus allow the user to spread this task over a period of time extending from about a month before use of the new computer system to a month after, even though a peak load would still occur near the cutover date.

The user should determine well in advance whether he will be able to use his existing magnetic tapes on the new tape drives, or must replace some reels with new ones. If the current library is usable, then it should be possible to carry out the duplication procedure (without having to purchase many new tapes) by rotating the current stock. In other words, as an old tape is copied into its new mode, the old reel itself may now be used as a "scratch" tape for the next reel to be duplicated.

However, it may be necessary to add enough new reels to provide a pool of scratch tapes labelled in accordance with the new operating system, because any tapes processed under emulation will still require the old system labels (if any). Since the library could contain three kinds of tapes—7-track, emulation mode 9-track, and new system 9-track—the user should make some provision for quickly identifying the kind of label that is recorded on any tape, such as ordering the new tapes on unique colored reels, numbering the reels in a different series, or placing a colored sticker on the reels.

The last suggestion is the most flexible, as it permits the use of any reel (no matter where it comes from) in either emulation mode or "native" mode of operation, simply by recording the appropriate label, and affixing the corresponding sticker. Two utility routines should be written, which would simplify this "scratch" conversion considerably:

1. Read the old system label, in 9-track mode, and write back a dummy new system label (this would execute under the new operating system)
2. Read the new system label and write back a 9-track old system label (this could function either under emulation or under the operating system, or both, to provide the greatest operator convenience)

A complete documentation package for a converted program would, of course, be as comprehensive as any newly designed program, but it is important that all of the old program documents be retained as well, preferably in a separate package to avoid confusion during future maintenance. In addition, the check list of conversion tasks and the file conversion documents and test results should be kept with the program documents. This would include data conversion control cards, test tape prints, and any console logs. The value of this documentation should not be underestimated: in a previous conversion experience, a program "bug" discovered two years after the program was converted was traced to a fault in the dynamic file conversion routine.

hughes-fullerton conversion

At Hughes-Fullerton, we are converting an installation of IBM 1460's and a 7074 to System/360 model 30's and a model 65 with 2311 disc drives and 1600 bpi tape units. The model 30's are already in, but are operating entirely in 1401 compatibility mode. The model 65 will be delivered in November, with the 7074 emulator feature. We are constantly revising our conversion plans as new problems come to light, but our current approach includes the following policies.

Whereas our programming commitments for at least a year would not permit us to divert many of our people into full-time conversion, and since very few had any COBOL training, we organized a "revolving" conversion team. This consists of two or three IBM systems engineers, one of our supervisors, and two or more programmers who are familiar with the application programs currently being converted. Then, when their task is completed, these programmers are replaced by people who know the next application on the conversion schedule.

This type of organization has several advantages:

1. Programmers familiar with the applications are participating in the conversion. Consequently, confusion about intended program functions is minimized, the documentation is more easily interpreted and updated, and functional refinements can more conveniently be added. Since the responsible programmers are aware of what transformations have occurred to their application, they are much better prepared to relate future maintenance to the appropriate program and section of coding.
2. Our programmers are being trained in the COBOL language, in the procedure for testing, and in the use of the new operating system features as they participate on the conversion team. This tends to make them more capable when they start designing new applications for the new computer system.
3. The permanent conversion team supervisor and the IBM personnel build a background of experience, which is valuable in guiding the "revolving" programmers through the conversion procedure, and in developing tools to solve recurring conversion problems.
4. Pertinent information from IBM is quickly brought into play by having the IBM people directly involved.

The only apparent drawback to this combination team approach is the difficulty of scheduling convertible applications to agree with the "uncommitted time" of the responsible programmers. Even then, a programmer may be called off the conversion project to meet an emergency on some current program.

After scheduling the earliest application to be converted, we began analysis of the first one. A closer look at the requirements revealed that it was not suited at all for conversion but should be redesigned instead. So, back on the shelf it went, and we scrutinized the second group of programs, which fared much better.

We also began looking for sorts that could easily be converted, either with or without modification. From program documentation and current operating records we compiled a list of our sorts, listing the machine time used per month, the file size, the record length and form, and the extent of modifications. This list was matched against a table of sort capacities (by record length) to determine which runs could be handled by tape sort, disc sort, or not at all (i.e., on our equipment configuration without major data conversion).

The conversion team early discovered that testing could not proceed without a detailed working procedure for linking modifications, written in COBOL, to to the sort program. Another aid that needed to be developed was a satisfactory Test File Generator. Both of these needs were met by the joint efforts of the IBM systems engineers and our team supervisor.

Concurrent with the organization of the conversion team and the selection of convertible applications, basic standards and ground rules were being developed and published. These included System/360 record layout standards, COBOL features pertinent to our installation, guidelines for the general conversion effort, control numbers for the accounting of conversion man-and-machine time, a completely new job and file numbering scheme (to be compatible with Operating System/360), and special considerations of operating in compatibility mode.

Since all System/360 production programs are being written in COBOL, it was decided that a COBOL pre-processor program could reduce the manual effort and errors in coding and keypunching, and would serve as a means of implementing features not actually available in COBOL, such as a skeleton table-handling procedure. The preprocessor permits shorthand clauses in the Identification and Data Divisions and data name abbreviations in the Procedure Division, besides the standard functions of listing and conversion of the five "dual" special characters from BCD to EBCDIC form.

We have adopted a programming policy of defining report data files (created by converted programs) in the same format used by the current 7074 programs. This will permit us to continue using the existing 1401 programs, running in compatibility mode, to print the reports from these files. In this way, we can devote our time to converting more 7074 programs without having to analyze the editing and processing functions performed by several hundred 1401 programs. Later, when more sophisticated report-writing features are available in our COBOL processor, we will write the report images directly from the converted programs.

Since we expect a major upheaval in our machine operating techniques, we are planning to expand a model 30 to a configuration equivalent to the model 65 a few months in advance of the bigger systems' delivery. This will enable us to explore the Job Control procedure and the various Operating System features and routines (especially the data conversion subroutines), at the same time that we are testing the converted programs. In this way, we expect to be much better prepared for immediate cutover to the model 65 when it arrives.

Library conversion may be our toughest problem to solve successfully. Each 7-track file to be read under 7074 emulation must be duplicated to 9-track 1600 bpi after its last use on the 7074. This is not difficult for monthly and semi-monthly files, but can become critical for weekly, daily, and special files. Out of more than 5000 library tapes, we anticipate that about 600 will have to be duplicated in a 50-hour period during the first week of operation of the 360/65.

To help ease this burden, we are going to keep the 7074 in operation for one month after startup of the model 65. This additional security will permit some slack in our duplication schedule, which is especially important in the case where a given tape is used as input to the 7074 during the peak-load duplication period, or in the event that the model 65 does not become operative as soon as expected. In a few instances, it may be necessary to save the original 7-track tape until after the 9-track copy is actually used; large master files or input tapes to critical runs would be included in this group.

summary

The importance of an early analysis of your conversion load cannot be overemphazised. The number of alternative plans from which you can choose decreases as the day of delivery approaches, until finally, only a brute force, crash program remains, leaving chaos in its wake.

"Plan your change, and change your plan" will be a recurring theme during conversion. Nevertheless, planning is a prerequisite to getting the job done. And the sooner the job is done, the sooner we can start using those "new generation" data processing techniques we have been promised. ■

ge goes ge

TRAINING FOR CONVERSION

by MARIO V. FARINA

In May, 1965, the first GE-625 computer was delivered to the huge Schenectady plant of the General Electric Company. The large-scale computer was to replace five other computers of various sizes and makes. This article describes the training program set up to help in converting old programs to the GE-625 and to help computer users plan important new programs.

the environment

In order to understand the tremendous problems of transition, something should be said about the organization of the Schenectady plant. In an area of about 730 acres are located about 25 separate company components, which are semi-autonomous businesses. These range from small-scale, employing several hundred people, to very large-scale, employing thousands.

Most, if not all, of these businesses use computers, some having used them for over 10 years. Historically, each business obtained and operated its own computer. A few years back, all the major computers in this plant were placed under the control of a new organization called Telecommunications and Information Processing Operation (TIPO). Computers, for the most part, remained at widely scattered locations, but their control was centralized. The users of computers became internal customers of TIPO. With the advent of the GE-625, plans were made to phase out the older computers.

how conversions are being made

Many Schenectady computer users began to plan for conversion a year or more before the new computer ar-

Mr. Farina has been an educational specialist at GE Schenectady since 1964 and for the preceding five years was a scientific techniques programmer with GE. He has written 30 training texts in carrying out his responsibilities of preparing and teaching computer courses.

rived. The conversion plans are almost as varied as the businesses involved.

One large product department is an example. As one of the earliest computer users in Schenectady, many of its original programs were written in machine language. Later it developed its own compiler language called TASMIN. For several years, programs for the department were written almost exclusively in that language. Management decided that a feasible way to solve many of that department's conversion problems was for TASMIN to be implemented on the GE-625. This implementation was undertaken by TIPO. The people of the department are also learning how to write COBOL, FORTRAN IV, and GE-625 machine language for possible programming use.

Another example of how conversion problems are being met in Schenectady is illustrated by a second department. This department is responsible for company-wide accounting functions. In connection with these functions, it maintains almost 700 programs and many master files. Its files often contain hundreds of thousands of records.

For many years the computer used by this department has been a dependable old-timer. Although more than adequate in its day, it is now ready for retirement. Conversion to the GE-625 computer is taking two forms: one, by rewriting programs in COBOL; the other, through interim use of a simulator. The simulator was written by TIPO personnel and is now beginning to see service.

A third example of how conversion problems are being handled is illustrated by the plans of a third large product department. This department consists of three operating components, each of which is semi-independent. Complete new systems are being designed by them. The new computer will permit the department, in three to four years, to complete sophisticated real-time systems, using remote terminals, time-sharing equipment and elaborate display devices.

TIPO'S education function

The complexities and varieties of transition problems made it apparent to TIPO management even before the GE-625 computer arrived that a computer training program should be initiated in TIPO.

Organizationally, TIPO's education and training function is one of the responsibilities of the Software Systems and Techniques Unit. I have been a member of this unit for two years and am responsible for the education and training function. It is my responsibility to ascertain customer training requirements, plan computer courses, and teach. Qualified people often are used from both within and without TIPO to conduct some of the planned courses.

The goals of the TIPO education function are two-fold: first, to enable programmers to cope with the immediate difficulties of conversion; second, to better prepare Schenectady computer users for the challenges of the future.

The GE-625, being a large-scale binary computer, is different from those computers most Schenectady programmers had been used to. For example, many of the programmers had used only character-oriented machines and had no idea what "bits" were. Other programmers had lived with computers of small 2000-word memories.

There was little question, therefore, *whether* an education and training program should be begun, but rather how intensive it should be; TIPO decided to undertake an intensive program since it had a vital interest in how efficiently the new computer was used. Their approach to the training requirement was to offer a steady stream of computer courses, repeating them as often as there was demand for them.

And demand there was! The stream of courses became a torrent. Many different computer subjects were covered. Classes were usually large; in some cases, very large. Forty and 50 students per class was not unusual. In one case, a FORTRAN IV course was given to over 100 engineers. The largest available classroom was booked, a room which is actually an auditorium. Except for a somewhat more formal lecture approach than usual and the use of a lapel mike, the course was essentially the same as that used in classes containing fewer people. Despite some initial misgivings, the course was a success, and a small army of engineers began "speaking" FORTRAN.

Courses are announced through 110 Schenectady-area education specialists. These specialists, who are responsible for education functions in their own components, circulate announcements among managers and collect the names of persons wanting to take TIPO computer courses.

courses offered

Courses offered are not only the familiar standbys—FORTRAN IV, COBOL, TASMIN, and machine language, but also a basic computer course for managers, an introduction to computers (for technicians), FORTRAN IV for engineers and basic courses in data communications.

The TASMIN and FORTRAN courses are 32-hour courses spread over 8 weeks, two 2-hour meetings per week; COBOL is a 40-hour course given over ten weeks. The other courses mentioned are shorter, varying from 12 to 20 hours each. All of these courses are also conducted in the evening, one session per week. Evening courses are, therefore, spread over a longer period of time. Courses require textbook study, homework problems, and lab work in the form of actual programs on computers.

Response to course offerings, even after two years, is enthusiastic. In many instances courses are oversubscribed, causing TIPO to open additional sections. No opportunity for giving users computer knowledge is overlooked. In some cases, small groups of users have requested specialized training and have been given crash courses.

Since mid-1964, when this intensive education and training program was initiated, almost 2,000 people have received some form of computer training in over 100 completed courses or seminars.

correspondence courses, too

Particularly successful has been a correspondence course in FORTRAN IV. This course was originally written in 33 lessons in 1964 and was offered to a small group of individuals who couldn't attend regular classes. Students read text material and mailed lessons to TIPO for correction proceeding at their own pace. The course required that students write and actually debug four programs on a computer. Though I seldom met the students personally, I got to know them from correspondence and phone conversations.

This correspondence course has been rewritten several times using actual experiences with it as a guide to improvements, and has evolved into an informal, easy-to-read text, avoiding much of the rigorous language found in some publications. It exists currently as a 40-lesson course in bound form. Early this year a version of the book was made available internally to General Electric plants.

courses for managers

To acquaint leaders in the Schenectady plant with computer challenges of the future, courses for managers were developed. One of these is Basic Computers for Managers. Its purpose is to acquaint managers with what computers are, how they are programmed, and their applications.

The course is offered frequently and is always filled quickly. To date over 300 managers have gone through the six evening sessions required for this course. Written lectures for this course include such subjects as "What Is A Computer and What Can It Do Well?", "The Nature Of Computer Applications" and "Is There A Computer In Your Future?" Documenting the managers' course has proven valuable because managers are not always able to attend every session of a course. However, they are able to read while on planes, or during odd moments. They can thereby keep up with the rest of the class.

In 1965, another course for managers was designed. This one was called "Computers In Action For Managers." It was set up for those managers who had completed the Basic Computers course and who wanted to know more about how computers are used in Schenectady and elsewhere. Each week for six weeks a different expert speaks to this class.

It was not difficult to find experts from the many various businesses in the Schenectady area. On occasion lecturers from outside the company have been invited to participate, such as a professor from a local university and the data processing manager of a near-by airline.

Courses for managers have been so successful that another course called "FORTRAN IV for Managers" is being initiated. This is a greatly abbreviated version of the standard FORTRAN IV course. The idea behind it is to give managers a quick look at FORTRAN IV so that they can learn to use computers more effectively. The course requires managers to write and debug one simple program.

This new course is not intended to teach managers to program, but simply to give them an insight into programming problems. The FORTRAN IV language was selected because it is simple to use and is representative of other compiler languages. It is expected that managers will benefit from the course even though their people use COBOL, TASMIN, or other languages. Managers should be

able to communicate better with programmers regardless of programming language used. In addition, managers should be better prepared to ascertain the feasibility of contemplated computer applications, to estimate their costs and to determine how soon the applications could be implemented.

operator training

An important facet of the program is the training of TIPO computer operators. The GE-625 is a versatile machine and requires highly skilled operating personnel. To help provide a supply of such personnel, the General Electric Computer Equipment Department gave a pilot operators' course in 1965 to a group of six skilled GE-225 computer operators. Some of these operators were selected by management to prepare and to teach additional GE-625 operators' courses. I conferred with the selected men and offered advice on how to prepare effective sessions. These men willingly took over the responsibility of preparing lectures and gave creditable performances. The operators' courses have been successful and I believe that operators training themselves is an optimum way to meet this critical need.

teaching methods

The TIPO training specialists are encouraged to document courses because a lecture once written satisfies many needs. For example, those who cannot attend formal classes can learn by studying the written material. Furthermore, if a person misses a class for some unavoidable reason, he can make it up easily by outside reading.

The publications generated by TIPO instructors include complete courses in FORTRAN IV, COBOL, and machine-language programming. Instructors have also written scores of shorter pamphlets on such computer subjects as binary arithmetic, how computers work, what computer languages are and what techniques are used in computer programming. These documents are offered to TIPO users and are widely accepted. Some of the publications are published as technical reports and are offered to computer users throughout the company. In 1965 over 1800 copies of such publications were distributed, not only in the United States, but also in Canada, Mexico and France. One of these publications was recently translated into Spanish by GE personnel and is being used in Mexico at a field office.

Education techniques in the classroom have included experimental use of recorded lectures. The FORTRAN IV lectures were recorded on tape and were played in the classroom. A clerk operated the recorder and, at preplanned times, mounted for display the poster-size exhibits associated with the lectures.

Results have been mixed. Experience has shown that recordings must be carefully planned to obviate unanticipated questions and to provide pauses now and then for student reflection.

Work is continuing on the development of recorded lectures in the hope that some courses can be taught without the presence of an instructor. If such lectures can be successfully developed, instructors would, of course, be free to perform other tasks. Further, students could take courses at hours convenient to them.

Most of the TIPO people who teach computer subjects are not primarily teachers, but programmers. Typically, such programmers have attended pilot courses conducted in Schenectady by the General Electric Computer Equipment Department. Now, on a part-time basis, they teach the subjects which they have learned. Those who teach have discovered that one never learns a subject so well as when he has to teach it himself. Therefore, they usually welcome the opportunity to learn by teaching. The Computer Equipment Department is always available, of course should training requirements exceed those which can be handled by TIPO personnel.

summary

The problems of transition are being solved by TIPO users in a variety of ways. Users are free to make their own conversion plans but TIPO helps them by providing assistance such as computer simulators and the implementation of compilers. It is also helping them make conversions by supplying the computer education and training they require.

In the area of computer education, TIPO plans to continue offering basic and specialized courses. The emphasis will shift from training for conversion to training to meet the challenges of a computer-oriented future. Several avenues for providing support will be maintained. Computer courses will be offered both during the day and in the evening. Self-teaching texts, correspondence courses and pamphlets will be available. Experiments to find effective ways to teach will be continued. ■

through the minefield

ECONOMIC CONSIDERATIONS OF CONVERSION

by D. M. BAKER

Perhaps some *Datamation* readers fit this profile: You are a member of management at a progressive company making a fairly reasonable profit and serving your customers as much as possible to their satisfaction. You have a sufficient volume of business and are a sufficiently progressive company that you have a room full (be it a large or small room) of computing equipment. Further, your company has run onto some good times and your computer room has been made into a real showplace, sitting there behind glass panels for all the world to see. The problem is, your computers are last year's models, they're getting a little dusty and, besides, all your friends are talking about the new ones. Therefore, you have received approval to redecorate your computer room with the latest equipment, thereby enhancing your company's image at the next users group meeting—and incidentally, the new machinery just might give you a little better utilization. If this description even hints at your situation, you can spend the next fifteen minutes drinking another cup of coffee and counting your somewhat questionable blessings rather than reading further. You, my friend, needn't be concerned about the economics of conversion. You've got it made—at least until you change a major cog in your top management gear.

But then there are the rest of us. We seem to fall roughly into three categories.

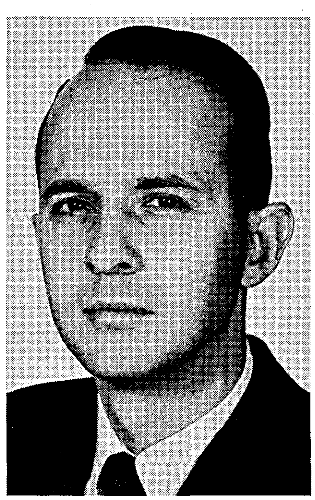
First there are those who haven't yet made the decision to convert to the new equipment. "After all," you may be saying, "We aren't using our current equipment to its capacity, so why spend a lot of money converting to some that will give us more capacity still?" An excellent viewpoint. You are obviously a person who has pretty well identified the factors that add up to the total cost of conversion and discovered, as have so many others, that it will require a lot of months of, hopefully, reduced rental and/or better utilization to break even. To you, the comments that follow may offer some reassurance that you have, indeed, identified all the cost factors and may reinforce that feeling of satisfaction you must have.

Secondly, there are those who, by some quirk of fate, have found the new equipment thrust upon them—possibly by an increase in business volume, or perhaps the need for computerizing an application which isn't feasible on your present equipment, or perhaps, and this is the case more times than the computing industry cares to admit, as a status symbol. At any rate, the copy of the equipment order is in your top desk drawer staring at you each morning, and now you have to deal with the problem—somehow get your installation converted at as small a cost as possible. But what is the cost? How can you be sure you haven't overlooked a major portion of the expense? For you, this article will attempt to cover both the major items of cost that readily show themselves and some of those that may be lurking in dark corners, ready to pop out and gobble up what remains of your already too small budget.

Third, there are those installations that have completed a thorough study of the factors involved in conversion. They have estimated the costs involved, offset these costs with the savings from anticipated increased performance and possibly chosen a configuration that will require a lower monthly rental than is now being paid—or at least a lower rental per unit of work. These installations are in an enviable position—maybe. The field of data processing changes so rapidly that few studies concerned with conversion are valid 90 days after they are written. It is hoped that this article may offer some aid in re-evaluation of the status of existing studies.

what are the costs?

Any discussion of the economics of conversion to a new line of equipment must cover the cost factors themselves in some detail. Many are immediately obvious to those making even a cursory study of conversion. Thus much of the following may seem elementary. However, some of the cost factors mentioned here may be new to the reader or some of the comments may evoke a new approach to ana-



Mr. Baker is supervisor of commercial utility programming for North American's Autonetics Division. An active GUIDE member, he has presented papers on conversion problems and is a member of the conversion committee. He has a BS degree from the University of California and data processing experience with Hunt Foods and Hughes Aircraft.

lyzing the costs. No attempt has been made to affix a dollars-and-cents value to the elements of cost in this discussion. Differences in accounting and cost structures among organizations, in the computer manufacturers under consideration, the scale and cost of the hardware to be installed and the degree and quality of support offered preclude being specific about actual costs expected. The purpose here is to point out to the reader some of the conversion activities that produce costs and offer some thoughts toward techniques to minimize them.

There are certain costs of conversion that are common to any organization and difficult to separate by function. The one that stands out the most clearly is the cost of management planning. A great deal of management time is usually involved in planning the hardware configurations' programming approaches, software configurations and, of course, the ever present justification to higher management. In some organizations it is not unusual to have at least one staff person involved full time in nothing but status reporting and justifications. Since these people are typically highly paid, this cost over a period of a year or more can be considerable.

A second non-functional cost is that of training. Many companies have discovered that launching a project as major as conversion without doing a considerable amount of previous training is folly. In the lines of computers that are currently offered, training is not a luxury; it is an absolute necessity. Those who have been in data processing for several years can remember when a programmer was handed one manual, given a place to sit and assigned a programming job. That one manual may have composed his entire training program. The study of the mountain of manuals presently available on, for instance, IBM's 360 line would be a career in itself for an ambitious student and there are constant revisions.

Too often it is assumed that management personnel can be overlooked in training programs since they have years of experience. Intelligent decisions regarding the new lines of computers, as sophisticated as some of them are, cannot be based upon the same knowledge that bred decisions back in the 402/604 days. Management must accept the fact that, if they are to do justice to their company, they must be retrained—and this costs a great deal of money. An associated expense which is often overlooked involves travel to and from training sessions, seminars, meetings of user groups and the like.

training—more than ever before

Let us assume then that we can agree that the training effort involved must not be overlooked, and that by virtue of its volume and complexity it will be expensive, applied to systems designers, programmers, and operators, as well as management.

New computer logic, new main frame capabilities and functions, new input-output devices, new storage devices and display equipment must all be familiar items to an efficient data processing specialist. It would not be unreasonable to apply several hundred hours of the time of key personnel to training, and only somewhat less to that of lower level personnel. The training of machine operators is becoming more and more critical as hardware sophistication increases. Production reruns are becoming more and more expensive and in most installations economic considerations make them virtually intolerable.

Well-trained machine operators, control personnel, those individuals concerned with job setup, data file librarians—all must have some amount of familiarization with the new hardware so that, if for no other reason, it does not appear to be a "black box" to them.

Another area of training that is sometimes overlooked is that of the data processing center's customers within the company. The training of at least the management in these areas, and preferably extended somewhat below the management level to key personnel, is very desirable. Customers cannot be expected to understand how they can be served if they have no idea of the philosophies of the trade. The training of these customer personnel is a very real item of cost involved with the conversion to new equipment.

Some installations operate in an open shop environment. In some companies there are as many as several hundred programmers scattered about the company, writing programs for one or more computers. Obviously, the training of these open shop programmers is a necessity and, when as numerous as in these instances, this training will become very expensive.

In all three areas discussed, data processing, their customers and open shop programmers, time away from the job for training could require overtime to keep up with the normal day-to-day work. If the cost of training preparatory to conversion is a part of conversion cost so, too, is the cost of the resultant overtime.

new internal procedures and forms

The internal procedures and preprinted forms currently in use will probably not be adequate during and after conversion. Procedures typically are written by either management or management staff personnel and a great deal of time may be involved in rewriting procedures and designing new forms. The cost of writing, typing, editing, reproducing, binding and distributing should be included as a conversion cost. The procedures will cover the areas of standards in system development, programming techniques, machine operating procedures and documentation standards. Typical forms that may require redesign are record format sheets, console run sheets, coding sheets and flow chart forms. Virtually every preprinted form should be reviewed to determine whether or not it will be affected by conversion. (Considerable savings can be effected by watching supplies of current preprinted forms and avoiding reorders of more than necessary. In some organizations the ordering of forms is handled by a group that is somewhat removed from the conversion planners. The automatic ordering by this group of 50,000 1401 run sheets 30 days before the 1401 is to be replaced by a new computer could occur.) Some companies have spent many thousands of dollars in developing well documented data processing standards manuals and forms. While some of the previous effort can be salvaged, a considerable amount of additional cost will probably be encountered to update this material.

cost of re-evaluating systems design

The amount of re-evaluation or re-definition of data processing systems that will be required depends to a great degree upon the approach to conversion. Some companies, in an effort to simplify the conversion effort, have elected to reprogram all systems without any redefinition whatever. This approach reduces the conversion cost, but will probably result in higher operational costs over a longer period of time since the facilities of the new hardware will not be efficiently utilized. Other companies have elected to either simulate or emulate current data processing programs, thereby eliminating even the need for reprogramming to some degree. Again, the result is an immediate reduction of the cost of conversion, but in virtually every case, operational costs will be higher than if the system were redesigned to take advantage of the new hardware.

In a typical installation many data processing systems could stand some degree of updating to include improvements requested by the customer or deemed desirable by the data processing center. The temptation is to make these changes or improvements at the same time that conversion is taking place. This approach, of course, makes good sense. However, the cost of improvements made at this time is not realistically a part of conversion cost, even though the changes would not have been made had conversion not been under way. Generally, then, the costs involved in re-evaluating the current systems to take advantage of the new line of hardware, the documentation of these changes and coordination with the customer are a very real and sometimes very expensive part of conversion.

what about reprogramming?

One of the most obvious costs in conversion is reprogramming. This is not only one of the most obvious but also one of the most expensive items. An installation that has anticipated conversion, or for some other reason has done a great deal of programming in a higher level language such as COBOL or FORTRAN may, in many cases, minimize the cost of reprogramming. Most major manufacturers supply some sort of software to aid in the conversion of, say, an existing COBOL program, to meet the requirements of their COBOL compiler. For example, IBM has developed the Language Conversion Program, which will convert programs written for their current COBOL compilers into a format acceptable to the S/360 COBOL compiler. The amount of help that this type of program may offer depends a great deal upon the complexity of use of the current COBOL compiler. Estimates have been made all the way from 20% to 80% for the amount of programming time saved by the use of conversion software of this type. Aids are very good; however, a considerable amount of programming time will probably be involved regardless of the use of conversion aid software.

Most installations find themselves faced with the problem of re-coding at least some of their programs into the new equipment's specific language. Due to the differences in the current hardware and the new hardware, reprogramming may take as much time as the writing of the original program. However, even in the lower level languages most major manufacturers offer some sort of software to aid in conversion.

The reprogramming effort, no matter how it is approached, will also require documentation changes. In

some organizations documentation is extremely expensive and the changes necessitated by conversion are a major portion of the conversion expense.

Machine time for program assembly and test, parallel production runs, and any machine time required for supporting activity such as special listings, etc. can become a major factor in the cost of conversion. The time taken from the normal work flow for these runs may cause scheduling problems in the machine operations, leading to overtime for operators plus extra shift rental. In planning conversion, many installations intended to arrange at least some checkout on a computer at another installation. This may be at a data center, a service bureau, or in a company that has converted previously. In some cases, trips to and from these locations may become frequent and rather expensive. It seems as though, no matter where you get time for this "remote" checkout, it's always in the wee hours of the morning. (Who gets the prime shift hours, anyhow?) As a consequence, overtime and extra meals are often involved.

In order to avoid some of the scheduling problems in both the machine room and the programming group, some installations are examining the possibility of "farming out" some or all of their conversion to one of the many service organizations. This approach has the advantage of minimizing the interruption in the current workload and removing the necessity for "staffing up," eliminating much of the overtime that may be required, and relieving the usually tight machine room schedule of an additional load. However, as with most plans, there are some definite disadvantages. Very few installations have documentation of their programs sufficient to turn over to a service bureau for conversion. Therefore, quite a bit of the time of key personnel may be involved either in updating documentation or in explaining unclear areas to service bureau personnel. Further, due to the great number of service bureaus that have sprung up in the past few years, the quality of the work of some of them is unknown. If this approach is being seriously considered, a reasonably accurate estimate of the cost of this type of service, including the involvement of in-house personnel, adequacy of the documentation and of the resultant product may be obtained by allowing a likely looking service bureau to produce their product on a "typical" program or system before the entire contract is let. Another approach to the use of a service bureau is to turn over enough of the new system development to them to relieve in-house personnel for the conversion effort. This approach has the definite advantage of using personnel familiar with the current systems to convert them. Regardless of which way the service bureau is considered for use, a careful cost estimate should be made and included in the conversion cost plans.

data file conversion may be expensive

The cost of converting data files to be acceptable to the new computing equipment can be a major one. Some installations are planning an off-line conversion only once for each data file and reconversion to the old format if necessary to allow the data file to be used in unconverted systems. Others will prefer conversion each time a file is used. Still others will prefer the use of inline "dynamic" conversion during the running of one cycle of a program.

No matter what method is used there will be some amount of machine time required. The measurement of this machine time, and consequently the cost, is relatively easy to determine if off-line data conversion is planned. However, the "dynamic" technique masks the amount of time required for file conversion with the normal running time of the program and makes the cost difficult to determine. Expenses related to data file conversion include the design of new record formats, the writing and implementing of new label handling standards, new procedures related to the physical handling of data tapes, disc packs, data cells, as well as the actual machine time to effect the conversion.

equipment installation

Since the subject of conversion obviously implies that the new equipment is replacing some existing equipment, we must assume that any installation planning conversion has a computer room in which the new equipment will be installed. There may be some amount of refurbishing of this room necessary to accommodate the new equipment. It may have to be made larger or smaller; air conditioning requirements may be increased or decreased. Thermostatic and hydrostatic controls may require some modification.

However, our friend mentioned at the beginning of this article may decide to repaint the walls, make the windows larger, or recarpet his machine room floors. These obviously are not conversion costs. It is sometimes difficult to distinguish between "necessary" and "desirable" modifications of the physical facilities. The simplest criterion seems to be, "Would we have done it if we weren't converting?" If you would have, it's not a conversion cost.

A conversion cost that is sometimes overlooked is the cost of freight for the new equipment. This cost varies among manufacturers. A manufacturer's representative should be contacted and the policy regarding freight determined and the cost established.

software conversion

It has been said that the third generation computer would not be practical were it not for the ability of third generation software to administer its conduct. I rather imagine a self-confident programmer would disagree with this viewpoint since he would probably feel that with whip and chair (manual and coding sheet) he could tame the unruly beast. And well he might—from his standpoint. However, the tremendous expense, duplication and confusion involved in every programmer using his own approach with a limited amount of coordination of his efforts with those of his comrades would be overwhelming. The better programmers would ultimately develop monitors, control programs, compilers, assemblers, sort/merges and all the rest of what we generally refer to as software. However, as today's computing hardware develops more sophistication, the software must keep, not only technically in close step, but almost exactly synchronized in its intricacy. It has been reported that IBM has spent more money in the development of its System/360 software than in all the research and development and the manufacture of the hardware itself. Software is becoming more and more an integral part of computers and the days of browsing casually through a list of software packages offered by a manufacturer to find some that look interesting (the "cafeteria technique") are almost as far gone as those in which each programmer wrote his own.

A major and increasingly important part of the planning for the installation of a new computer must be devoted to the examination of available software and the selection of the components that will most nearly fill the needs of the installation. This selection can make the difference between a well-run computer room and mass confusion, between productive systems analysts, programmers and operators and those bogged down with trying to "second guess" the system, between a profit and loss for the computer installation itself.

Careful consideration must be given to both the adequacy and the accuracy of the software considered. In determining adequacy, some questions that should be answered are:

1. What functions are performed by our current software?
2. Which of these functions will be required of our new software?
3. How many of these functions are built into the software under consideration?

Those functions required but not built into the new software will have to be supplied, either by negotiation with the hardware supplier for addition to the software offered, by purchase from a software supplier or written "on site" by the installation's own programmers. Obviously the first alternative is the least expensive, but the last is more likely to satisfy specific requirements while providing the fastest response to change.

The accuracy of the software selected is as important economically as any other factor in conversion. One major error in the software can, in certain instances, cause every program to malfunction or not to function at all. It can bring the production of the computer installation to a complete and abrupt halt until the software programmers diagnose the problem, correct it, test the corrections and follow up on the resumption of production. This process may take anywhere from an hour to several days and the costs can be considerable. To illustrate, let us briefly discuss a situation that occurs in some instances.

It's midnight in the computer room. A new application is being run for the first time and the deadline for production is tomorrow morning. The computer stops, indicating a program error. If it is not apparent that the

software is at fault, the application programmer is called in to inspect his program for the "bug"—overtime may be involved. If he cannot find the problem, the software programmer, typically, is called in next – perhaps more overtime. It is 8:00 a.m. now and management is called into the situation to begin warding off the customer who is, by now, pounding on the door. If this is a particularly elusive problem the computer engineers may begin looking at the hardware at this point to be sure the problem was not caused by an erratic transistor. Now it is approaching noon, the application programmer has gone home to get the sleep he missed, the software programmer (by now probably plural) is working on this problem rather than his normal project and the computer is spread all over the machine room floor, obviously non-productive. Sound like an exaggeration? It happens more often than most people like to admit and the cost is staggering. Dependable software can do a great deal to avoid this kind of situation. Past experience with the software of a given supplier is probably the best indication of what can be expected in the future.

The study and selection of software will require considerable time from the most experienced personnel. Time for training, for gaining familiarity with existing internal procedures, for planning a basic approach to the solution of data processing problems and, probably, several alternatives. This is slow, frustrating work—frustrating because nothing seems to hold still long enough to "draw a bead" on it. And the people assigned this responsibility should be the most experienced available, and consequently relatively highly paid. But, assuming the job is well done, money could not be better spent. One large company with which the author is familiar has formed a "task force" of its best data processing talent. This effort has involved up to 19 people over a period of 10 months and is expected to continue for some months to come. The cost of an activity of this scale is tremendous—but, properly managed, is money well spent. Most smaller companies, of course, do not require this extensive an operation. However, the recognition of its importance, and the intelligent management of such a plan on whatever scale is appropriate, may reduce the cost of conversion considerably.

can we really afford conversion?

We have seen some of the more common areas where conversion cost is accumulated. The next question is, "How can these costs be minimized and what can be done to use our resources to best advantage?"

First of all, the probability of achieving success in conversion can be improved by taking the same approach that you would if walking through a minefield. Plan carefully, take your time and train personnel thoroughly *before* they begin.

The plan should be developed as thoroughly as possible. Every known aspect of conversion should be included. Some of these considerations, those that have the most direct effect on the costs of conversion, have been discussed earlier. Most computer manufacturers offer excellent check-lists for conversion planning which can be used to advantage. You will probably find one or more articles in this issue of *Datamation* which will be of considerable help. The plan should be thorough and formalized. Do not make the mistake, made by so many, of allowing only one person or a very small group to develop a conversion plan without a great deal of contact with (1) the manufacturer's representatives (2) systems analysts (3) programming experts (4) machine operations personnel (5) management personnel (6) data processing customers (for an indication of further requirements) and (7) other companies planning conversion. A plan that is formally developed and documented before action upon it is begun, and updated as necessary changes arise, has the greatest likelihood of success and the least likelihood of causing restarts or rework of the effort that is expended. Restarting of effort in data processing is without a doubt one of the greatest causes of accumulation of unnecessary expense.

Take your time in conversion. Granted, there are sometimes unusual circumstances which necessitate haste, but these are not the most common circumstances. Formulate the entire conversion plan *before* establishing hardware delivery dates, and then leave them flexible. Some hardware salesmen are a little overzealous and will oversimplify conversion considerations to assure early delivery—don't allow yourself to be pressured.

Your own personnel may tend to take a cursory look at some problems and develop an approach to the solution based upon too little examination of the factors involved and without sufficient consultation with the seven groups of people mentioned—assure yourself of thoroughness in all studies. More time will be required, but less than necessary to do it over again.

Train your personnel thoroughly and early. Training that comes after development of the project nearly always results in a re-evaluation of progress and either restarting or reworking a good portion of it.

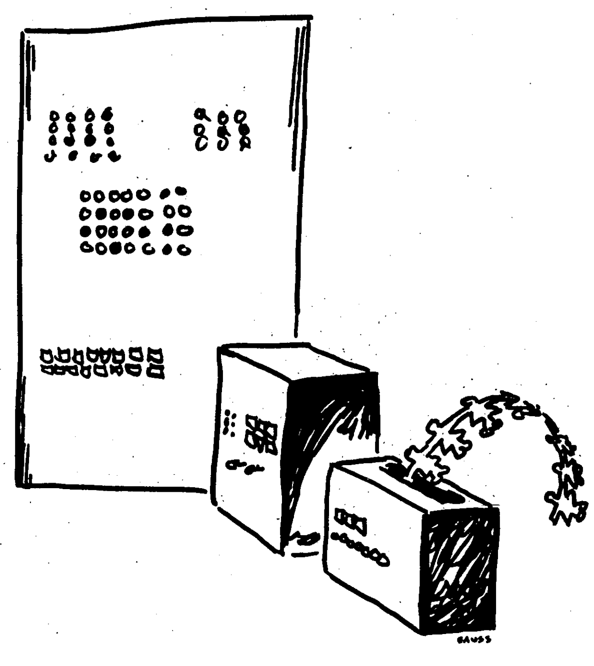
timing of conversion

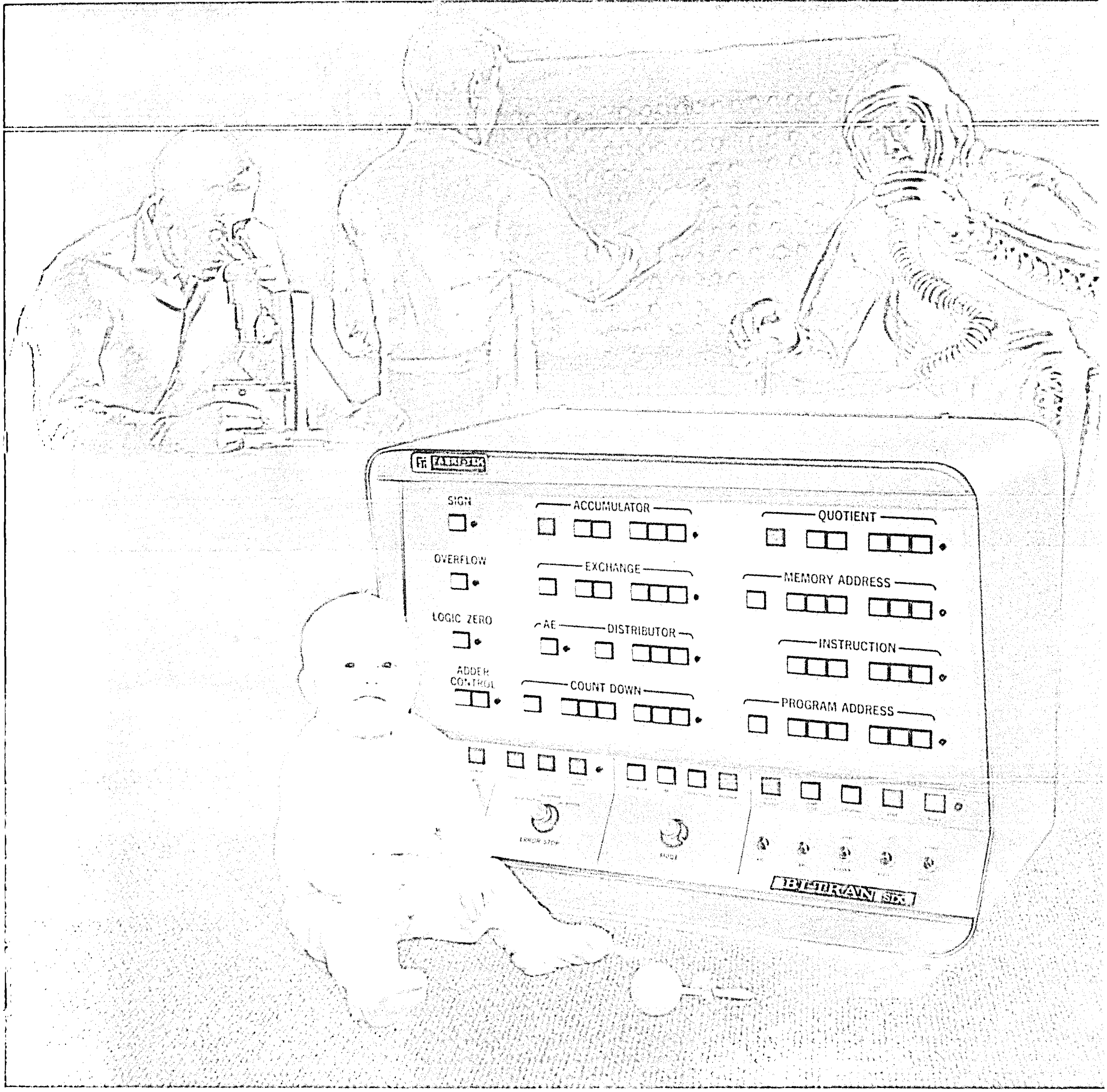
The timing of conversion is one of the major areas of possible cost saving. As mentioned earlier, rushing into conversion can prove to be extremely expensive if it results in redoing work done previously. Another consideration in timing the conversion is the maturity of both the hardware and software offered by the manufacturer. Our little "drama" regarding software dependability above may well have been caused by hardware and/or software that was too young and not sufficiently debugged. Even if the manufacturer "picks up the tab" for some expenses involved here, the damage done to the installation in the eyes of its customers and the personnel expenses accrued which are not paid by the manufacturer can be costly. There will always be an unusual amount of expense involved in conversion as a result of lack of familiarity with the equipment and a certain number of hardware or software bugs. However, beginning conversion before these bugs are minimized as much as possible can increase the expense tremendously.

In most cases there is a reduced rental plan offered by a manufacturer when replacing computing equipment with that of the same manufacturer. A careful timing of the delivery of the new equipment can result in considerable savings in machine rental for quite a period of time.

Considerable savings can also be effected by taking advantage of free or special price checkout time offered by the manufacturer. Again, a thorough plan linked with careful timing of the conversion can take advantage of these plans and result in almost free chekcout time for the programs being converted.

The company considering conversion to new equipment, whatever it may be, must exercise very careful judgment in making estimates of anticipated costs. The effects of a poorly planned conversion may be felt in areas somewhat removed from the act of conversion itself. Missed schedules in the development of new projects, a disproportionate amount of errors due to unfamiliarity with the new philosophies and equipment and lower than optimum efficiency in early systems can be expected; but the related costs can be minimized by careful consideration of the original plan for conversion. The situation should not be allowed to arise which is best expressed by the oft-heard quotation, "Why is it there's never time enough to do it right, but always time to do it over?" There is information available and talent available on which to draw. The careful study of every known problem area followed by the searching out of hidden problems; the learning of everything possible from as many different sources as possible; and above all, the development of a formalized plan—these are the best assurances of a successful conversion at the lowest possible cost. ■





TWO FOR THE FUTURE

FREE—Send for complete details and price information . . . and your copy of "**COMPUTER EDUCATION**: An answer to the challenge!"

TO: Educational Products
Fabri-Tek Incorporated, 5901 County Road Eighteen
Minneapolis, Minn. 55436 · Phone 612-935-8811

FROM:
Name
Title
Street
City .... State .... Zip

One is a boy. Computer science will influence every aspect of his life. The other is a Computer Education System, designed exclusively to help young people and adults to meet the challenges of the Computer Age. Put these two together with an informed teacher in between and you have the basic ingredients of a bright and promising future.

Our business is to provide the Computer Education System. If you are concerned with the vital responsibilities of teaching, please let us help you! The BI-TRAN SIX Computer Education System has a unique advantage of fitting into any curriculum from secondary grades through college, and in vocational or military education programs.

FABRI-TEK INCORPORATED

Leading in memory technology and computer education systems.

THE DAC-I SYSTEM

by GERALD S. DEVERE, BARRETT HARGREAVES and DENNIS M. WALKER

The General Motors Research Laboratories DAC-I System is an experimental facility for studying methods for incorporating a computer in the design process.[1] The computer aids the designer by performing many of the routine non-creative tasks. The object of the designer-computer team is to reduce the costs and time required to complete a design cycle.

Since experimental operation of the DAC-I System began, the graphic display hardware and software have been used for nearly two shifts a day. Users have been at the console for as little as 30 seconds and as much as 8 hours at a time. A wide variety of graphic display techniques has been tested.

This paper deals with the conclusions drawn from our DAC-I experience. It is written primarily for the computer specialist who may be writing specifications or programs for a conversational computer graphics system. The discussion covers:

1. Requirements of graphic display hardware and software.
2. Fundamentals of graphic display programming.

hardware and software requirements

If the computational speed of the computer is to be effectively combined with the experience and reasoning ability of the designer, it is essential that a communication medium be established in which the language employed is graphics, the language of the designer. It is further essential that the designer have complete control of the course of the design operation. These two criteria for effective designer-computer communication distinguish on-line designer-computer communication from batch processing.

The graphical language imposes a new set of problems for the programmer. The formatting of data to and from subroutines often becomes more of a problem than the computational requirements. It is no longer sufficient to think in terms of printing out answers which a man can ponder at his leisure. It is necessary to generate a graphic display immediately recognizable and usable by the man at the console. The graphic display software becomes user oriented to the point where the programmer must accept human factors such as information density, physical dexterity, positive action-reaction, etc., as part of his job. The programmer must also plan the graphical language to allow for changes to the graphics as demanded by the user community.

The second criterion—complete user control of program execution—is also an extremely interesting problem from a programming standpoint. In batch processing, the programmer organizes his core storage, subroutine sequencing and data flow to maximize efficiency for one pass through the program. In computer graphics with man-machine communication, the program must have some form of dynamic program and data storage allocation since the man at the console will insist upon being able to process forward, backward (to recover from a bad decision) and even laterally (from one approach to another). These random data and program requests make the use of a random access memory a necessity.

Summarizing the difference between program control in batch processing and man-machine communication, one concludes that in batch processing the programmer specifies and implements his own control sequence, while in man-machine graphical communication the programmer provides the man at the console with a means for complete program

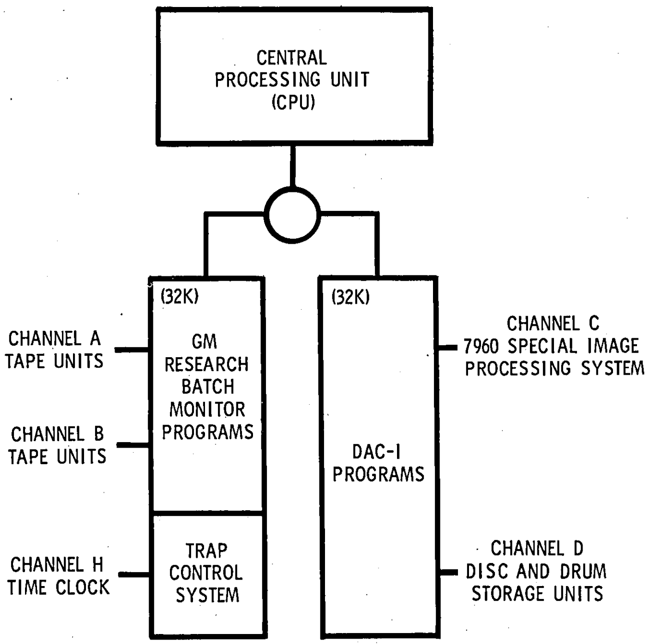
[1] Jacks, E. L., "A Laboratory for the Study of Graphical Man-Machine Communication," *Proceedings*, Fall Joint Computer Conference, 1964.

Mr. Devere, a member of the SHARE Ad Hoc Committee on Graphic Requirements, is associate senior research engineer at GM Research Lab's Computer Technology Department in Warren, Michigan. He received a BME from Univ. of Detroit.

control. The latter process implies more interesting and demanding responsibilities for programmers.

Our experience with DAC-I has been that a graphical, rather than a grammatical, language and complete user control of program sequencing are necessary for a workable

Fig. 1



man-machine system. In this discussion, emphasis will be placed upon software planning parameters which have proven to be fundamental to successful computer graphics in the DAC-I system. The following description of the DAC-I system is important because it will help the reader to understand the environment of DAC-I computer graphics.

DAC-I hardware

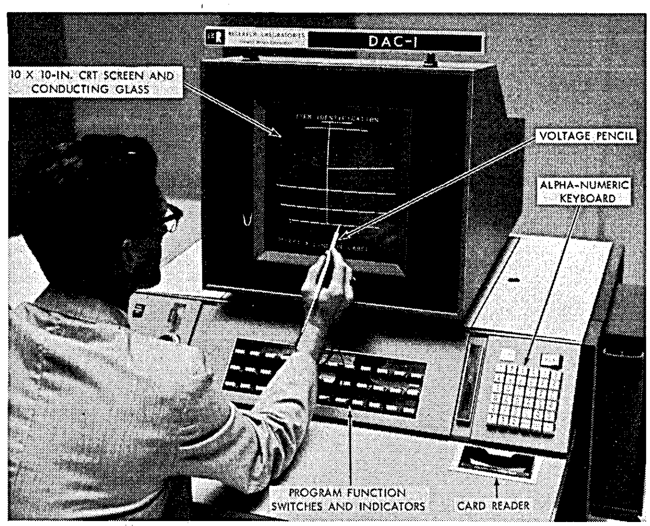
A functional configuration of the DAC-I hardware is shown in Fig. 1. An IBM 7094 supplies the basic computing. The 64K core storage has memory partition and protect capabilities which are used to divide core into two 32K halves for simultaneous residence of batch operation and DAC-I programs. Two disc storage units and three drum storage units can be reached by either of the two resident programs. Subroutines are compiled and stored on the disc from the batch processing side. DAC-I programs can be executed in the batch mode, without console interaction, if console load is high.

The DAC-I 7960 graphic console and image processing hardware, which were designed and built by IBM to GM Research specifications, are tied to the 7094 through a modified IBM 7909 data channel. The channel has a command repertoire which allows simultaneous execution of CPU instructions and data channel commands. This multiprogramming is an essential part of an economic man-computer communication system.

The display buffer in the DAC-I system is part of main core. Although the buffer size is variable, room for 3,000 to 4,000 straight line vectors is generally provided. The image display requirements frequently exceed 4,000 vectors but flicker on the CRT then becomes the limiting factor.

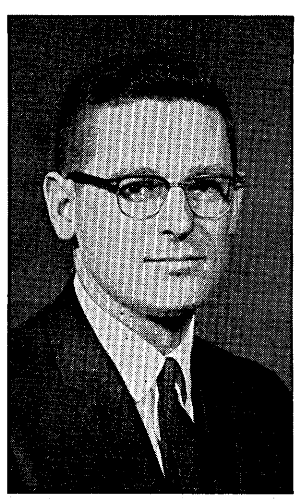
The DAC-I graphic console is shown in Fig. 2. The two essential parts of this console are the 10 x 10-inch CRT

Fig. 2

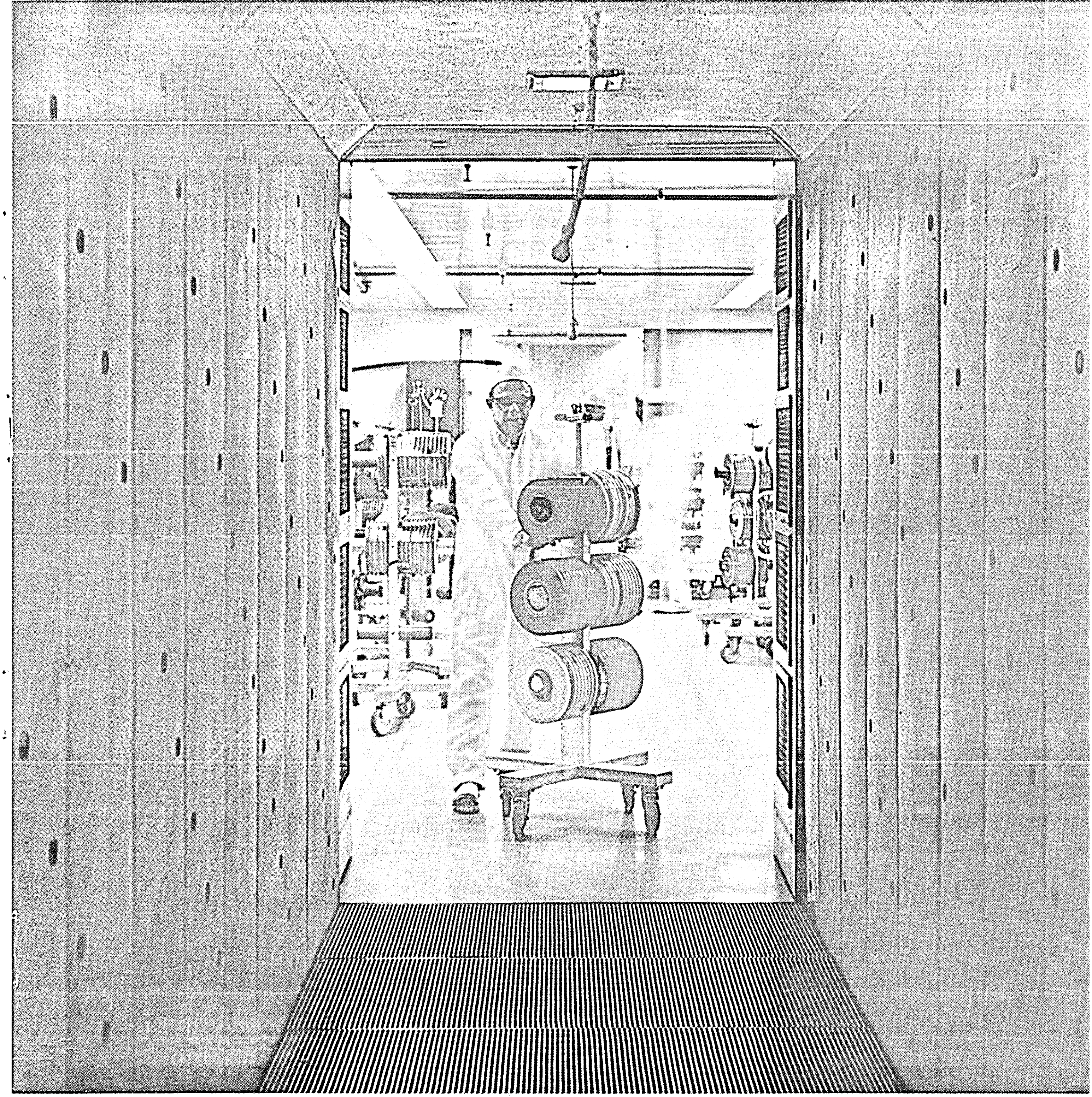


display and the voltage pencil stylus. Experience by many users over the past three years has led to the conclusion that the voltage pencil is an extremely effective stylus for communication from man to computer. Its fast reaction time, its instant readiness without an off-on switch, and its ability

Also with GM Research Lab's Computer Technology Dept., Mr. Walker, research engineer, is primarily concerned with the man-machine interface and users application phases of DAC-I. He received a Bachelor's degree in mechanical engineering from Univ. of Detroit.



Senior research engineer in the Computer Technology Dept. of GM Research Laboratories, Mr. Hargreaves is responsible for DAC-I application experimentation. A former ACM chapter chairman, he holds a BSEE from Michigan State Univ. and an MSEE from Wayne State Univ.



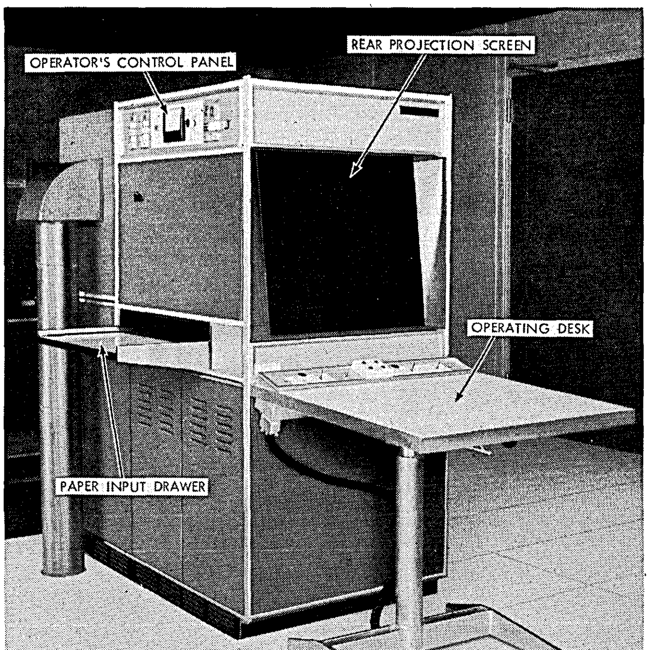
to point to void areas of the display screen make the voltage pencil a comfortable tool for a console user.

Another important part of the graphic console is the program control facilities. Thirty-six function keys and program-controlled function lights along with an exchangeable overlay have proven to be an effective man-computer communication medium. A standard mode of operation is to have the program define allowable control options by turning on appropriate function lights. The overlay is an easily exchangeable transparent plastic sheet with function button labels.

Experience has led DAC-I toward a completely graphically-oriented control mode. Whenever possible, control options are displayed on the CRT and response is made with the voltage pencil. Alphanumeric selection is also provided whenever possible at the display screen. This has the advantage of immediate feedback to the user of his alphanumeric selection and it keeps the user in an operating mode centered around the display CRT and the voltage pencil.

The DAC-I image processor shown in Fig. 3 has a dual film train output recorder for making microfilm copies of line images. The image is available for review within 30 seconds at the 20 x 20-inch projection screen. In the DAC-I system, the image processor recorder output is mounted in aperture cards and then printed xerographically. The DAC-I user has found the image processor valuable as an off-line recorder or as a means of documenting his steps as he progresses through a graphic design activity at the console. The recorder plays a very active role throughout the design cycle in the areas of evaluation and documentation.

Fig. 3



DAC-I software

More than 90% of the DAC-I software is programmed in NOMAD, a modification of the Univ. of Michigan MAD compiler. The advantages of compiler language utilization over assembly language programming have proven to be even more dramatic in man-machine graphics than in a batch operating mode. The problems of maintenance, documentation and modification become more critical because of the larger variety of uses put to display codes in a graphic system. By using NOMAD we have been able to react quickly to the constantly changing needs of display program requirements as dictated by an experimental graphics laboratory.

Another key software aspect of the DAC-I graphics system is dynamic program and data allocation. Without a dynamic storage scheme, console systems which allow a user unrestricted call on a large library of subroutines are not feasible. In fact, the only alternative is enough core space to house all programs, and enough buffer space to contain all data which may be required at any one time.

A complete description of the DAC-I dynamic storage system has been described elsewhere.[2] As used in our experimental graphics laboratory, a procedure change, recognizable as an overlay change, results in the "outing" of all except a few universal subroutines. Programs required by all functions of the particular overlay are then loaded from disc and stacked above the universal subroutines. As functions are requested by the user, more subroutines are loaded. When more space is required, these latter subroutines are declared "not in" by a control program. Dynamic storage is thus effected on three levels, the first two being essentially preplanned, the third a completely dynamic operation.

In the development of a display-centered design system, two points soon become apparent. First: the difference between a feasibility study and a usable production operation lies in those facets of the system which, when examined in detail, seem trivial, yet the composite are essential for a working system. Second: the potential graphic system user must be an integral part of the system development if the optimum problem solution is to be achieved. The computer programmer's inherent "feel" for the machine must be transferred to the designer in a manner which is wholly compatible with the intended user's current or conventional mode of operation. What has proven to be fundamental to a graphically-oriented design system will be discussed under the following categories:

1. Feedback
2. Control
3. Scale and Shift Requirements
4. User Nomenclature

feedback

The designer, when using the graphical design system, must always be sure that the computer is either responding to his last request, working on someone else's request (in the case of time-sharing), or waiting for the user to take action. This is most often done by way of display signals. These display signals can be broken down into "action-reaction" signals and "love and security" messages.

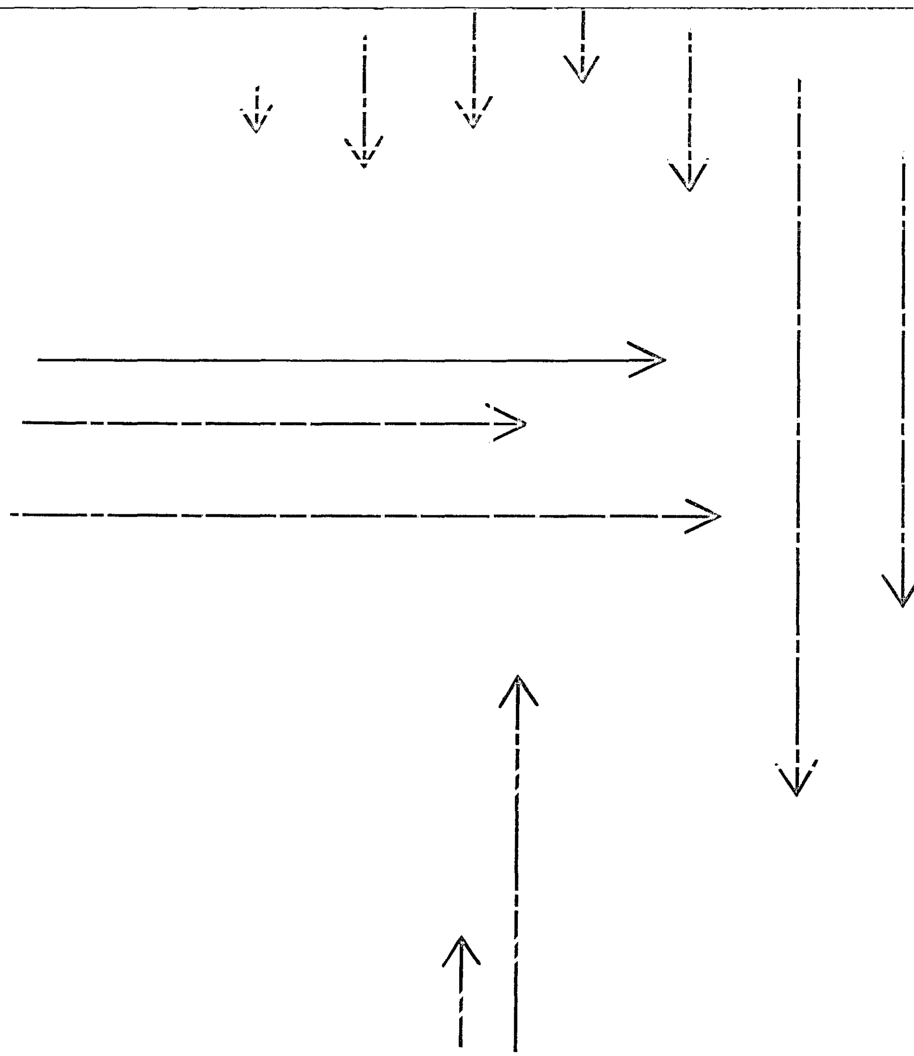
Fig. 4 is an example of the "action-reaction" signal. The message at the top of the screen shows the designer that the last function key he depressed was DELETE A POINT. This type of message reminds him of his current mode of operation and reaffirms that the action of the computer was indeed the action he wanted. The box around a point in Fig. 4 indicates that the designer has selected this particular point on a line for deletion and that the computer is aware of his choice. The word RESET amplifies the fact

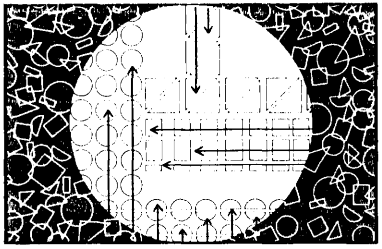
[2] Cole, M. P., Dorn, P. H., Lewis, C. R., "Operational Software in a Disc Oriented System," *Proceedings*, Fall Joint Computer Conference, 1964.

One of a series on topics of importance to data processing management

Honeywell report on Operating Systems

What's an operating system? What can it do? How much will it cost? Why should you use one? Today "operating systems" — the generic term applied to software packages aimed at improving compute operating effectiveness — are a key topic of interest among users of data processing equipment Operating systems, in one form or another, have been in use over the past decade. However, today' new generation of computer performance has done much to highlight the significant role an oper ating system can play in harnessing the full potential of a new generation data processing system





HONEYWELL REPORT ON OPERATING SYSTEMS

New generation computers, such as Honeywell's Series 200, have the potential to do more work in less time; to perform individual operations faster, to perform multiple operations at the same time. Yet even the most casual observer will quickly realize that a new computer, by itself, is no guarantee of increased data processing efficiency. Thus the interest in operating systems — those impressive, if not mysterious, software packages that appear to "guarantee full computer performance when used as directed." This report describes Honeywell's progress in the development of operating systems, illustrates important design concepts, and offers several criteria for determining how successful an operating system will be in meeting your particular operating needs.

WHAT IS AN OPERATING SYSTEM?

An operating system can be viewed as a framework within which all of the user's data processing jobs can be scheduled and performed. More specifically, an operating system is a comprehensive set of language processing and service programs executed under the supervision and coordination of an integrated group of control routines.

From a management standpoint, however, the value of an operating system should be measured not in terms of what it is, but rather in terms of what it can do. The following list indicates how major data processing objectives can benefit from the use of an operating system.

Objective	Operating System Benefits
1 Minimize turnaround time — the interval between submittal of a job for processing and return of processed results.	All required operations receive maximum automation; the extent of human participation is limited and controlled. Delays are eliminated through automatic processing of jobs from beginning to end on a single system.
2 Maximize throughput — the total amount of work which the system can perform in a given period of time.	All available system resources are effectively allocated. Idle system time and job setup time are reduced to an absolute minimum. Job-to-job transition is handled automatically.
3 Provide flexible and orderly growth potential.	Standards imposed by the operating system assure orderly expansion of functions and program compatibility. The user's programs and data files can be consolidated into a unified system together with manufacturer-supplied utility programs.
4 Make optimum use of computer memory and peripheral devices.	Through multiprogramming, an operating system can use central processor memory and peripheral units to maximum advantage. Programs can be device independent, giving great freedom in selection of input/output media.

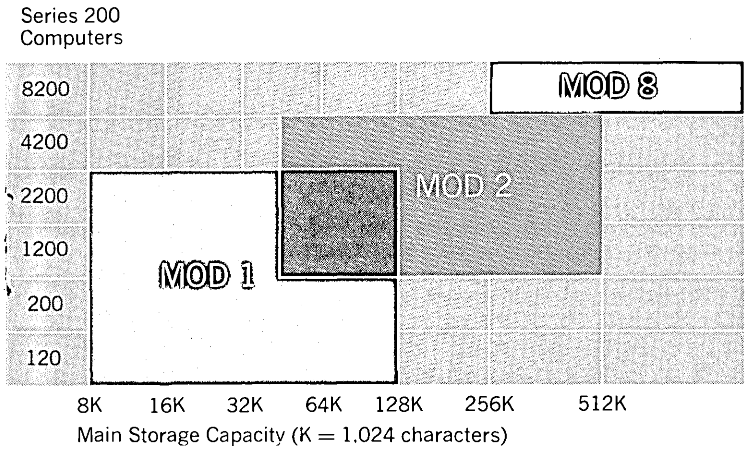
DIFFERENT DESIGNS FOR DIFFERENT NEEDS

The functions that can be performed by an operating system range from relatively simple clerical tasks to highly complex operations such as dynamic allocation and control of system resources for multiprogram operation. In fact, a listing of all the functions which could be performed by an operating system would include dozens of entries. Yet extensive as it might be, such a list could not indicate how efficient a particular operating system would be in performing these functions.

In order for an operating system to do an effective job in meeting your operating requirements, it must be designed to be most efficient in those activities performed by your computer most of the time. This means that the basic design of an operating system is an important consideration because efficiency can come only by design, not by accident.

Realizing that one operating system design is not sufficient for handling the wide range of functions required by the users of Series 200 computers, Honeywell has developed an operating system which is divided into three models. This division reflects the fact that the operating requirements of a small-scale computer, such as Honeywell's Model 120, are better handled by an operating system with a basic design that is attuned to these requirements than by one designed to fit the requirements of a large-scale Model 4200.

Each model is designed to fit a specific range of core memory and system environment features. Furthermore, each model offers unique capabilities which reflect the needs of users at various levels of system development. For example, a major and important difference between Mod 1 and Mod 2 lies in the control of input/output functions. Mod 1, designed primarily for the smaller user, reduces equipment overhead to a minimum by decentralizing input/output control functions. Mod 2, designed to achieve maximum throughput efficiency, uses centralized control to permit greater flexibility in the larger equipment configuration. The following table shows the relationship between the models of the operating system and the various Series 200 computers.



HARDWARE DESIGN AFFECTS ROLE OF OPERATING SYSTEM

In order for a computer to solve a user's problems it must first be able to solve its own problems. The computer's problems involve knowing what to do next and how to go about doing it. In computers, such as the members of Honeywell's Series 200, which can perform several input/output operations concurrent with computation, the magnitude of the computer's own problems is significant. Thus the way in which the computer solves its own problems is significant too.

An important design feature of every member of Series 200 is the ability to control all simultaneous input, output, and computational activities via automatic, built-in hardware. By building all basic control functions into the hardware, the following significant advantages are realized:

1 **The computer, large or small, in no way depends on an operating system as the basic form of system control. This eliminates the undesirable situation of having a potentially large memory overhead for the purpose of enabling the computer to solve its own problems.**

2 **With all basic control functions handled by automatic hardware, the operating system can devote its full attention to the area of greatest importance to the user: the efficient application of the computer's resources to the solution of the user's problems.**

3 **The overhead imposed by the operating system can be held to an absolute minimum, since it performs only those functions required by the user, not by the computer itself.**

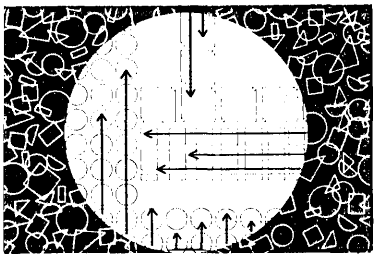
HOW MUCH DOES AN OPERATING SYSTEM COST?

On the surface, operating systems appear to be free of charge. The computer manufacturer can supply one at no extra cost to the user. However, in actual operation, an operating system can be quite costly in terms of the equipment it uses and the time it takes to perform its functions. Here again, the basic design of the operating system and its ability to fit the user's requirements play an important role.

In order for the computer user to tolerate the overhead imposed by an operating system, it is imperative that the overhead yield significant advantages which could not otherwise be attained. In the case of a Honeywell Model 4200 user, for example, an operating system overhead of 32,000 characters out of a total memory of 262,000 characters is tolerable if such a trade-off enhances the responsiveness of his on-line real-time management information system. On the other hand, a Model 200 user applying the same operating system to his simple stacked job processing operations, may find the memory overhead to be intolerable because the level of performance offered by the operating system does not justify the cost of the memory overhead.

Honeywell has made it possible for the smaller user to avoid a major operating system overhead by offering an operating system model especially designed to fit his requirements. The following table lists the equipment necessary for the various operating system models as an indication of what it really costs to use them.

Operating System Model	Minimum Memory Overhead (K = 1,024)	Input/Output Requirements For Program Execution
MOD 1	1.4K char.	1 card reader or 1 magnetic tape or 1 mass storage unit
MOD 2	17.5K char.	3 magnetic tapes 1 console
MOD 8	64K char.	1 mass storage unit



HONEYWELL REPORT ON OPERATING SYSTEMS

THREE GENERATIONS OF OPERATING SYSTEM EXPERIENCE

The following timetable of developments highlights Honeywell's role as a major innovator in the design and production of operating systems.

1957 Honeywell creates its first operating system for the D-1000 computer. Containing a monitor program and extensive program testing facilities, it was the first operating system of its kind to employ file updating techniques for program checkout operations.

1960 Honeywell releases the Executive System, the industry's first multiprogram operating system. Developed to fully automate the simultaneous execution of up to seven programs, the Executive System provided several important features for job scheduling, equipment allocation and supervision of program execution.

1963 The operating system concept is expanded significantly by the introduction of the Admiral operating system. Offering a dynamic scheduling facility, Admiral enables the user to stack job requests in a queue and obtain automatic processing with optimal utilization of all system components.

Today Models of the Series 200 operating system compress all of the necessary and desirable features for automated multiprogramming operations into the smallest possible amount of core memory. The Series 200 operating system is modular in design, enabling it to control a wide range of operating environments; including real-time, data communication, and random access file processing.

The experience gained from the development of three generations of operating systems has enabled Honeywell to offer users at all levels a full complement of automatic operating functions with truly minimal equipment requirements.

BCDEFG

): Honeywell EDP
60 Walnut Street
Wellesley Hills, Mass. 02181
Attention: Information Services

ease send me your publication entitled "Operating System Orien-
ion For Management."

ıme____________________

tle____________________

ımpany____________________

ddress____________________

ty__________ State__________ Zip Code__________

HOW TO GET TO A HONEYWELL OPERATING SYSTEM

Honeywell's unique Liberator concept makes it possible for users of IBM 1400 series equipment to automatically translate existing program libraries into Series 200 programs which operate under operating system control. Specifically, 1401, 1440, and 1460 programs can be translated into Series 200 programs which operate under control of Mod 1. Programs written for the 1410 can be translated to operate under control of Mod 2. In addition, users of small scale Series 200 computers in moving up to large equipment can take advantage of the extensive capabilities of Mod 2 without major reprogramming.

CHECKLIST FOR EVALUATING AN OPERATING SYSTEM

The tremendous disparity in operating speeds between computer hardware and its user magnifies the importance of allowing the computer to control itself, by itself, with the aid of an operating system. The following checklist summarizes the major points to consider when evaluating operating systems.

- Check the functions performed by the operating system. How many of *your* operating requirements does it meet?
- Check *all* equipment requirements. How much memory does the operating system require? How many peripheral devices must be reserved for use by the operating system?
- Check the experiences of current users. Find out how the operating system has helped them.
- Determine to what extent reprogramming will be required to enable existing programs to fit into memory left after insertion of the resident portion of an operating system.
- Determine what additional expenditure will be required to provide hardware necessary to move up to a more comprehensive operating system.

WRITE FOR MORE INFORMATION ON SERIES 200 OPERATING SYSTEM CAPABILITIES

For more detailed information on how major data processing objectives can be attained with the aid of an operating system, send for the publication listed in the coupon.

Honeywell

ELECTRONIC DATA PROCESSING

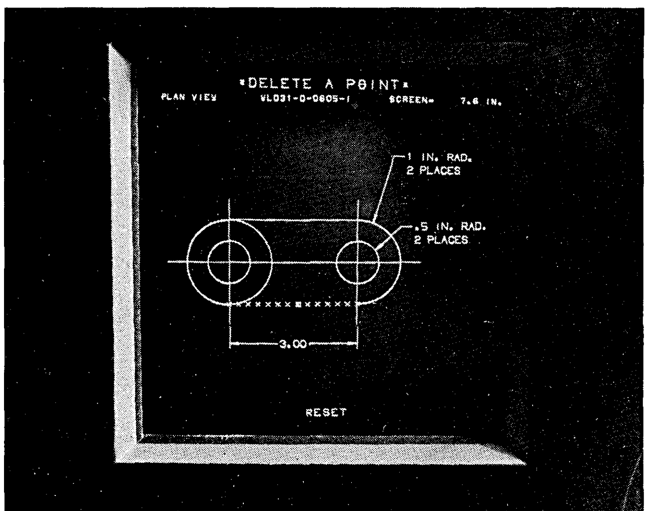
that a point has been selected and allows the designer to negate his last action by pointing at the word RESET with the stylus.

Occasionally the computer cannot respond to a designer's request immediately. In these instances a "love and security" message is required. For example, if the designer requests a recording on a film train which is currently being processed, it is not sufficient to simply ignore his request until the film train is through processing. Rather a message should be displayed indicating that the film train is busy at the present time.

Two other forms of feedback which are very useful, as well as economical, are sound and lights. Sound can be used to indicate to the graphic console operator that the CPU is working on his problem. In the case of the time-consuming request, sound may very often serve as the aforementioned "love and security" message. It has been our experience that sound used as an indicator is not just a frill, but that console users, once exposed to sound, come to rely on it heavily and evidence displeasure when for some reason the sound is shut off.

Properly programmed lights can perform a great many feedback functions. For example, a light labeled PROBLEM IN PROGRESS may be used to indicate that the CPU is acting on the user's request. Lights on function keys may

Fig. 4



be used to indicate to the designer a subset of operations which are now available to him after his last request. Fig. 5 shows three lit function keys. Here the user has just made a recording on one of the film trains. He may now take another recording [REPEAT], process film or continue on to another phase of his problem.

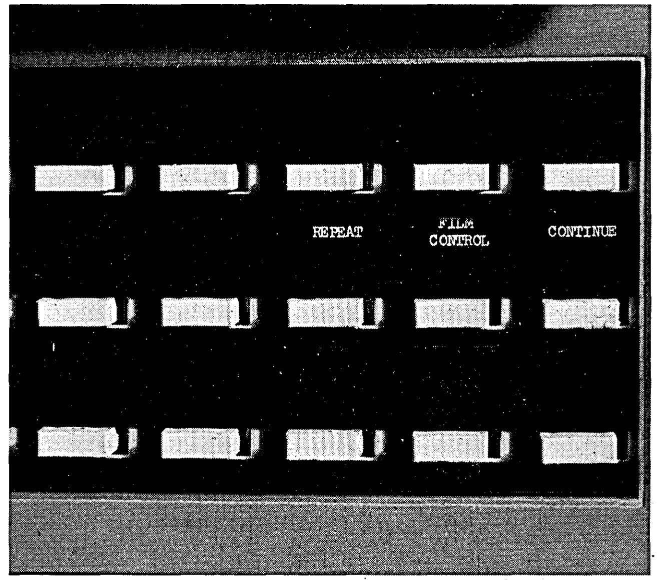
control

In discussing program control, as in discussing other aspects of a graphically-oriented system, many of the fundamental points seem trivial in retrospect. Yet these fundamentals are not always evident in the planning stages and appear obvious only after implementation.

The first fundamental under control is pre-selection. Many problems, design and otherwise, which can be solved in a display console environment are iterative. That is, a console user may be led to the same set of options many times in a short period of time. If the designer must repeat his selections each time he reaches this stage, considerable time can be lost.

The program can usually make an initial guess as to what options are desired at any given time. A more sophisticated program will "remember" the designer's last selections and offer them to him as initial choices at any subsequent re-entry in the program sequence. When this

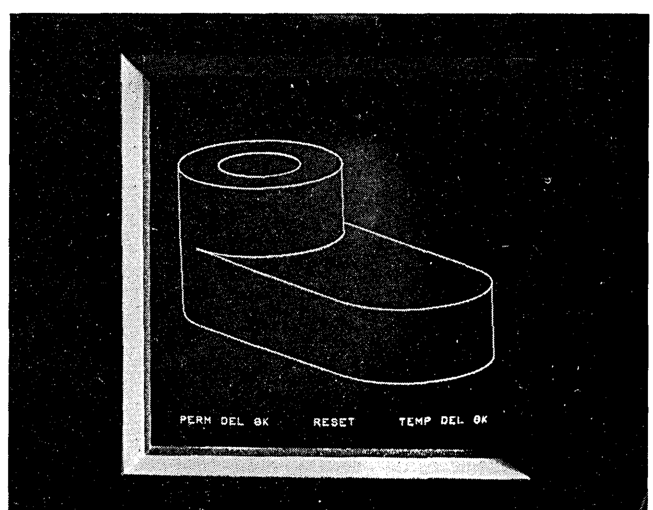
Fig. 5



mode of operation is followed, the designer need only indicate changes to his selections as opposed to wholesale selections every time a set of options is encountered. It is also important to allow the designer to answer as many questions as possible in one display rather than generate a separate display for each question. It is faster from a real-time standpoint to answer many questions with one display, but more important, the user can see how he is answering questions with one display, which may relate to each other instead of being forced to remember his answers, which he must do if individual choice displays are used.

There is a definite advantage to displaying control options on the screen with the line display. In general, the designer has an affinity for his design and feels more comfortable making decisions which affect this design while viewing it, rather than making these same decisions while trying to remember what his design looked like. An equally important advantage to this mode of operation is that the line display does not have to be regenerated as often. As a result of this, time and costs are reduced. Fig. 6 is an example of this where the upper and lower screen borders

Fig. 6

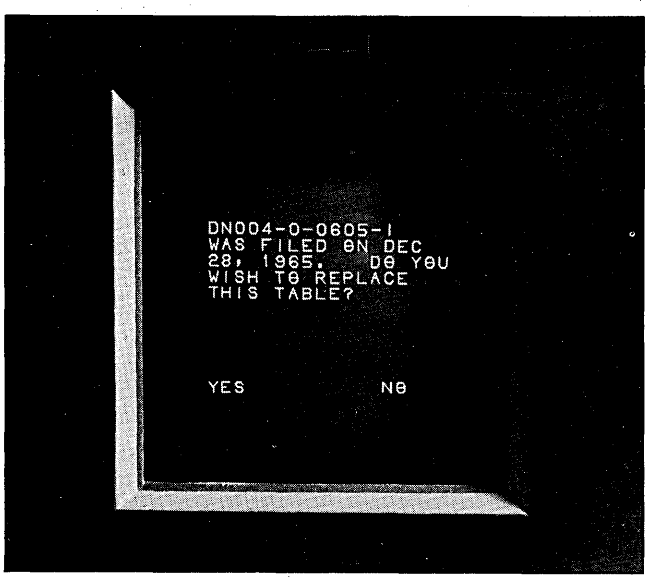


are used as either message fields or control areas. The user is told that he is in the LINE DELETION mode and that he should SELECT A LINE for deletion. Having selected a line, he is now given three options, any one of which he may exercise by pointing at the appropriate field.

The ability to recover rapidly from a mistake or simply to change one's mind is a definite requirement in any graphic system. The computer has two courses of action with regard to any user request. The request may be processed immediately with a reset facility readily available or a display may be generated which informs the user as to what effect this particular action will have on his over-all solution. The time or cost required to perform the action in question and the ease with which a reset can be performed are the determining factors in deciding which course of action the software should provide. An example of the first alternative is when points are deleted from a point set as the designer selects them, but may be added back into the point set by simply pointing at the word RESET. Here we can see that the deleting of points or their subsequent restoring constitute a fairly easy task involving little time or cost.

A typical use of the second approach to user action/computer reaction is illustrated in Fig. 7. Here the console user has built up a drawing consisting of many lines,

Fig. 7



points, and labels and now wants to store this drawing on the disc. The computer is informing the designer that on a particular date another drawing of the same name was stored by him, which may have taken a long time to generate, and does he really wish to destroy this previous drawing of the same name by storing over it.

The context in which a display is presented to the user is very important. It is desirable to display a large number of items such as lines or points which may be used as a background or frame of reference by the user and at the same time allow him to make rapid changes in a discrete area of his display. One such method is pictured in Fig. 4. Here the designer has selected a particular line as his "work line" which appears in the display as a series of X's rather than as a solid line. Actions as point addition or deletion, movement of points or .various line fitting techniques, may be applied automatically to the "work line" without the need for the designer to specify a line of interest with every action he takes. Because his display contains more than one line, he can see immediately the effect of his design modification on the total problem. This idea of automatic identification exemplified by the display of the "work line" as X's can be extended by simply choosing a different display mode (crosses, dots, dashes, etc.) for a particular display entity.

When developing a graphic display system a great deal of care must be taken to insure that all the power of this system is available to the user with the minimum of delay and cost. This means, for example, that the designer can switch from one major function to another major function without going through an involved initialization or sign-on procedure. It has been our experience that a user who has become familiar with a graphical operation will register displeasure when a major function change requires the depressing of more than one function key or takes more than five seconds.

scale and shift requirements

A large set of problems arises as a result of the need to scale and/or shift the display on the graphic console screen. Unfortunately, none of the hardware currently available offers any solution to the scaling problem. Any display changes (normally enlargements) must be handled by the software. These scaling problems not only pertain to lines and points, but also to any alphanumeric characters or special symbols such as labels and dimensions which are an integral part of the design. Character generators cannot be used to handle these characters or symbols as character generators do not produce displays which are a function of the size of the design in real space. We have found that a limited fixed set of scales (which would allow complete use of a character generator) is not sufficient to handle the total display scaling problem. Character generators, however, are quite useful as message generators wherever the messages are not a part of the design.

Depending on the design in question, work may be performed on a display in which the width of the graphic console screen represents 200 inches or 0.002 inches. Since design evaluation must be done on a 10 or 12-inch screen, it is very important to know the relationship between what one is viewing and what this same design would look like in real space. One way to handle this problem is always to display a message of the form SCREEN = XX.XXX inches with any line display. A second solution is to display a grid of known spacing with the design display.

A great deal of time and cost may be saved by projecting the spatial data (especially in the case of non-orthographic or perspective displays) into a viewing plane, storing the projected data on some relatively high speed device such as a drum, and then using this projected data to modify the display. Many design problems can be worked on using only the projected data. The software manipulating the design data need reference the three-space coordinates only when modifying the input data itself or when generating a completely new projection.

Within the DAC-I system there are three general methods utilized to either change the scale of a display or shift a display. Fig. 8 (a) through 8 (c) indicate these methods. In Fig. 8 (a) pointing at the words INCREASE or DECREASE will modify the display by a factor of 2 about the center of the current display. Pointing anywhere else on the screen will shift that point to the center of the new display with no change in scale. In Fig. 8(b) a box has been displayed around a point selected by the stylus. The size or the location of this box may be changed by appropriate action with the alphanumeric keyboard. In Fig. 8 (c) the designer has circled an area of interest which will appear full screen when the stylus is lifted from the screen.

The number of vectors being displayed should be an influence on which method is to be used. For a large number of vectors the methods depicted in Fig. 8 (b) or 8 (c) are best as the program need only perform one set of computations prior to arriving at the desired final scale for display. On the other hand, the method presented in Fig. 8 (a) is best for sparse data as it requires less action by the console user.

Fig. 8A

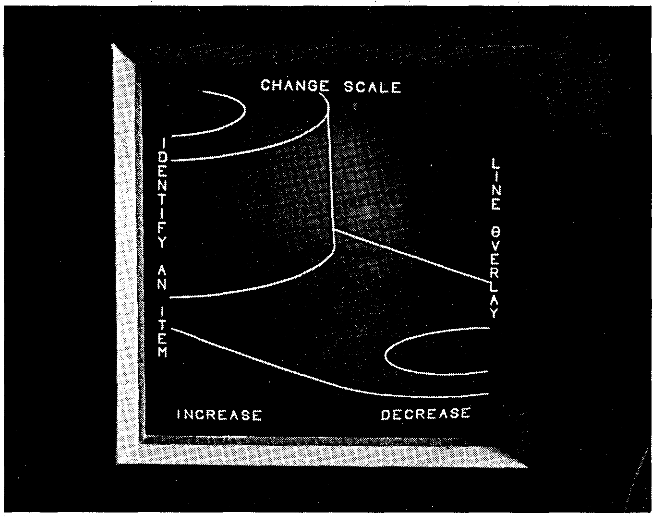


Fig. 8B

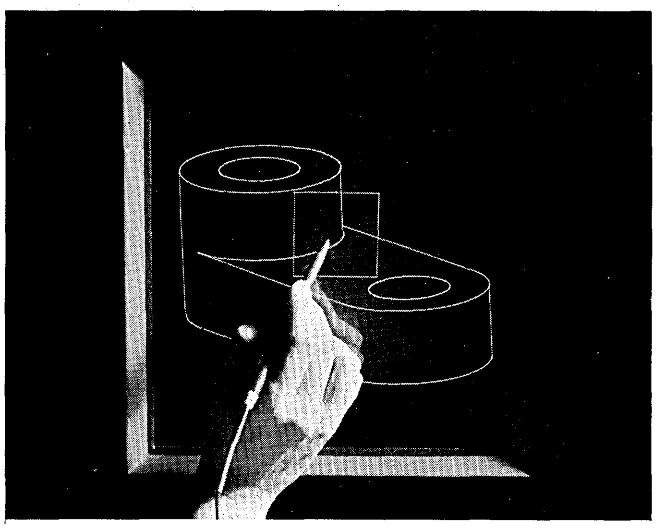
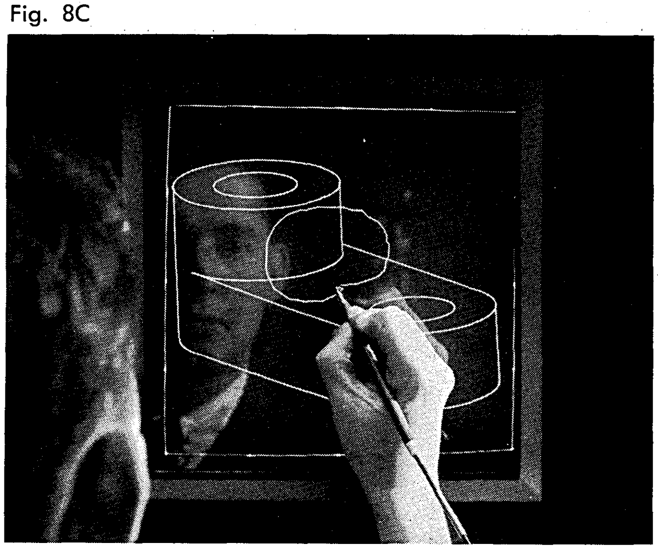


Fig. 8C



user nomenclature

In order to make a computer display system really useful and helpful to the non-programmer user, we have found that it is imperative to communicate with the user at his level, and in his language. It is not enough to merely enable someone to do something with a computer that he can already do without a computer; he must be able to do it easier, given normal economic considerations. A graphic console, not properly programmed, can be very frustrating to the person who uses it as a tool every day. Thus octal numbers, core snapshots, computer instructions, etc., which are very dear to the professional programmer, are less than meaningless to the average designer. If he puts a line into the computer, he wants to see a line, not a list of numbers, octal or decimal. If he makes a mistake, he wants to know where it occurred, why it occurred, and what he can do about it. And, he wants to know in English, in terms he is familiar with. Thus, much of our effort in DAC-I has been to experiment in creating a meaningful graphical man-machine interaction.

As an example of communicating graphically, consider the problem of showing a person the direction of a unit vector he has stored in core. The three numeric direction cosines define this, of course, but it is much superior to show a picture of this vector. This is especially true since this vector may be displayed in context with other pertinent information.

DAC-I did not leave out the programmer entirely, however. Any table on the disc file may be recorded or displayed in numeric form—octal and decimal. Facilities are also available to change program and data constants at the console. These facilities have proven to be a great aid in the continuing checkout of the evolving DAC-I system.

Our experience has been that a graphic console can help the programmer, but it is essential to the non-programmer who wishes to use the computer in his everyday work. It is the responsibility of the programmer to make the computer as accessible as possible via a graphic console. The challenge to the programmer is to make using a graphic console as acceptable and natural as any other design tool.

summary

In both hardware and software, it is essential that planning and evaluation of a display program or device be made not only by the provider of the program or device, but rather by both the provider and the eventual user. Although this has been generally attempted in other modes of computer operation, it is essential in man-computer graphics. The individual who will spend hours at a graphic console attempting to complete a task will without exception be uncomfortable with a display program as first presented by the programmer. This is because the graphic system requirements are not completely understood until after intense and extended contact between the user and the display program. In drawing up the specifications for a display centered system, the following fundamentals must be considered:

1. A conversational mode as opposed to a monologue mode must be established through the proper use of feedback displays.
2. A flexible graphic display system is based upon an efficient core management procedure which affords the user all the power of the system with the least amount of effort or time wasted on his part.
3. Wherever display evaluation is required or large amounts of graphical data are to be handled, the system must include versatile scaling provisions.
4. The computer display system must be at the level of, and in the language of, the non-programmer user. ■

COMPUTER-ASSISTED WRITING

start * para * j * void *

by ROBERT A. MAGNUSON

THIS ARTICLE WAS PRODUCED BY MEANS OF THE SYSTEM IT DESCRIBES. THAT SYSTEM WAS DESIGNED AND IMPLEMENTED BY THE AUTHOR. ITS PURPOSE IS TO SPEED UP ENORMOUSLY THE ITERATIVE PROCESS OF WRITING ANY SORT OF DOCUMENT. THE SYSTEM USES COMMONLY AVAILABLE DEVICES AND ITS COST COMPARES FAVORABLY WITH USUAL 'MANUAL' METHODS.

IN THE SYSTEM WE USE A KEYPUNCH INSTEAD OF A TYPEWRITER. THE FIRST DRAFT OF THE EMBRYONIC DOCUMENT IS KEYPUNCHED ONTO CARDS ALONG WITH INTERSPERSED 'EDITING INSTRUCTIONS'. THESE EDITING INSTRUCTIONS BEING ENGLISH-LIKE ARE EASY TO LEARN BUT ARE DESIGNED SO THAT INSTRUCTIONS AND TEXT ARE NOT CONFUSED. DURING THE KEYPUNCHING OPERATION THE TYPIST DOES NO COMPOSING, I.E., SHE IGNORES ENDS OF LINES AND PAGES. THE CARDS AUTOMATICALLY FEED AS SHE TYPES AND SHE PAYS NO ATTENTION TO CARD COLUMNS. FOR THESE REASONS THIS TYPING IS EASIER THAN EITHER THE USUAL TYPING OF DRAFTS (ONTO PAPER) OR THE USUAL KEYPUNCHING OF DATA (ONTO CARDS). SINCE THE KEYPUNCH (BESIDES PERFORATING THEM) PRINTS ON THE CARDS, THE CARDS THEMSELVES (OR A SIMPLE TABULATING-MACHINE LISTING) MAY BE SCANNED FOR THE INITIAL PROOFREADING.

AS PART OF THE SYSTEM THE AUTHOR HAS WRITTEN AN IBM 1401

PROGRAM WHICH WILL PRODUCE A DOCUMENT FROM SUCH A DOCUMENT DECK. THE DOCUMENT IS FORMATTED -- LINES AND PAGES COMPOSED -- ACCORDING TO BOTH THE PROGRAM'S BUILT-IN LOGIC AND TO THE EDITING INSTRUCTIONS ENCOUNTERED (IF ANY). THE COMPUTER PRINTS THE DOCUMENT ON ITS HIGH SPEED LINE PRINTER AT A SPEED OF FROM TEN TO FIFTEEN SECONDS PER AVERAGE PAGE. 1401'S ARE QUITE AVAILABLE -- THERE BEING OVER TEN THOUSAND IN THE COUNTRY -- AND TIME CAN BE BOUGHT FROM THIRTY DOLLARS AN HOUR UP. THE DOCUMENT MAY BE PRINTED ON INEXPENSIVE PAPER FOR USE AS A WORKING DRAFT. WHEN THE DRAFT IS CONSIDERED FINAL THE LINE PRINTER'S OUTPUT MAY BE PHOTOGRAPHED TO PRODUCE A PLATE FOR THE MASS PRINTING PROCESS. IF NO REDUCTION IS DESIRED THE DOCUMENT MAY BE PRINTED DIRECTLY ON PAPER MASTERS.

LARGER PRINT CHAINS ARE AVAILBLE FOR THE 1401 (AS WELL AS FOR THE FORTHCOMING 360 COMPUTER SERIES). THESE CAN CONTAIN ANY CHARACTER DESIRED -- INCLUDING UPPER AND LOWER CASE LETTERS. THE PARTICULAR 1401 ON WHICH THIS ARTICLE WAS RUN HAS UPPER CASE ONLY. THE PRESENT SYSTEM MAY BE REGARDED BOTH AS A PRODUCTION SYSTEM AS WELL AS A RESEARCH PROTOTYPE. WE ARE WORKING TOWARDS THE USE OF A SLUG-FREE PRINTING SYSTEM IN WHICH ANY CHARACTER SET IN ANY STYLE AND SIZE CAN BE OBTAINED BY PROGRAMMING (AND AN EXPANDED SET OF EDITING INSTRUCTIONS).

THE SYSTEM IS BEST EXPLAINED BY ILLUSTRATING ITS USE. HERE IS A VERBATIM LISTING OF THE CARDS COMPRISING A FRAGMENT OF A SAMPLE DECK.

```
*PARA*WE HEAR THE PHRASE 'INFORMATION EXPLOSION' QUITE OFTEN THESE DAYS.

  IT SUGGESTS THAT WE ARE DELUGED BY DOCUMENTS AND THAT THIS LARGE NUMBE

R OF DOCUMENTS IS HARMFUL.  WE ARE IN THE MIDST OF A TECHNOLOGICAL EXPLO

SION AND WE ACTUALLY HAVE AN INFORMATION SHORTAGE -- NOT A SURPLUS.  THI

NK OF ALL THE COMPUTER SYSTEMS, OF ALL THE MANUFACTURING TECHNIQUES, OF

ALL THE NEW METHODS TO READ FASTER, ETC., WHOSE DOCUMENTATION EITHER LAG

S FAR BEHIND THE INVENTION/IMPLEMENTATION OR DOES NOT EXIST.  *VOID**OK*
```

NOTE THAT THE FIRST CARD BEGINS WITH '*PARA*', AN EDITING INSTRUCTION WHICH CALLS FOR A NEW PARAGRAPH. (ALL EDITING INSTRUCTIONS ARE EMBEDDED IN ASTERISKS.) THE FIRST CARD ENDS WITH A PERIOD. AS SOON AS THAT PERIOD WAS TYPED, THE SECOND CARD AUTOMATICALLY FED INTO PLACE -- READY TO RECEIVE THE TWO SPACES THAT FOLLOW THE PERIOD. THE SECOND CARD HAPPENS TO END IN THE MIDDLE OF THE WORD 'NUMBER'. HENCE, THE THIRD CARD CONTINUES THAT WORD. THE LAST CARD HAS SOME SPACE LEFT OVER FOLLOWING THE TWO SPACES AFTER THE PERIOD. THESE COLUMNS ARE VOIDED BY MEANS OF THE '*VOID*'-'*OK*' INSTRUCTION PAIR. NEITHER THE '*VOID*' NOR THE '*OK*' NOR ANYTHING IN BETWEEN IS PRINTED. A VOIDED AREA MAY BE EXTENDED OVER ANY (LARGER) NUMBER OF COLUMNS OR CARDS AND FORMS THE BASIS FOR CORRECTING DECKS AT THE KEYPUNCH.

THIS SEVEN-CARD DECK WAS EXACTLY DUPLICATED A NUMBER OF TIMES

USING AN EAM REPRODUCER. THUS WE WILL SEE HOW THE SAME MATERIAL CAN BE RUN IN A DIFFERENT NUMBER OF FORMATS -- WITHOUT RETYPING -- AND HOW IT CAN BE MODIFIED. HERE, FOR EXAMPLE, IS THE RESULT OF RUNNING THAT DECK UNDER ONE SET OF CONDITIONS.

```
             WE HEAR THE PHRASE 'INFORMATION
        EXPLOSION' QUITE OFTEN THESE DAYS.  IT
        SUGGESTS THAT WE ARE DELUGED BY DOCUMENTS AND
        THAT THIS LARGE NUMBER OF DOCUMENTS IS
        HARMFUL.  WE ARE IN THE MIDST OF A
        TECHNOLOGICAL EXPLOSION AND WE ACTUALLY HAVE
        AN INFORMATION SHORTAGE -- NOT A SURPLUS.
        THINK OF ALL THE COMPUTER SYSTEMS, OF ALL THE
        MANUFACTURING TECHNIQUES, OF ALL THE NEW
        METHODS TO READ FASTER, ETC., WHOSE
        DOCUMENTATION EITHER LAGS FAR BEHIND THE
        INVENTION/IMPLEMENTATION OR DOES NOT EXIST.
```

NOTE THAT THE POINTS OF DIVISION OF THE MATERIAL INTO LINES WERE NOT CONTAINED WITHIN THE DOCUMENT DECK.

LET US RUN THE SAME MATERIAL AGAIN UNDER A DIFFERENT FORMAT.

```
             WE HEAR THE PHRASE
        'INFORMATION EXPLOSION' QUITE OFTEN
        THESE DAYS.  IT SUGGESTS THAT WE ARE
        DELUGED BY DOCUMENTS AND THAT THIS
        LARGE NUMBER OF DOCUMENTS IS
        HARMFUL.  WE ARE IN THE MIDST OF A
        TECHNOLOGICAL EXPLOSION AND WE
        ACTUALLY HAVE AN INFORMATION
        SHORTAGE -- NOT A SURPLUS.  THINK OF
        ALL THE COMPUTER SYSTEMS, OF ALL THE
        MANUFACTURING TECHNIQUES, OF ALL THE
        NEW METHODS TO READ FASTER, ETC.,
        WHOSE DOCUMENTATION EITHER LAGS FAR
        BEHIND THE INVENTION/IMPLEMENTATION
        OR DOES NOT EXIST.
```

THESE FORMATS ARE OBTAINED BY PRECEDING THE CARDS WITH A CARD SPECIFYING LEFT AND RIGHT MARGINS AND WHERE PARAGRAPHS BEGIN. HERE, FOR EXAMPLE, IS WHAT SUCH A CARD MIGHT HAVE ON IT.

```
*LEFT*MARGIN*I**RIGHT*MARGIN*O**START*PARA*J**VOID*                        *OK*
```

YOU WILL NOTE REFERENCES TO THREE TAB STOPS, 'I', 'O' AND 'J', AT WHICH THE MARGINS AND PARAGRAPH-START WERE SET. THESE ARE THREE OF THE 26 SYMBOLIC TAB STOPS WITHIN THE PRESENT SYSTEM. THE PRINT POSITION THAT ANY OF THESE SYMBOLIC STOPS REFERS TO CAN BE RESET AT ANY POINT IN THE DOCUMENT DECK BY MEANS OF ANOTHER EDITING INSTRUCTION. THERE ARE ALSO EDITING INSTRUCTIONS WHICH SKIP LINES, SPECIFY HOW MANY LINES TO A PAGE, TAB TO A TAB STOP, CALL FOR A NEW PAGE AT ONCE, PUNCH A PORTION OF SELECTED LINES ONTO

CARDS, HANDLE SPECIAL CHARACTERS AND INDICATE THE END OF THE DOCUMENT DECK.

NOW SUPPOSE WE WISH TO MODIFY THE ABOVE PARAGRAPH. WE WANT TO ADD SOME MATERIAL AND ALSO TO BREAK IT UP INTO TWO PARAGRAPHS AS FOLLOWS.

WE HEAR THE PHRASE 'INFORMATION EXPLOSION' QUITE OFTEN THESE DAYS. IT SUGGESTS THAT WE ARE DELUGED BY (***INSERT.1***) DOCUMENTS AND THAT THIS LARGE NUMBER OF DOCUMENTS (***INSERT.2***) IS HARMFUL. (***INSERT.3***) WE ARE IN THE MIDST OF A TECHNOLOGICAL EXPLOSION AND (***INSERT.4***) WE ACTUALLY HAVE AN (***INSERT.5***) INFORMATION SHORTAGE -- NOT A SURPLUS. (***INSERT.6***) THINK OF ALL THE COMPUTER SYSTEMS, OF ALL THE MANUFACTURING TECHNIQUES, OF ALL THE NEW METHODS TO READ FASTER, ETC., WHOSE DOCUMENTATION EITHER LAGS FAR BEHIND THE INVENTION/IMPLEMENTATION OR DOES NOT EXIST.

(INSERT 1)	AN EXCESS OF
(INSERT 2)	-- LIKE THE LARGE NUMBER OF PEOPLE SUGGESTED BY 'POPULATION EXPLOSION' --
(INSERT 3)	IF YOU THINK ABOUT THIS CAREFULLY YOU WILL AGREE WITH ME THAT
(INSERT 4)	THAT
(INSERT 5)	ACUTE
(INSERT 6)	*PARA*

WORKING ENTIRELY AT THE KEYPUNCH, USING ITS DUPLICATING ABILITY TOGETHER WITH THE EDITING INSTRUCTIONS, WE TRANSFORM OUR ORIGINAL SEVEN-CARD DOCUMENT DECK INTO THE FOLLOWING FIFTEEN-CARD DECK.

```
*PARA*WE HEAR THE PHRASE 'INFORMATION EXPLOSION' QUITE OFTEN THESE DAYS.

  IT SUGGESTS THAT WE ARE DELUGED BY AN EXCESS OF *VOID*

                                  *OK*DOCUMENTS AND THAT THIS LARGE NUMBE

R OF DOCUMENTS  --  LIKE THE LARGE NUMBER OF PEOPLE EXPRESSED BY 'POPULA

TION EXPLOSION' --  *VOID*

           *OK*IS HARMFUL.  IF YOU THINK ABOUT THIS CAREFULLY YOU WILL A
```

3M TASK FORCE Reports:

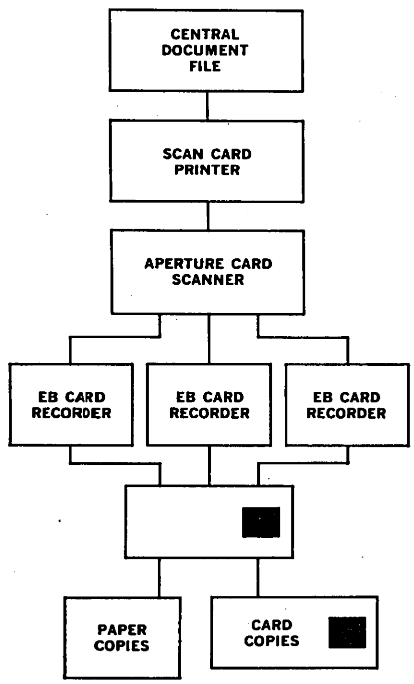
In a previous report, the 3M Task Force (a group of systems development people at the 3M Company) wrote about microfilm developments in electron beam recording technology. Because this is such a wide area to explore, you may want to discover how EBR relates to engineering drawings on microfilm and to high speed computer printing.

Microfacsimile for remote engineering drawing retrieval

Perfection of the microfilm aperture card concept has met a need for efficient storage, maintenance and distribution of engineering documentation. In these systems, low-cost duplication makes it possible to maintain satellite files nearer to the point of use. Going a step further, a hard copy facsimile transmission system could theoretically provide immediate documentation dissemination to any point and eliminate the need for duplicate local files. Unfortunately, engineering files include drawings of a size and quality which has exceeded the capability of any hard copy facsimile system.

Now, electron beam recording technology is making possible the direct electron beam scanning and recording of microimages at resolutions exceeding 150 lines per millimeter. Drawings up to 'E' size in any 35mm aperture card file can be transmitted on demand and recreated at the requesting point on a duplicate 35mm aperture card for viewing or hard copy reproduction.

A typical system includes an aperture card scanner, wide-band transmission link, and one or more aperture card recorders. A transceiver can provide two-way transmission using only a single terminal unit.

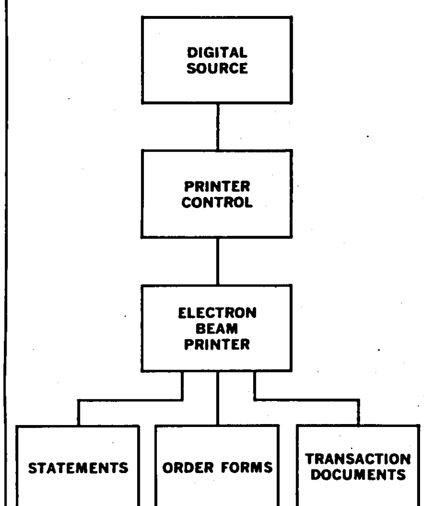


Transmission time for a 'D' size drawing might range from a few seconds to a few minutes depending on available band width. Film developing time can be as low as one or two seconds if new 3M electron recording films are used.

High speed computer printing

Banking and many other business EDP systems require the high speed production of customer statements and other transaction documents. Today's mechanical printers are unable to keep pace with this increasing demand.

Electron beam technology provides impactless printing to produce full-sized hard copy at the needed speeds. The high energy of the electron beam makes it possible to use special inexpensive papers which produce an instantly available image without processing or require only heat for development of a stable print.

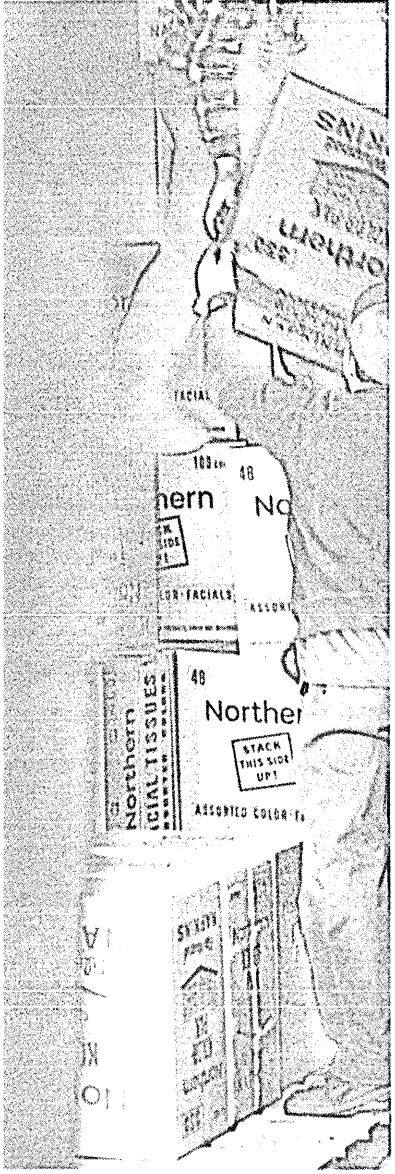
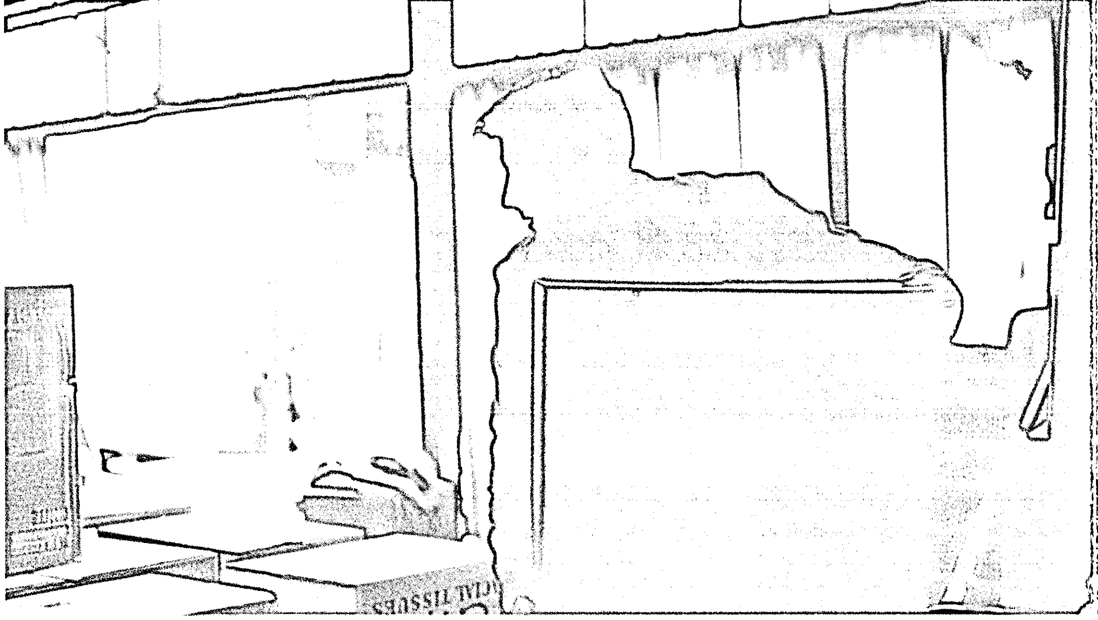
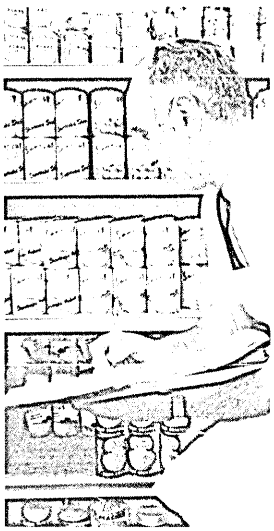


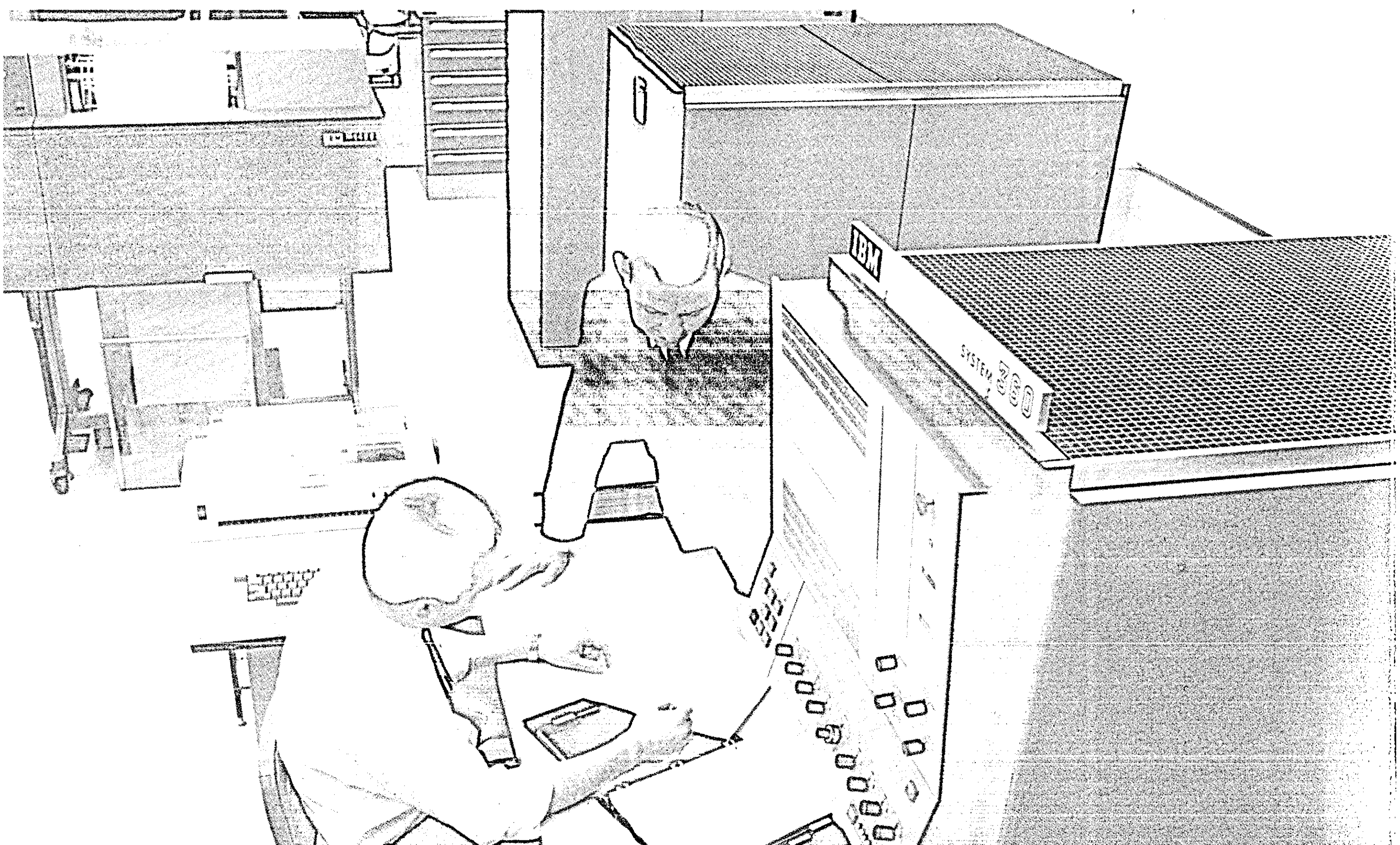
Alphanumeric printing can proceed at normal tape transfer rates. Font and format can be varied according to the needs of a specific application.

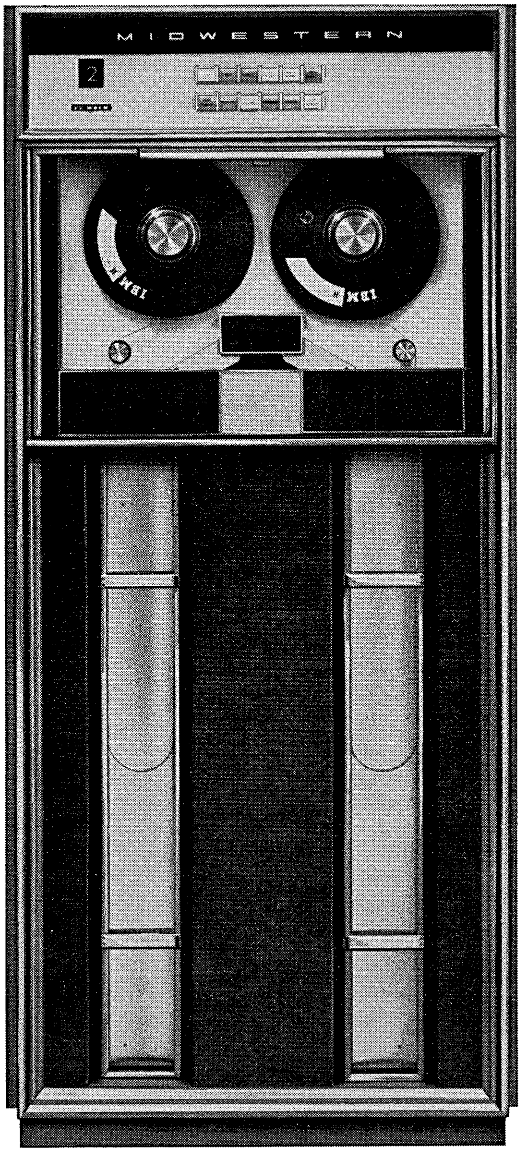
The direct, electronic recording of modulated signals onto paper at information rates up to ten megacycles is possible. A unique paper transport and recording head permits all operator functions including paper loading to be accomplished at normal room pressures.

For more information about electron beams and microfacsimile reproduction, get in touch with Rolf Westgard (612-733-4995), 3M Co.,
Building 209,
Dept. FDJ-66,
St. Paul, Minn. 55119.

3M COMPANY


Northern
STACK THIS SIDE UP!




IBM
SYSTEM 360



How does Midwestern provide 7/9 channel convertibility at no extra cost?

M4000

DIGITAL TAPE TRANSPORT

COMBINING UNPARALLELED OPERATING DEPENDABILITY WITH THIRD GENERATION COMPUTER SYSTEM PERFORMANCE FOR ADVANCED DATA PROCESSING SYSTEMS

All M4000 digital tape transports are designed and manufactured for direct field conversion between 7 and 9 channel IBM tape formats. Head cables, data modules and interface connections are factory wired and tested for 9 channel operation.

Field conversion between 7 and 9 channels is accomplished by simply plugging in the circuit boards for 2 additional read/write channels and replacing the read/write head assembly.

The uniquely engineered Midwestern unit head combines factory aligned head cartridges, tape guidance and precision mounting in a rigid, pluggable assembly. All head assemblies are mechanically and electrically interchangeable with all other 7 and 9 channel assemblies as well as with all M4000 transports. Static write head deskewing for 800 bpi recording is provided by direct exchange of a factory aligned circuit board at no additional cost.

For more information on the M4000, write or call Ralph P. Bohn, Digital Tape Products Division, P. O. Box 1526, Tulsa, Oklahoma 74101. Our phone number is 918-627-1116.

MIDWESTERN INSTRUMENTS
SUBSIDIARY OF THE TELEX CORPORATION

CIRCLE 26 ON READER CARD

GREE WITH ME THAT *VOID*

*OK*WE ARE IN THE MIDST OF A TECHNOLOGICAL EXPLO

SION AND THAT *VOID*

*OK*WE ACTUALLY HAVE AN ACUTE *VOID*

*OK*INFORMATION SHORTAGE -- NOT A SURPLUS. *PA

RA**VOID* *OK*THI

NK OF ALL THE COMPUTER SYSTEMS, OF ALL THE MANUFACTURING TECHNIQUES, OF

ALL THE NEW METHODS TO READ FASTER, ETC., WHOSE DOCUMENTATION EITHER LAG

S FAR BEHIND THE INVENTION/IMPLEMENTATION OR DOES NOT EXIST. *VOID**OK*

NOTE HOW THE VOIDED-AREA CONCEPT ALLOWS US TO EASILY ACCOMPLISH THE EQUIVALENT OF WHAT IS ACTUALLY IMPOSSIBLE, E.G., TO INSERT MATERIAL BETWEEN ADJACENT CARD COLUMNS. YOU CAN SEE THE SECOND CARD OF THE ORIGINAL DECK IN THE SECOND AND THIRD CARDS OF THE CORRECTED DECK, THE THIRD CARD OF THE ORIGINAL DECK IN THE FOURTH, SIXTH AND EIGHTH CARDS OF THE CORRECTED DECK, ETC. WE HAVE A COMPLETE FACILITY TO ADD, DELETE, CORRECT OR MOVE PARTS AROUND WITHIN THE DOCUMENT. THESE MODIFICATIONS ARE ACCOMPLISHED AT THE KEYPUNCH, AWAY FROM THE COMPUTER, WITHOUT THE NEED TO COUNT PAGES, LINES AND CHARACTERS IN ORDER TO WRITE SOME MODIFICATION ORDERS.

NOW LET US SEE HOW THE PROCESSING 1401 PROGRAM UNDERSTANDS THE CORRECTED DOCUMENT DECK. YOU WILL NOTE HOW SMOOTHLY THE CHANGES HAVE BEEN INCORPORATED INTO THE NEW COPY WITH THE LINES COMPOSED ANEW.

> WE HEAR THE PHRASE 'INFORMATION EXPLOSION' QUITE OFTEN THESE DAYS. IT SUGGESTS THAT WE ARE DELUGED BY AN EXCESS OF DOCUMENTS AND THAT THIS LARGE NUMBER OF DOCUMENTS -- LIKE THE LARGE NUMBER OF PEOPLE EXPRESSED BY 'POPULATION EXPLOSION' -- IS HARMFUL. IF YOU THINK ABOUT THIS CAREFULLY YOU WILL AGREE WITH ME THAT WE ARE IN THE MIDST OF A TECHNOLOGICAL EXPLOSION AND THAT WE ACTUALLY HAVE AN ACUTE INFORMATION SHORTAGE -- NOT A SURPLUS.
>
> THINK OF ALL THE COMPUTER SYSTEMS, OF ALL THE MANUFACTURING TECHNIQUES, OF ALL THE NEW METHODS TO READ FASTER, ETC., WHOSE DOCUMENTATION EITHER LAGS FAR BEHIND THE INVENTION/IMPLEMENTATION OR DOES NOT EXIST.

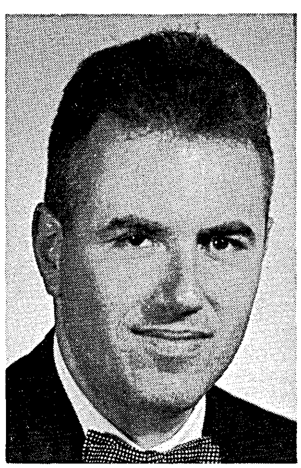
YOU CAN EASILY SEE THAT A DOCUMENT DECK MAY ACQUIRE MANY VOIDED AREAS AFTER IT HAS GONE THROUGH A LARGE NUMBER OF CHANGES. THE AUTHOR HAS WRITTEN ANOTHER 1401 PROGRAM WHICH COPIES A DOCUMENT DECK, SQUEEZING OUT THE VOIDED AREAS IN THE PROCESS. IN ADDITION, THIS PROGRAM SEQUENCE PUNCHES THE NEW CARDS IN COLUMNS THAT HAVE BEEN SET ASIDE FOR JUST THAT PURPOSE. THE FOLLOWING IS

HOW OUR CORRECTED PARAGRAPH'S FIFTEEN-CARD DOCUMENT DECK COMES OUT OF THE SQUEEZING PROCESS AS A TEN-CARD DECK.

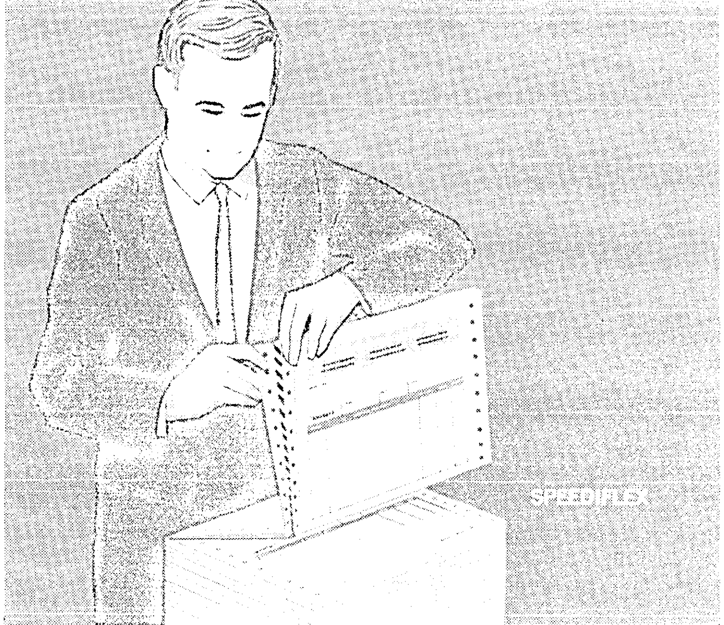
```
*PARA*WE HEAR THE PHRASE 'INFORMATION EXPLOSION' QUITE OFTEN THESE DAYS.    00001
 IT SUGGESTS THAT WE ARE DELUGED BY AN EXCESS OF DOCUMENTS AND THAT THI     00002
S LARGE NUMBER OF DOCUMENTS  --  LIKE THE LARGE NUMBER OF PEOPLE EXPRESS    00003
ED BY 'POPULATION EXPLOSION' --  IS HARMFUL.  IF YOU THINK ABOUT THIS CA    00004
REFULLY YOU WILL AGREE WITH ME THAT WE ARE IN THE MIDST OF A TECHNOLOGIC    00005
AL EXPLOSION AND THAT WE ACTUALLY HAVE AN ACUTE INFORMATION SHORTAGE --     00006
NOT A SURPLUS.  *PARA*THINK OF ALL THE COMPUTER SYSTEMS, OF ALL THE MANU    00007
FACTURING TECHNIQUES, OF ALL THE NEW METHODS TO READ FASTER, ETC., WHOSE    00008
 DOCUMENTATION EITHER LAGS FAR BEHIND THE INVENTION/IMPLEMENTATION OR DO    00009
ES NOT EXIST.  *VOID*                                                 *OK*  00010
```

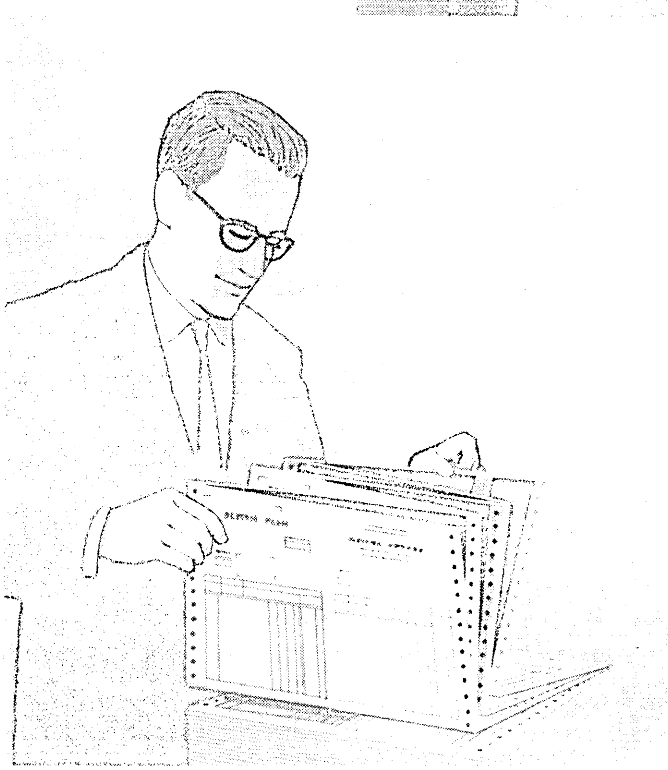
THE SYSTEM HEREIN DESCRIBED -- USING KEYPUNCH, EAM EQUIPMENT AND SMALL COMPUTER -- IS BELIEVED TO BE SUPERIOR TO MANY OTHER SYSTEMS IN THIS FIELD. IT IS VERY INEXPENSIVE TO USE. THE TYPIST DOES NOT HAVE TO SIT AT A TYPEWRITER WHILE THE PREVIOUS VERSION OF THE DOCUMENT IS AUTOMATICALLY TYPED OUT -- A CHARACTER AT A TIME -- AND WAIT FOR THE POINT(S) OF CORRECTION TO ARRIVE. NO HEAVY INVESTMENT IN EQUIPMENT IS REQUIRED TO TRY OR TO USE THE SYSTEM SINCE 1401'S ARE SO AVAILABLE. ALL THAT IS NEEDED IS A KEYPUNCH. THE SYSTEM IS ALSO HERE, NOW. IT HAS A GOOD REPERTOIRE OF EDITING INSTRUCTIONS AND IS CAPABLE OF EASY MODIFICATION.

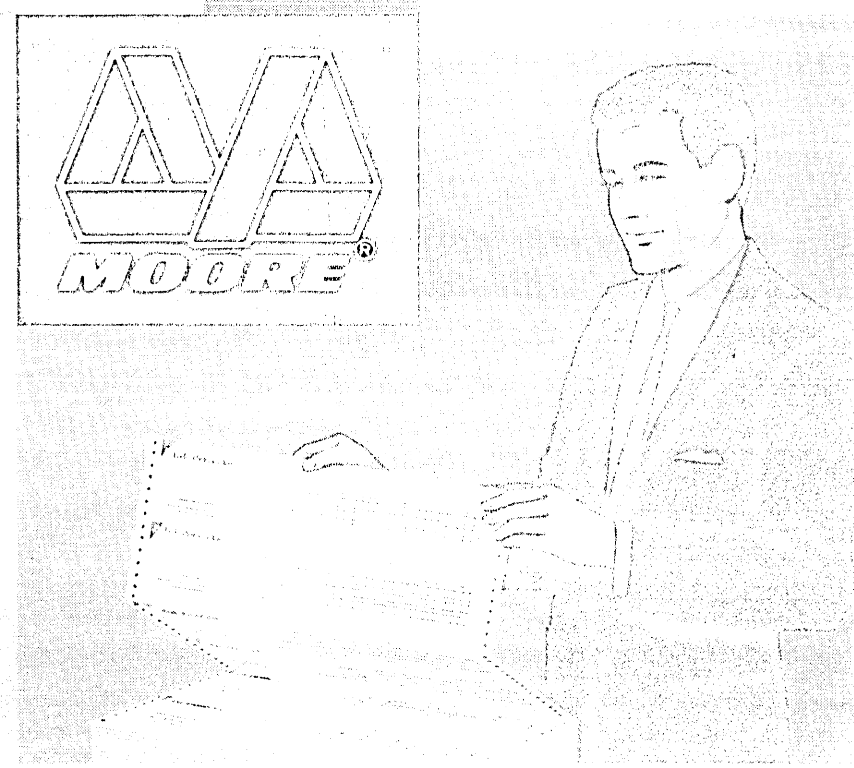
WE MAKE REFERENCE HERE TO A DETAILED MONOGRAPH, 'AUTOMATED DOCUMENTATION', WRITTEN BY THE AUTHOR (USING THE SYSTEM, OF COURSE) DESCRIBING THE SYSTEM IN DETAIL, GIVING THE 1401 PROGRAM LISTINGS, ETC. THIS MONOGRAPH WAS COPYRIGHTED IN 1964 BY RESEARCH ANALYSIS CORPORATION AND GIVEN A SMALL INITIAL DISTRIBUTION. THE FIRM IS PRESENTLY DECIDING HOW TO PUBLISH THIS DOCUMENT.



A member of the Advanced Research Div. of Research Analysis Corp., McLean, Va., Mr. Magnuson has been engaged in software development and programming for more than 10 years. He has been associated with RCA's Systems Engineering staff, System Development Corp., General Electric, and Laboratory for Electronics. He holds an AB in math from New York Univ. and has done graduate work at NYU, Stevens Institute of Technology and Yeshiva Univ.







Moore Continuous Forms bring Total Value to your total effort. Moore, leading supplier of these products, has developed its forms to optimum efficiency through precision manufacture and constant research. Speediflex has the revolutionary flex-cut that bonds paper to carbons for perfect part-to-part register at the point of machine writing with narrow-carbon advantages. 2-Wide Fanfold forms offer many system advantages with economy to users who can benefit from its unique side-tie construction and system flexibility. Moore 2-Wide Tab Cards also offer many economies. If you work with forms, we can show you how to make forms work for you. Moore Business Forms, Inc. Over 500 offices and factories in North America.

CIRCLE 27 ON READER CARD

NATURAL-LANGUAGE PROCESSING

where it stands now

by R. F. SIMMONS

The eventual goal of language-processing research is the development of highly sophisticated question-answering systems. These would accept and analyze natural-language questions, search a multilingual library for pertinent factual text, translate from that widely separated text and generate essays that answer the question at any desired level of detail.[1]

The first step toward this goal was the concept of Memex, in 1945, Vannevar Bush's dream of a computer system that would remember what people recorded of their associations when reading or browsing through a microfilmed library, then guide subsequent readers down interesting paths and byways. Memex was a magnificent imaginative extrapolation form 1945's technology.

Fifteen years later we began to envision—instead of a Memex—a Synthex. This would be a general language-processing system that could read and understand text in ways analogous to the human capability and store whole libraries of material. When asked a question Synthex should extract relevant texts, relate them to the question, and synthesize an answer or an essay.

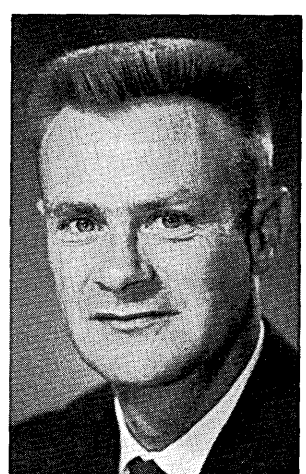
How all this was to be accomplished was in no sense as clear as the envisioned result. But by 1959 we had decided optimistically that if a problem could be formulated symbolically, it could almost invariably be programmed and perhaps solved on a computer. It took quite a while for us to realize how difficult symbolic formulation of natural-language problems was. However, by the late fifties, several researchers were working on various language-processing devices.*

where we are now

Today computers can deliver answers to questions. For example, a system called Protosynthex was asked the following:

HOW STRONGS IS A SPIDER'S WEB? Within a second it searched a small encyclopedia, scored potential answers in terms of how highly their words correlated with the question's words and responded: SCORE = .99

> ++SPIDERS ARE WONDERFUL ENGINEERS . THE WEBS THEY SPIN ARE STRONG . IN FACT, SPIDER SILK IS STRONGER THAN STEEL WIRE



Dr. Simmons is head of the language processing and retrieval staff at System Development Corporation. He has been with SDC since 1955, when it was a part of the RAND Corp. He holds BA, MA, and PhD degrees in psychology from USC and is a lecturer at USC and UCLA.

The research reported in this paper was sponsored by the Advanced Research Projects Agency Information Processing Techniques Office and was monitored by the Electronic Systems Division, Air Force Systems Command under contract AF 19(628)-5166 with the System Development Corporation.

* The names of many researchers and their systems are mentioned in this paper. The survey references at the end provide detailed descriptions and citations.

OF THE SAME SIZE . SOME WEBS ARE BEAUTIFUL , TOO .

Some programs make logical inferences. Raphael in an MIT thesis gave his program the following information:

THERE ARE 5 FINGERS ON EVERY HAND
THERE ARE 2 HANDS ON A PERSON
A BOY IS A PERSON
TOM IS A BOY
DICK IS A BOY
HARRY IS A BOY
TOM HAS 9 FINGERS
DICK HAS 1 HAND

He then asked four questions to which the program responded as below:

HOW MANY FINGERS DOES TOM HAVE?
Computer response: THE ANSWER IS 9.
HOW MANY FINGERS DOES DICK HAVE?
Computer response: THE ANSWER IS 5.
HOW MANY FINGERS DOES HARRY HAVE?
Computer response: THE ANSWER IS 10.
HOW MANY FINGERS DOES JOE HAVE?
Computer response: I DON'T KNOW WHETHER FINGER IS PART OF JOE.

Another program is able to solve algebra word problems at least at the high school level. Dan Bobrow's system developed at MIT can handle this one:

MARY IS TWICE AS OLD AS ANN WAS WHEN MARY WAS AS OLD AS ANN IS NOW. IF MARY IS 24 YEARS OLD, WHAT IS ANN?

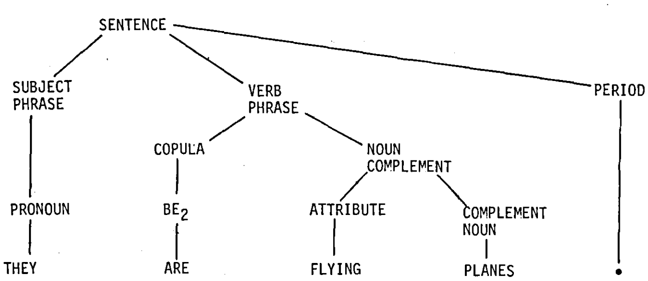
The computer's answer was:

ANN'S AGE IS 18.

Perhaps even more striking, considering problems that plagued us as high school students, is parsing or syntactic analysis of sentences. A program developed by Oettinger and Kuno at Harvard finds several analyses for the sentence:

THEY ARE FLYING PLANES.

One of them is equivalent to the following tree structure:



Several other mechanical parsers do almost as well.

Using an automatic syntactic analyzer of his own design, Klein, at Carnegie Institute of Technology, analyzed a paragraph of text and used the resulting analysis as input to an essay-writing program that generated the following loose paraphrase:

JOHN WHO MARRIED PENNILESS MARY MET HER . CLEVER JOHN WAS A BUSINESSMAN . HE LOVED FRIENDLY HELEN . HE PLAYED GOLF . HE WANTED HELEN . JOHN WHO KILLED A BUDDY LIKED PENNILESS MARY .

The linguistics Research Center of the University of Texas has a mechanical translation system that translated the following German clause

DAS ANWENDUNGSGEBIET DER SPEKTRALANALYSES IST SEHR GROSS UND MANNIGSFALTIG . . . into:

THE AREA OF APPLICATION OF SPECTRAL ANALYSIS IS VERY LARGE AND VARIED . . .

Moving to the college freshman level, a program by Darlington of MIT takes selected text, translates it into symbolic logic, and tests for consistency. The example below was successfully managed by this program.

THERE IS A PROFESSOR WHOM EVERY STUDENT WHO LIKES SOME PROFESSOR LIKES . EVERY STUDENT LIKES SOME PROFESSOR . THEREFORE THERE IS A PROFESSOR THAT ALL STUDENTS LIKE .

A system developed by Kirsh at the National Bureau of Standards accepts drawings of simple geometric figures, recognizes these, and is able to say whether statements such as the following are true or false:

EACH POLYGON SMALLER THAN THE BLACK TRIANGLE IS A SQUARE .
A BIG BLACK POLYGON WHICH IS ON THE LEFT IS A TRIANGLE .

A similar system by Simmons and Londe recognizes two or more drawings and generates such statements as:

THE SQUARE IS ABOVE AND TO THE LEFT OF THE TRIANGLE .
THE BOY IS BESIDE AND ON THE RIGHT OF THE GIRL .

On-line consoles on which a scientist or programmer interacts with a computer hold spirited conversations typified by the sample below:

Computer:	TIMESHARING IS ON THE AIR .
User:	LOGIN 0300 JG035 LOAD SYNTHEX
Computer:	WAIT
	NO LOAD DRUMS FULL
User:	DRUM
Computer:	WHAT ?
User:	DRUMS
Computer:	26,800 WORDS AVAILABLE
User:	LOAD SYNTHEX
Computer:	LOAD OK ON 17
User:	GO
Computer:	INPUT QUESTION . . . (ELSE '.').
User:	! STATUS
Computer:	WAITING FOR INPUT
	etc.

Granted, the language is telegraphic, but it seems at least to be a form of English.

Such information retrieval systems as MITRE's ADAM and SDC's LUCID accept statements couched in a limited parody of English. Questions such as the following are successfully understood and answered.

ADAM Query:	FOR DESTINATION BOSTON . IF ORIGIN NAME EQ LOS ANGELES , PRINT FLIGHT , DURATION , IF NONSTOP .
LUCID Query:	PRINT (FLIGHT NUMBER) (SPACE AVAILABLE) MAX (SPACE AVAILABLE) MIN (SPACE AVAILABLE) WHERE DATE EQ (21 DEC 65) WHERE AIRLINE EQ (PAC).

It is apparent from these examples that today's computers can answer simple questions, accomplish easy logical deductions, solve high school level algebra word problems, write poor essays, translate (not very well) from one language to another, generate simple sentence in response to nonverbal stimulation, and accept and understand verbal commands to action. The examples too are only a sample. Many programs have been written to allow computers to understand specialized aspects of English; to answer questions about baseball; to build family trees from sentences about family relationships; to find a path of verbal relationships between pairs of words; and to *learn* to parse sentences, to mention a few more. Such areas as stylistic and content analysis of text have also received attention.

With all these accomplishments, one might assume that the day of the automatic library is near—when we can give a carefully worded question to a computer system that can synthesize pertinent material from a library and write an essay tailored to our needs. But this will not be possible for a long time.

These examples of linguistic gadgetry are analogous to experimental prototypes of vacuum tubes, photoelectric scanners, cathode-ray tubes, power packs, one-tube radios, and other such simple electronic devices. The problem of language processing, however, is analogous to that of producing television on a commercially feasible scale. In short, although many language-processing devices exist in the experimental prototype stage and some primitive language processing is even used in commercially useful systems, not enough components are available. Those available are unreliable and usually highly specialized. They don't yet fit together into a meaningful whole. Furthermore, if they did, today's computers are not yet large enough to contain them or inexpensive enough to make their use attractive.

the theoretical situation

When Fleming and DeForest invented the vacuum tube there was a significant body of electromagnetic theory available. Today in language work there exist some fairly coherent structures of linguistic theory, a fragmentary understanding of semantic structure, and a body of psychological constructs that loosely delimit the idea of meaning.

Linguists have defined and classified many elements of language structure—phonemes, morphemes, word forms, syntactic structures, kernels, transformation rules, sememes, etc. Multilevel theories of how the elements of language interact have proved highly predictive and useful. Of particular benefit is recent transformational theory, which provides increasingly clear definitions of the mechanisms by which words can be combined into phrases and phrases can be transformed from one form to another. At the syntactic level of language there are fairly strong and reasonably complete theoretical descriptions of how structural elements of natural languages fit together. It is worth noting, however, that grammars—the actual formal rules of structure—are remarkably incomplete for all natural languages.

At the lowest level of meaning—the semantic structure—there exist more problems and ignorance than theory. The purpose of syntactic analysis in language processing is to make explicit the structure of interrelationships among the words and phrases making up a sentence. Similarly, in semantic analysis the goal should be to make explicit the relations within and among the meaning structures that comprise the sentence. A first goal of semantic analysis is to discover the meaning *in context* of a word, a phrase, a clause, or a sentence.

Considering words alone, the typical English word "strike" has several dictionary definitions—to hit, a work stoppage, the result of a pitched ball, a rich find—to mention a few. The first problem is to separate out and choose one definition that fits the word's usage or context in the paragraph. If this can be accomplished, the next problem is to combine the meanings of two or more words such as "Saturday" and "noon" into the meaning of the phrase, "Saturday noon." Assuming the definition "seventh day of the week" has been selected for "Saturday," and "middle of the day" for noon, the combined meaning becomes "middle of the seventh day of the week."

How we as humans accomplish these semantic feats is not wholly clear. How to accomplish them on computers has only recently become an area of study. However, the germs of theory have been developing in recent years. Fodor and Katz have outlined a plausible structure in which to encode meanings so that semantic analysis might become feasible. Quillian and Karen Sparck-Jones have each contributed experimentally as well as theoretically in the area. However, it is painfully apparent that when it comes to semantic analysis we know neither what is required nor how to accomplish it.

Assuming we could get dictionary meanings for words and phrases as a result of analyzing sentences, there remains yet a significant gap between a meaning *structure* and what can be accomplished with it. The psychological idea of meaning is largely a pragmatic one that is concerned with what results from a person's hearing or reading of a sentence. A semantic analysis that resulted in a single dictionary type definition for an entire sentence is not in itself a useful meaning. The comparison of how closely two definitions resemble each other or the discovery of other strings of words that can generate the same definition are useful meanings and would both be examples of psychological or pragmatic meanings of the sentence. Thus the question, "Is sentence A a paraphrase of sentence B?" might be answerable by measuring some distance function between their two definitions or in some manner generating strings of words from A, until B is derived. How such measurements can actually be made is not obvious although Quillian and Sparck-Jones have each shown that the distance of definitional paths between words tends to be less in proportion to the similarity of their meanings.

Other aspects of using meaning include the requirement of somehow mapping from the semantic structure of a question or a command onto the structure of a set of functional subroutines and perhaps a data base to accomplish such tasks as question answering or command control. A few techniques for the analysis of meaning in the pragmatic sense can be glimpsed in some of the existing devices, but none of these seems general enough to suggest a path to a clear understanding of the problem.

Of course there is much more of theory than can be described here, but the three areas of syntax, semantics, and pragmatics show a rapid progression from the fairly well-formulated syntactic theories to the only dimly perceived pragmatic aspects of meaning. Available theory is useful and suggestive but far more is needed.

syntactic problems of language processing

On the practical level we can gain a great deal by looking at specific problems and how they've been avoided —or even occasionally solved—in the various extant language-processing systems. One of the first things that one notices in working with words is that the same word occurs in many different forms with only minor changes in meaning. Thus for some machines, "farm," "farmer," "farming," "farms" can be treated alike, ignoring their differences in meaning provided they can be recognized as alternate forms for the same root, "farm." This particular aspect of morphology—the rules for combining root forms with suffixes—is well understood by linguists and is expressible as a small, neat set of rules. As a consequence several programs exist in various laboratories across the country that can strip suffixes and recognize root forms of words. Nevertheless, many of the language-processing devices do not include them—to these a word is a particular combination of characters that allows for no deviation. The human user of an interactive time-shared computer system may fret and fume when he asks "DRUM" and a system responds "WHAT?" instead of recognizing that he meant "DRUMS." In today's more complicated data retrieval systems which depend on a completely de-

You'll pay a little more for digital computer tape with this label on it.

8+8 TOTAL SURFACE TESTED

800 BPI

Gladly.

New **8+8 Total Surface Tested** tape is worth more because it saves *much* more — saves man hours, lost data, computer time, dollars. Available from stock for all compatible systems in 200, 300, 600, 900, 1200 and 2400 ft. lengths. Each reel individually registered and guaranteed by the U.S. Magnetic Tape Company.

Study the chart at the right to see why **8+8 Total Surface Testing** is at least eight ways better than the techniques most widely used today.

Order today from your nearest U. S. Tape distributor, or write for your *free copy* of a new booklet entitled "The *facts* about testing magnetic tape for digital computers."

Here's why 8+8 testing is at least 8 ways better

	7-track	9-track	Full-width 7/9-track	Total Surface 8+8
1. Usable area tested Usable area untested	52% 48%	76% 24%	88% 12%	**100%** **none**
2. Head alignment compatibility (of user's tape transport and tape manufacturer's test equipment)	critical	critical	critical	**not critical**
3. Untested edge	25 mils	10 mils	10 mils	**8 mils**
4. Track width	30 mils	40 mils	30-40 mils	**32 mils**
5. Possibility of missing migratory particles	yes	yes	yes	**no**
6. Possibility of undetected permanent dropouts	yes	yes	yes	**no**
7. Possibility of errors in recording channels caused by dynamic skew	yes	yes	yes	**no**
8. Test track overlap	none	none	partial	**complete**

US TAPE

U.S. MAGNETIC TAPE COMPANY

A Subsidiary of Wabash Magnetics, Inc.

HUNTLEY, ILLINOIS 60142

fined query vocabulary, such a restriction is particularly galling. Ironically, although at the research level, the problem of dealing with alternate forms of words has been solved, the solution has not yet been generally adopted in practical systems.

Syntactic analysis is another practical problem area. As a prerequisite to understanding a query or a sentence it is necessary to make a syntactic analysis. Approaches to syntactic analysis are fairly well understood; as a first step, one looks up each word in a sentence in a dictionary to find its part of speech. Later steps combine the part of speech into such phrase structures as noun-phrase, verb-phrase, clause, or sentence. Final steps may include discovering the simple kernel sentences and the transformations they undergo to produce the complicated English sentence that is being analyzed.

In looking up parts of speech for each word one may encounter a few difficulties. The word may not be found in the dictionary—it may be a new word or it may be misspelled; if found it is most likely to have more than one part of speech associated with it. Thus, "like" may be a verb, an adverb, a preposition, a noun, or an adjective. Resolving these ambiguities is an important first step in analyzing a sentence or question.

Errors in spelling can sometimes—riskily—be taken care of by clever little programs that relate letter combinations to frequent errors or introduce some small amount of phonemic logic. Using them is rather risky because the program has no way of knowing whether the word is a legitimate one that it has not previously experienced or whether it is just misspelled. If the purpose is only syntactic analysis, the fact that a word is not in the dictionary for whatever reason can just be ignored. Since multiple-part-of-speech assignment is the rule rather than the exception, the word may simply be assigned "noun," "verb," "adjective," "adverb" classes and the analysis may continue.

However, the ambiguity of these part-of-speech or word-class assignments must still be resolved or at least minimized if the analysis is to be useful. This can be accomplished by computing the word class that is actually being used in the context of the sentence. This computation is accomplished by developing a set of frames that record, either from a linguist's knowledge or from a program's experience with text, the permissable combinations of word classes. Thus, in the frame "art—noun" and adjective, a present participle, or a past participle may occur between the article and the noun. All of these may usually be treated in that frame as an adjective. Many frames will allow more than one word class. For example, the frame "noun—adverb" will allow a noun, a participle, a verb, a preposition, or another adverb between the noun and the adverb. If the word's possible parts of speech are "adjective" and "adverb," a simple intersection procedure shows that in this context it can only be an adverb. Later more complex interrelations of words in the sentence, such as the requirement of noun and verb to correspond in number, may be used to reduce ambiguity further. If all else fails, and the particular system requires a single interpretation—right or wrong—probabilities based on frequency of previous occurrences have occasionally been used without disastrous consequences.

However, the problem of ambiguous syntactic analyses is one of the great still-unsolved difficulties of language processing. Using word classes and structural information alone, as all existing syntactic analysis systems do, the problem cannot be solved. The solution depends on knowing the meaning of the word and how the meaning of words in a phrase relate to each other. Thus the problem of ambiguity of syntactic analysis depends for its solution on the development of techniques for semantic analysis. In some cases such as "I saw the man with the telescope on the hill" there is no way to resolve either the syntactic or semantic ambiguity without introducing additional context from preceding and following sentences.

Today's syntactic analyzers usually offer several presumably valid syntactic analyses. In fact, depending on the completeness and accuracy of the dictionary and the grammar, one or more of these may be false, the several may be unlikely and/or the intuitively correct analysis may not be included. Thus, although automatic systems for syntactic analysis have been under study for almost ten years and are certainly among the best-understood components of a language-processing system, they still leave much to be desired.

While language-processing researchers have not yet been able to *solve* the gamut of syntactic problems, they have shown their real cleverness in the means they've used to *avoid* them. By selecting a small subset of English words and restricting the structure of the language to be handled to the simple English subject-verb-object sentence, they have built many interesting devices, and the researcher has freed himself to deal with the often more interesting problems associated with discovering the meaning of sentences or questions.

problems of meaning

Every attempt to deal with meaning depends on some form of dictionary. An early machine by Lindsay had a dictionary that included a small number of words that pertained to family relations such as "father," "mother," "sister," "brother," "cousin," "aunt," etc. On the basis of an analysis of the syntactic relations of these words to proper names in a sentence, the meanings of the words were interpreted as connective relationships among human names in a family-tree structure.

A much more ambitious system by B. Green developed a dictionary of more than a hundred terms that could be used in asking questions about baseball games and their scores. Meanings of words in the baseball system ranged from purely syntactic word-classes to complicated series of subroutine calls. The question analysis had the unenviable task of translating from English into an appropriately ordered set of calls to subroutines that would retrieve information from the data base. The researchers were able to solve this analysis task for a fairly general set of simple English questions. The magnitude of their achievement can be estimated from the fact that such questions as the following were understood and answered correctly:

HOW MANY GAMES DID THE YANKEES PLAY IN JULY ?
WHO WON THE GAME BETWEEN THE RED SOX AND THE CARDINALS ON AUGUST 15 ?
WHAT TEAM WON THE MOST HOME GAMES IN AUGUST ?

The difficulty of the achievement can really only be appreciated by a personal attempt to build systems that can understand questions. But the fact of three years of effort by a topflight team of four or five researchers gives some measure of the problem's recalcitrance.

Of course this problem of understanding the meaning of questions and of text can be avoided too. One of the more effective systems for finding answers to simple questions is the author's Protosynthex I. This system uses a deep indexing of all the content words in the text as its main cue for understanding. The index shows the sentence and paragraph location of each content word. Answering a question involves looking up each of its content words in the index and finding the sentence or paragraph in which

Burroughs sets the pace for the computer industry

The new B 2500 and B 3500 are the latest Burroughs 500 Systems to be developed for business, scientific, and data communication tasks. In every measure of hardware and software performance, they far outpace other computer systems in the low- to medium-price range.

Two major factors are responsible for the exceptionally high performance-to-price ratio of the B 2500 and B 3500. The first is a design principle common to all Burroughs 500 Systems. In 1960, Burroughs Corporation determined that, in the future, computer performance would depend as much on software as on hardware. Events have proved this to be true. For this reason, *every* Burroughs 500 System has been *designed from the beginning* by *teams* of engineers and software experts.

Many economies result for the user. For example, the Master Control Program for the B 2500 and B 3500 not only performs many more useful functions than other automatic operating systems, but also reduces by a factor of 10 the amount of main memory that must be set aside for its exclusive use. Other gains are made in compiling times, programing ease, and speed and efficiency of operation. In short, the teamwork approach to computer design has allowed Burroughs to build a better bridge of communication between the B 2500 and B 3500 and their human users.

A second major factor is the use of monolithic integrated circuitry in construction of virtually all logic and the two control memories. The Burroughs B 2500 and B 3500 make use of complementary transistor logic, plus some use of array monolithics—two proven design concepts at the forefront of this newest logic technology. The results are smaller, faster, more reliable circuits at lower costs—and operating speeds measured in billionths of a second.

Like the other Burroughs 500 Systems—the larger B 5500 and the very large B 8500—the two newest systems can handle a variety of input/output activities simultaneously—as many as 20 at a time with the B 3500—while the processor continues its work. They multiprocess many unrelated jobs at one time, keeping the whole system fully utilized and greatly speeding the turn-around time for jobs. *And, since no human being could manage and schedule their multiple split-second operations, they are self-managing through their control programs.* All this, in the low- to medium-price range.

No wonder Burroughs is regarded as the pacesetter for the computer industry.

Burroughs Corporation

Detroit, Michigan 48232

CIRCLE 29 ON READER CARD

the greatest number of words from the question intersect. A complicated scoring system gives weights for the informative value of words, for ordering of words, and for relative conciseness of the answer, thus measuring how relevant the retrieved material is to the question. By retrieving the text which scores highest relevant to the question, Protosynthex often delivers good answers to questions.

But avoiding the problem is only a temporary measure. Direct attacks on the computation of meanings promise a far greater eventual reward. Karen Sparck-Jones at Cambridge Research Center has been studying methods to build a thesaurus by automatically using cluster-analysis techniques to group sets of synonyms. At the same time she has developed the beginnings of a semantic analysis technique that traces verbal paths through a synonym dictionary for any pair of words. It appears from her research that the words of a sentence tend very strongly to be interrelated by very short paths through such a dictionary. Quillian at Carnegie Tech has made the similar finding that the dictionary path between two words shows how their meanings interrelate.

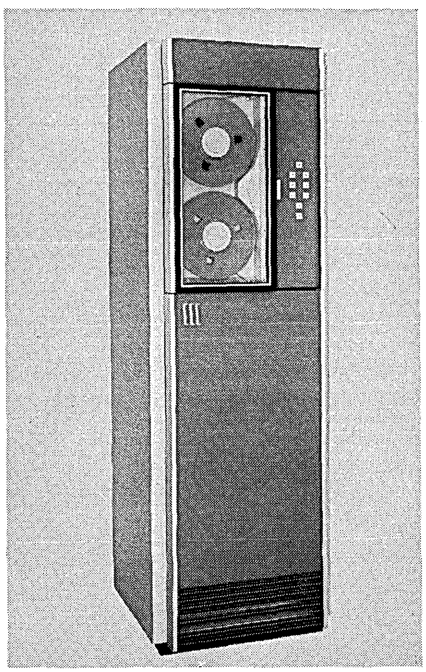
Fodor and Katz at MIT have developed the beginnings of a formal structure for a semantic theory. They suggest a formal method for coding the various aspects of meaning for words showing also the limitations and possible combinations for each. Such logicians as Darlington and Bohnert have spent much effort in attempts to translate from simple English structures into the formalisms of the relational and propositional calculi. In these attempts the meaning of the sentences must be made explicit in a logical formalism without distorting the English sense. But a strong indication from the work of these logicians is that the relational calculi are so far less rich in structure than natural languages that only a tiny fraction of English is expressible in them. In general, the attempt to translate from English into logical calculi does not appear to be a promising approach.

Some of the more exciting work with meaning squarely confronts the requirement of a highly specialized dictionary. Such a dictionary must make explicit things we ordinarily take for granted when we look up a word. The conceptual dictionary of the author's Protosynthex II is an example. In this dictionary, each noun is defined by a set of simple English statements that show what it is, has, and does. Fig. 1, *(p. 69)* shows examples of input statements, questions, commands, and the system's responses.

While Protosynthex II directly attacks the question of meaning, it deals syntactically with only simple English sentences and thus temporarily avoids the pitfalls of syntactic ambiguity. However, the direct study of answering questions from a well-coded dictionary has brought to light a whole series of problems. One of these is the shocking realization that understanding a question is quite a different matter from understanding a declarative statement. A question contains a command, a limiting statement and a clue as to what the answer must be like. A question uses English words partly as commands to action, e.g., "count," "name," "how many," "difference," etc.; partly as syntactic and semantic cues to the structure and nature of the answer, e.g., "where," "when," "which animals," "how many kinds," etc.; and partly simply as retrieval indicators, e.g., "Where do *ducks migrate in winter*?" "When was *George Washington born*?" In fact the analysis of questions and commands promises to prove worthy of be-

If you consider the cost... and the performance... and the versatility...

you won't consider any other.



For this is CEC's DR-3000 — the first truly universal digital magnetic tape system. It offers unequalled performance and versatility — at the lowest cost of any comparable digital tape system available today.

The DR-3000 series is designed to cover the full range of tape speeds and computer compatibility.

The following advantages sum up the reasons why this system has become the obvious choice for so many digital data processing requirements.

Compatibility. The DR-3000 will guarantee complete machine compatibility with any other DR-3000, or with any IBM-compatible tape system operating within IBM specifications. A complete selection of IBM-compatible accessories is available.

Operator convenience. The DR-3000 is the easiest of all to load due to a straight tape-loading path which requires no threading.

The entire operation takes less than 10 seconds. CEC's patented self-locking reel hubs with quarter-turn action provide fast, positive reel retaining. Front access only is required for all normal maintenance.

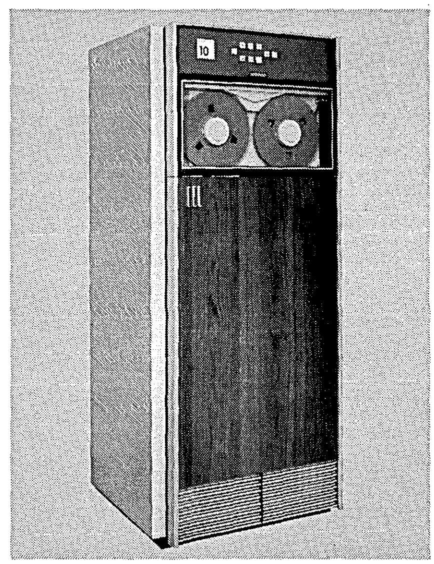
Formats. 7-channel 729 series or 9-channel 2400 series formats are standard, reading and writing at 200, 556, or 800 bpi — plus 1600 bpi phase-encoded format available on special order.

Versatility. High, medium, or low speed units feature major interchangeability of parts. The most compact system made, it will mount 2 or 3 to a rack—even fit through a submarine hatch. It is available in horizontal or vertical cabinets. Rugged construction for semi-mobile environments. It provides a complete selection of input/output logic levels. The DR-3000 is the ideal unit for most commercial or laboratory data processing systems.

Reliability. Only field-proven design concepts are used. Dual capstans with rugged drive actuators provide positive accurate drive. There are no belts or mechanical linkages to cause tape slippage or creep. Tape drive actuators are self-aligning for minimum skew and do not need adjusting. CEC-built all metal-front-surface read/write heads have achieved *over 12,000 hours* operational life in field environments. All electronics are modular and solid state.

Performance. The DR-3000 assures the most performance per dollar available today. Fast start/stop characteristics provide complete unrestrictive programming, high speed rewind. Air bearings virtually eliminate tape friction. Average steady state tape speed variations are less than ± 0.5%.

CIRCLE 32 ON READER CARD



Transport Specifications:

Standard ½" tape, 7 or 9 channels • Tape speeds — 37½, 75, or 112½ ips • Standard IBM formats • Operates at 200, 556, 800 bpi NRZ or 1600 bpi phase-encoded (on special order) • Start time —less than 4 msec • Stop time — less than 3 msec • Rewind — 2400 feet in less than 2½ minutes • Bit dropout rate less than 1 in 10^7 • Maximum total skew — within full IBM machine-to-machine compatibility at all speeds • Average tape speed accuracy — within ± 0.5% of absolute • Cycling rate — 200 commands-per-second without programming restrictions • Power —1 kva • Size — 19" x 24½" x 13½" • Weight — 135 lbs.

For complete information about the DR-3000, call CEC or write for Bulletin 3000-X8.

CEC

Data Instruments Division

CONSOLIDATED ELECTRODYNAMICS

A SUBSIDIARY OF BELL & HOWELL/PASADENA, CALIF. 91109
INTERNATIONAL SUBSIDIARIES: WOKING, SURREY, ENGLAND AND FRIEDBERG (HESSEN), W. GERMANY

Fig. 1. Examples of Control Statements, Questions, and Answers from Protosynthex II.

```
ENTER(((HORSE . NOUN)(IS . ISVB)(ANIMAL . NOUN)(LIVE . VERB)
(ON . PREP)(FARM . NOUN)(STRONG . ADJ)(PULL . VERB)
(WAGON . NOUN)(MOST . ADJ)(ARE . ISVB)(EAT . VERB)(HAY . NOUN)
(ALL . ADJ)(RED . ADJ)(MANY . ADJ)(HAVE . HAVB)(LONG . ADJ)
(MANE . NOUN)(SOME . ADJ)(PERSON . NOUN)(RACE . VERB)))
 DICTIONARY
PLURALS(((HORSE . HORSES)(ANIMAL . ANIMALS)(FARM . FARMS)
(WAGON . WAGONS)(MANE . MANES)(PERSON . PEOPLE)))
 OK
START()
 READY
A HORSE IS AN ANIMAL / HORSES LIVE ON A FARM / STRONG HORSES
PULL WAGONS / MOST HORSES ARE STRONG .
 LEARNED
 READY
HORSES EAT HAY / ALL HORSES ARE RED / MANY HORSES HAVE LONG
MANES / SOME PEOPLE RACE HORSES .
 LEARNED
 READY
FORGET((ALL HORSES ARE RED))
 FORGOTTEN
 READY
WHAT IS A HORSE ?
 HORSE IS AN ANIMAL
 READY
WHAT DO HORSES DO ?
 HORSES LIVE ON A FARM AND EAT HAY / STRONG HORSES
 PULL WAGONS
 READY
WHAT DO STRONG HORSES DO ?
 STRONG HORSES PULL WAGONS
 READY
DO MANY HORSES HAVE LONG MANES ?
 YES
 READY
DO ALL HORSES HAVE LONG MANES ?
 TO MY KNOWLEDGE- NO
 READY
DESCRIBE HORSES ?
 HORSES ARE AN ANIMAL / MOST HORSES ARE STRONG / MANY
 HORSES HAVE LONG MANES / HORSES LIVE ON A FARM AND EAT
 HAY / STRONG HORSES PULL WAGONS / SOME PEOPLE RACE HORSES
 READY
WHAT DO HORSES EAT ?
 HORSES EAT HAY
 READY
```

coming a whole discipline itself. Finding and recognizing the answers after understanding the question is yet another problem.

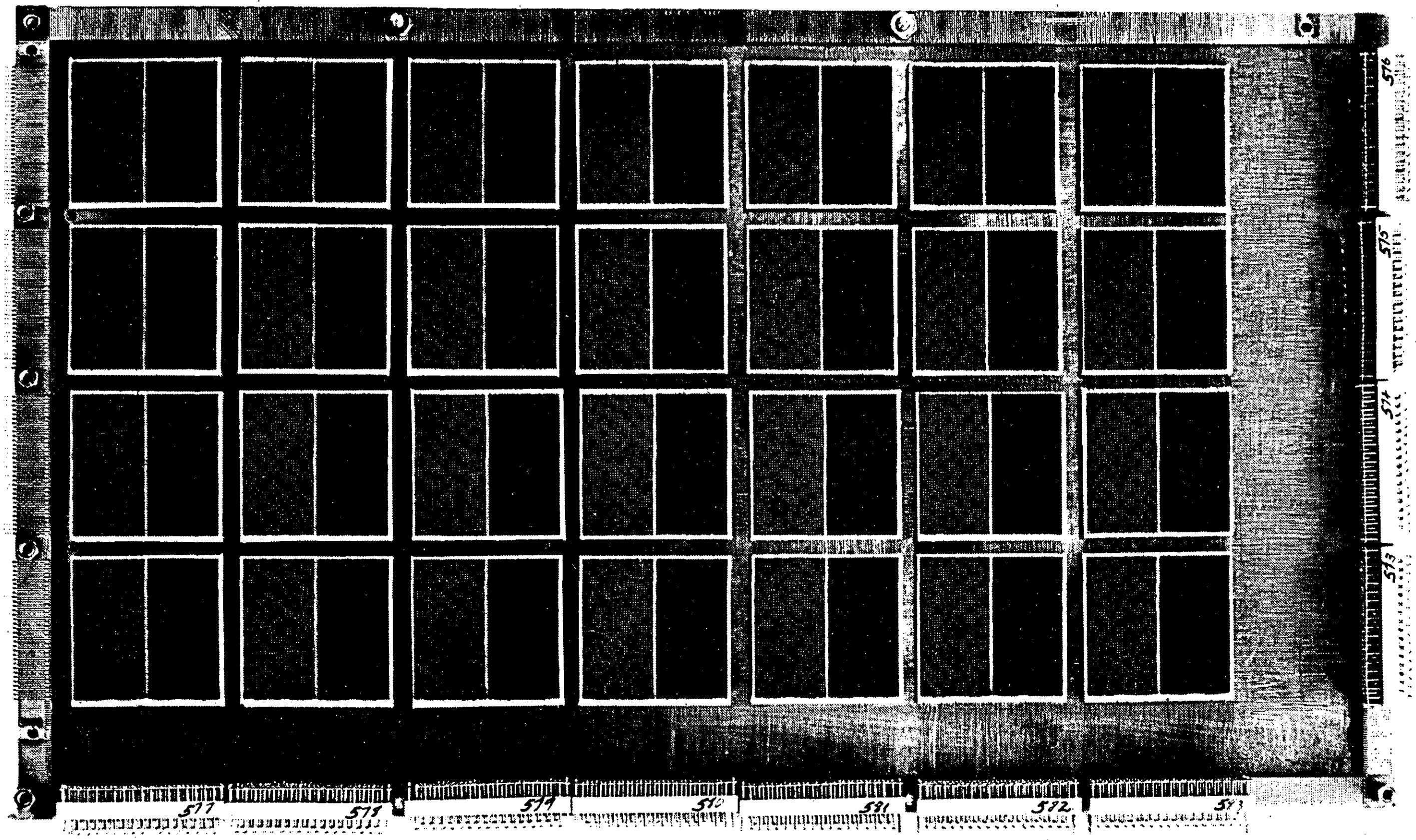
This latter problem becomes partly manageable by storing the text that has been read in a carefully organized structure. Since a successful syntactic analysis resolves the elements of a sentence into some form of a simple tree structure, and since trees map perfectly onto lists with sublists, it is usually a list structure that is used to store simple sentences of text. Collecting all sentences about a given subject into a single more complicated list and then cross-referencing the subject word to other sentences in which it appears serves the double pupose of organizing and indexing the text that has been read.

Fig. 2, *(p. 71)* shows how a paragraph of English is reorganized into a convenient though complex list structure. The list labeled HORIZONTAL shows other subjects under which word, Bolivar, is included.

Answering a simple question such as "Where was Bolivar born," resolves into a process of analyzing the question into a comparable structure and matching its components against the structure of the stored sentences. A more complex question such as "How many times did Bolivar go to Europe?" requires much more difficult operations to resolve it into a structure such as the following:

(Count routine) (Bolivar) do (go / went / traveled / sailed) (Europe / England / Spain / etc.)

The count routine counts the number of times elements of the right-hand structure of the example match the data base. In the end, finding and recognizing an answer resolves into matching given and derived elements of the question against the elements and structure of the or-



ganized data base.

The problem of using a dictionary to "understand" language plunges us again into the difficult problems of explaining what is meant by "understand." At the dictionary level, one aspect of understanding is to discover the word sense or particular definition that applies to each word in the context of a particular sentence. It means also to find the antecedents for any pronouns or pronoun-like expressions in the sentence and to substitute for them the meanings of their antecedents. It probably also means to combine the definitions of words into a single definition for a phrase, for a clause, and for a sentence. Assuming the achievement of a single definition for the meaning of a sentence, "undestanding" implies further that this definition will be stored in a convenient structure that links it to similar definitions, however they may be expressed in words.

Research on these problems of meaning has only just begun. Useful and practical results are undoubtedly still years away.

Fig. 2. An Example of Text Structuring by Protosynthex II.

```
(BOLIVAR (POS . NOUN)
   (PL . BOLIVARS)
   (IS1 ((((HERO) (A) (GREAT) (OF ((AMERICA) NIL (SOUTH)))))
     (SIMON)))
   (DO ((((WAS BORN) NIL (IN ((VENEZUELA) NIL NIL)) NIL NIL))
     (SIMON))
    ((((WAS SENT) NIL (TO ((SPAIN) NIL NIL)) NIL NIL)
      ((GOT)
       NIL (AT ((NINETEEN) NIL NIL)) NIL ((EDUCATION) (AN) NIL NIL))
      ((MARRIED) NIL NIL NIL ((GIRL) (A) (BEAUTIFUL SPANISH) NIL))
      ((TOOK)
       (BACK) NIL NIL ((HER) NIL NIL (TO ((VENEZUELA) NIL NIL))))
      ((WENT) (AGAIN) (TO ((EUROPE) NIL NIL)) NIL NIL)) NIL))
   (IS2 ((HEARTBROKEN) NIL))
   (HORIZ (GIRL FAMILY)))

(GIRL (POS . NOUN)
   (PL . GIRLS)
   (DO ((((DIED) (LATER) NIL NIL NIL)
      ((DIED) (LATER) NIL NIL ((MONTHS) (A) (FEW) NIL)))
     ((OF ((BOLIVAR) NIL NIL)))))
   (HORIZ (BOLIVAR)))

(VENEZUELA (POS . NOUN)
   (IS1 ((((PART) NIL NIL (OF ((COLONY) (A) (BIG SPANISH))))) NIL))
   (DO ((((WAS RULED) NIL (BY ((SPAIN) NIL NIL)) NIL NIL)) NIL))
   (HORIZ (BOLIVAR)))
```

Note: POS means Part of Speech
PL " Plural
NIL " Blank
IS1 and DO are Verb Classes

mechanical translation and other applications

Certainly the most widely publicized application of language processing has been mechanical translation. IBM offered a display at the New York World's Fair that gave reasonable translations from Russian to English. The Air Force is actually using mechanical translations to help them. But as years pass researchers in this area speak less about mechanical translation; they have all become researchers in basic linguistics and language processing. Generally their publications deal with syntactic analysis, linguistic structures of English, Chinese, Russian, etc., and with other basic linguistic studies. Actually there still exist several strong research projects whose primary goal is to develop automatic translation. IBM, Bunker-Ramo and the University of Texas are notable leaders in the area. But their problems are the language-processing problems discussed earlier plus the unique problem of transforming meaning structures derived from one language into the structures and symbols of another. Just as the problem of question-answering introduced a whole new level of analysis above the level of dealing with declarative sentences, so the problem of translation introduces the level of transformations of meaning structures and symbols between two languages.

This problem has been most clearly stated by Wayne Tosh at the University of Texas in a monograph called *Syntactic Translation*. This model of the translation process calls for a deep syntactic analysis of the first language. Meanings from an intermediate artificial language are then assigned word-by-word and phrase-by-phrase to the resulting syntactic structures. These meaning structures can then be used to generate syntactic structures and eventually verbal symbols in the second or target language. The problems inherent in this very complicated process are those of syntactic and semantic analysis just as they were in the question-answering paradigm. Additional problems of controlled generation of meaningful text must also eventually be faced in both areas. Other applications of language processing to stylistic and content analysis of text have also reached the public eye. The determination of the authorship of the Federalist papers with the aid of a computer, the supporting use of computers in decoding and assembling contexts of the Dead Sea Scrolls, the content analysis of psychotherapy protocols and of political science documents are all well-publicized examples of applied language processing. Generally in these applications, language processing is at the simplest—and for some time to come the most useful and reliable—level of counting identical or near-identical tokens of words. Disputed authorship can often be resolved by word counts of such function words as "of," "by," "from," "but," "however," etc., which turn out to distinguish the styles of different writers.

Content analysis usually uses a computer to count the frequency of occurrence of words which have previously been decided by humans to have been of special significance. Thus in political science such words as "communist," "democracy," "front," etc., can be used to categorize the content of documents. In the analysis of psychotherapy protocols, the frequent co-occurrence of words such as "mother," "love," "father," "self," "jealous," "fear," etc., is taken to reveal certain types of complexes. In some cases content researchers have attempted to interpret the syntactic structures in which words occur. They are then plunged almost immediately into the full range of language processing problems.

Perhaps the most significant use of language processing —automatic indexing—occurs at this apparently superficial level of word counting. With the preparation of permuted indexes of titles and the later developments of Quik Indexing and automatic extracting a significant scientific breakthrough may have occurred. The underlying idea was the simple one that words could be coded as numbers and computers could compare two such numbers to discover identity or difference of words. The idea has been around for many years; the code was ordinary sortable Hollerith, which had long antedated computers in punched card forms. But the breakthrough couldn't occur until computer memories became large enough to contain several thousand words, and computing speeds increased to the point where millions of comparisons per minute became possible. That it was a breakthrough can be seen by the fact that until indexing became available, very few applications of computers to analyses of English text had been published. Thereafter a very large literature built up with great rapidity. Applications to concordance building, stylistics, automatic extracting, and aids to document retrieval all became common within a period of two or three years. Underlying all of these techniques was the basic concept of associating with words that occurred in a text, the locations at which they occurred, i.e., building an index.

With information such as this computed automatically, it was possible to count word frequencies within text and to score sentences proportionally to the number of frequent content words. The best scoring sentences could be taken as an extract that more or less fulfilled the role of an abstract as a short form of characterizing the document. Words judged particularly significant for any reason could be found and thus sentences or documents could be characterized on the basis of significant content words. So characterized, such representations of documents could be classified even automatically with such tools as factor analysis.

Today, although we reach eagerly into a rarified atmosphere for theories of meaning, of understanding, of syntactic and semantic analysis, it is still true that our most reliable tool is the ability to index a text—to discover whether two words are alike or different and to record where they occur in the text.

the future

As language processing researchers, we would like to understand language well enough to instruct a computer just what to do in every linguistic situation. Our eventual goal is to make the recorded verbal product of millions of thinkers easily available via large computers to anyone who needs some portion of it. Those computers must eventually be able to analyze questions and text from several languages into some basically meaningful structure and synthesize answers, essays, translations, etc., in any of several natural languages.

In the last decade, significant progress has been made. Theoretical formulations, although still only beginning, have brought some ordering of ideas about syntactic and semantic analysis. Concepts of meaning are gradually developing into operational definitions. Experimental devices have emerged as eventual prototype components of some useful language processing system. Now as relatively useless as the first solid-state components patented in the thirties, these linguistic gadgets and their descendents will eventually fit together into a complex system. But this is many years away.

For today, we have a few solid accomplishments in language processing. The increased understanding of formal linguistic structures has greatly augmented the capability of compiler builders and data base users to make meaningful statements in forms usable by computers. The well-understood capability of indexing text has made computers highly valued partners in such important tasks as concordance production, document retrieval, and various kinds of text analysis on a scale once impossible. Word-finding and context-matching by computer has already become of considerable use for linguists studying the actual structures of natural languages.

On the one hand then, a few solid accomplishments; on the other, small but measurable progress toward a perhaps grandiloquent dream. This is language processing in the beginning of 1966. ■

REFERENCES

The names of many researchers and of their systems or approaches to language processing have been mentioned in the text. The following two references will allow the interested reader to find more detailed descriptions and citations of the original work.

Simmons, R. F. Answering English questions by computer: A survey *Communications of the ACM*. January 1965, 8(1), 53-70. Surveys the English question-answering systems up to the Fall of 1964.

Mechanical Translation. June and October 1965, 8(3,4). In this issue, articles by Sparck-Jones, Darlington, Klein, and Needham discuss many aspects of semantics.

STACKTRONICS

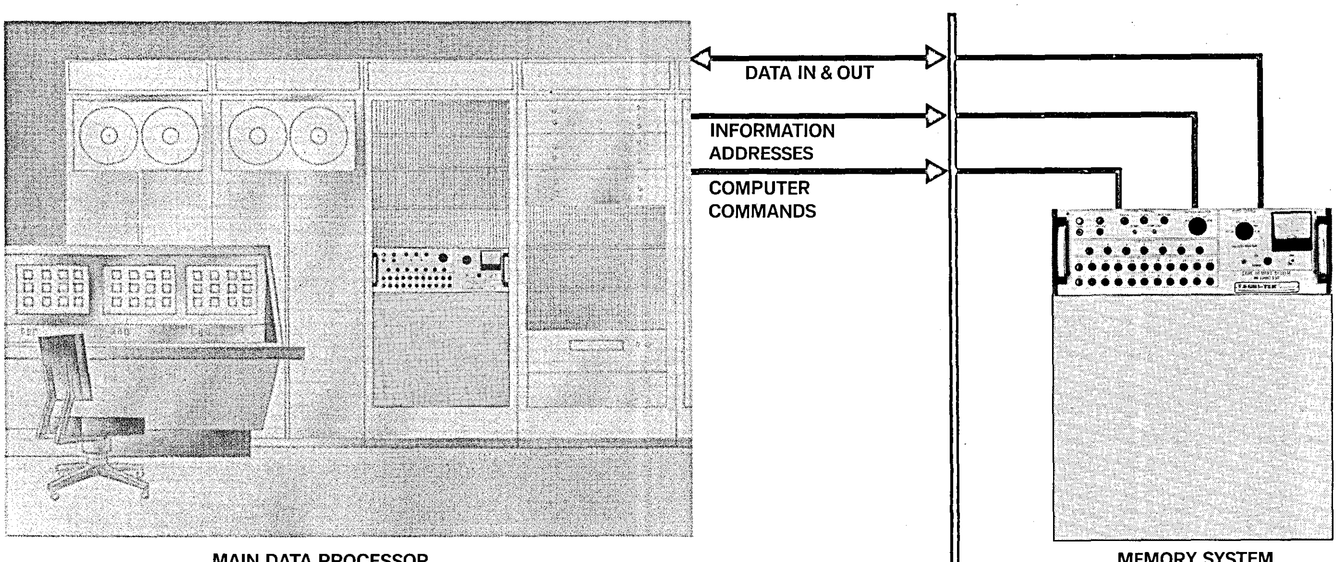
Computers don't talk to memory stacks. Electronic circuitry is the necessary intermediary which allows storage and retrieval of information in the form and at the rate compatible with the computer's timing and organization. Such circuitry plus the stack make a complete memory system.

When "wedding" a stack to the necessary electronics, a competent memory designer takes every opportunity to reduce the number of electronic components used. These circuit cost and reliability design decisions are balanced carefully with stack costs and overall system utility.

To control a given number of storage elements in a coincident-current memory, it is necessary to energize each of the X and Y coordinate conductors. The array can be square or rectangular. Or the array can be segmented into a number of squares or rectangles. The choice of any of these array forms is determined by the amount of electronic components versus the stack size and data storage capacity and speed requirements.

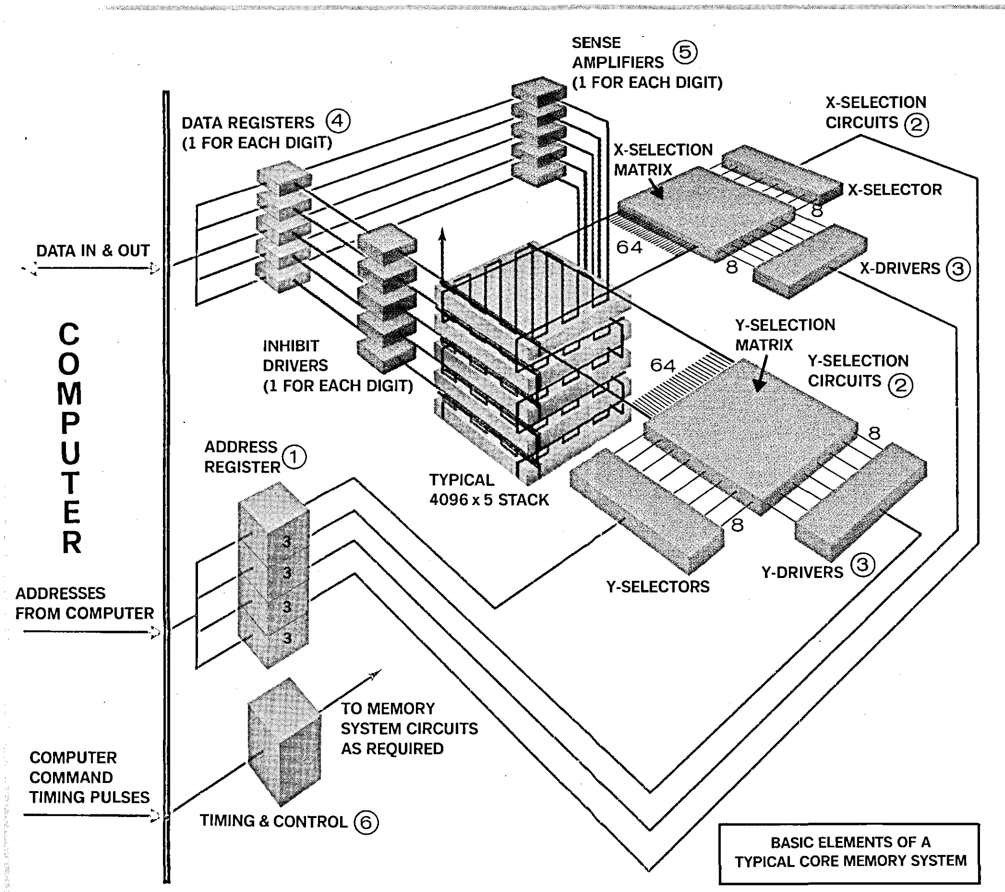
Many component-reducing schemes have been developed to cut costs and improve reliability. Diode and transformer matrices and other current steering circuitry reduce the number of costly driver circuits. Other circuit savings are realized by sharing functions wherever possible.

A properly designed memory system matches computer design objectives at the lowest possible cost while performing every required function with reliability. A low per-bit-cost stack design can lose its price advantage quickly when additional electronics are needed. Lowest ultimate cost results from complete system consideration.

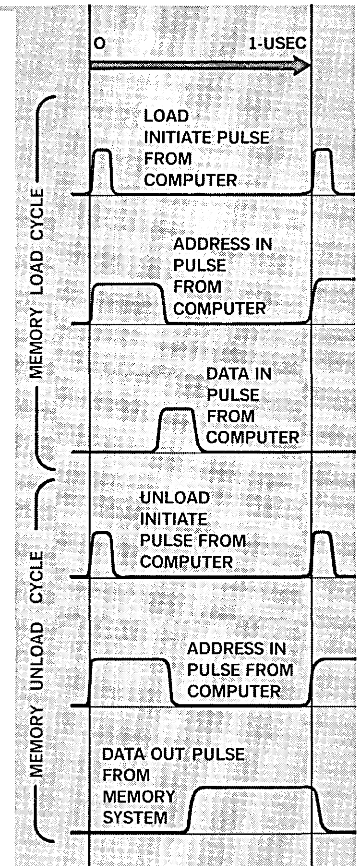


ABBREVIATED FUNCTIONAL CONNECTIONS BETWEEN A COMPUTER AND ITS MEMORY SYSTEM

This is the last in a series of six discussions dealing with the design of core memory systems. The complete series is now available in booklet form. Please circle 63 on reader service card if you would like to receive it.



BASIC ELEMENTS OF A TYPICAL CORE MEMORY SYSTEM



TYPICAL TIMING OF A 1-USEC CORE MEMORY SYSTEM

1. ADDRESS REGISTER –
Temporarily stores address words which later determine the XY coordinates of data to be stored or retrieved until memory system is ready to act on this information. Controls XY selection circuits.

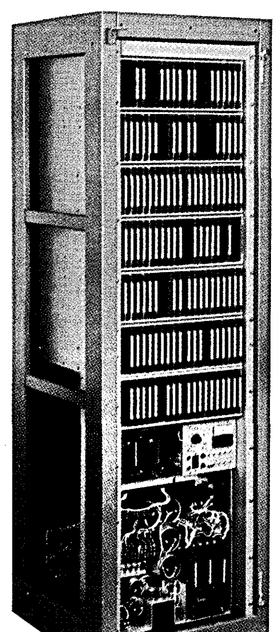
2. X AND Y SELECTION CIRCUITS –
Steer the X, Y read-write currents through the proper stack drive lines to switch the cores at the X-Y coincidence. Diode or transformer matrices reduce the number of current drivers needed by switching one driver to any of several drive lines as needed.

3. X AND Y DRIVERS –
Provide current pulses to drive lines to cause core switching at the X-Y coincidence. These currents are steered by the selection circuits which are controlled by the address register.

4. DATA REGISTER –
Temporarily holds binary information to be stored or retrieved from memory stack. Receives data from either computer or memory sense amplifiers. Triggers inhibit drivers when a binary "0" is to be written.

5. SENSE AMPLIFIERS –
Receive a pulse from the sense line when cores are switched by the read-write drive currents and converts signal levels in the stack to those required by the data register.

6. TIMING AND CONTROL –
Provide the proper sequence of events in the memory system to receive and retrieve data at the rate usable by the computer. Each initiate pulse from the computer triggers one cycle of memory system operation.

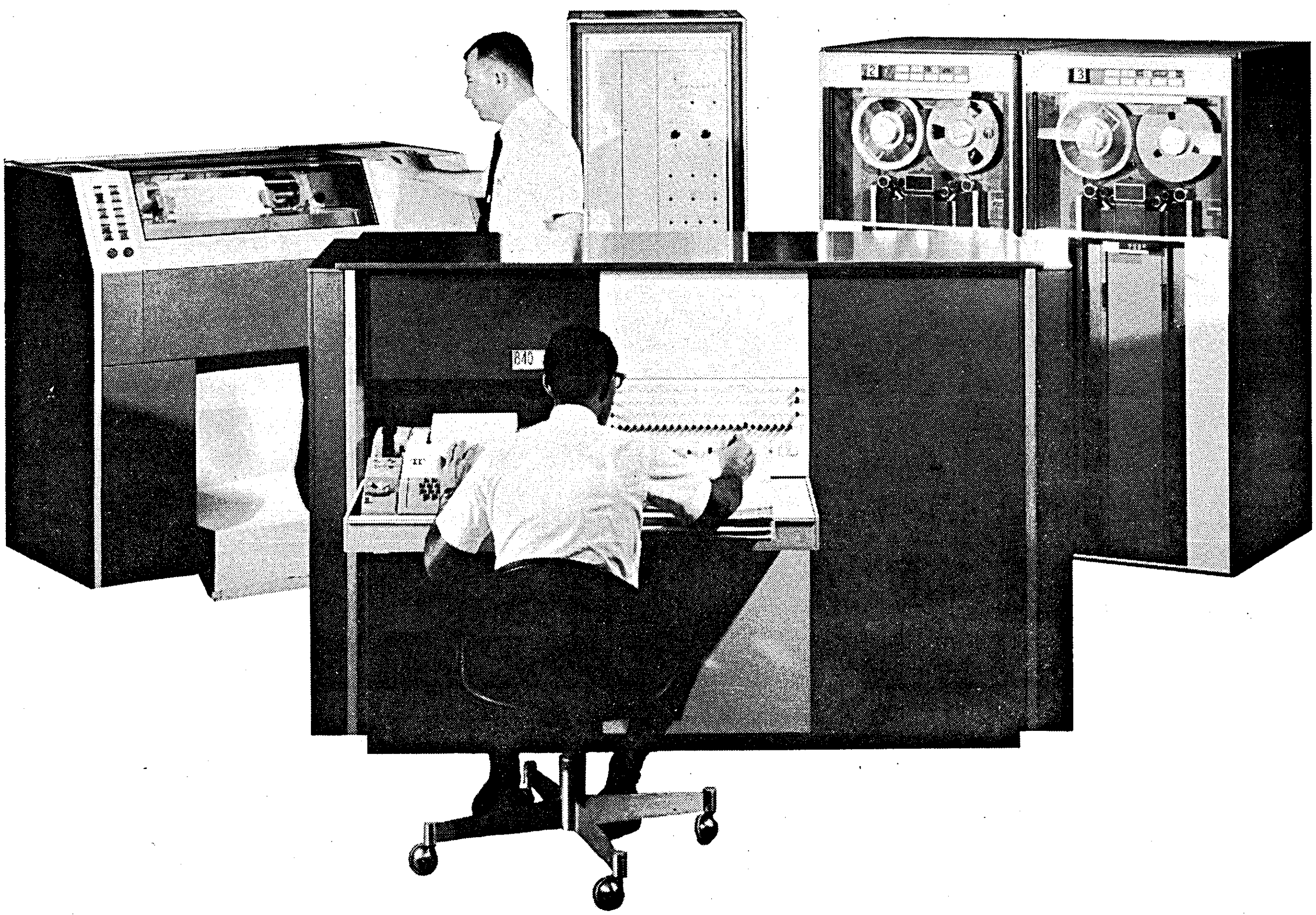


This 1-microsecond memory system is packaged in a customer-furnished cabinet and has a capacity of 16,384 words of 49 bits per word. "Dual-rail" addressing is incorporated for faster access. Input logic levels are zero and +3.5v. The entire system design is matched to computer requirements for maximum utility at the lowest ultimate cost.

For solutions to your memory problems: Write Fabri-Tek Incorporated, 5901 South County Road Eighteen, Minneapolis, Minn. 55436; or call 612-935-8811; or TWX 910-576-2913.

FABRI-TEK LEADS IN MEMORY TECHNOLOGY

Check with Fabri-Tek for rewarding engineering opportunities!



A better computer can be bought

It's the SEL 840A. Why is it better? It's 24-bit, it's fast (1¾ usec full memory cycle time), it has all silicon monolithic integrated digital circuits — and it has field acceptance. What about price? This is the best point of all. For only $60,900 you can get the 840A with 8K of core, 10½ usec multiply and hardware divide, three hardware index registers, memory parity and program protect. Do you want this high powered machine in sixty days? You can get it. Need additional hardware capabilities? As an option, you can have floating point and double precision hardware. Software? A field proven operational FORTRAN IV package that exceeds the ASA standards is provided with each 840A. Attractive options, such as mixed on-line assembly statements, are available with this package. For more information, telephone or write your nearest SEL office.

SEL ®

Boston Los Angeles San Francisco Huntsville
Washington, D. C. Fort Lauderdale

SYSTEMS ENGINEERING LABORATORIES, INCORPORATED
P. O. BOX 9148 • FORT LAUDERDALE, FLORIDA 33310 • AREA CODE 305 • 587-2900

CIRCLE 38 ON READER CARD

NOT-SO-RANDOM DISCS

and other stories

Many of our existing computer shops are busily converting to the next generation. We peer into the murky mists of the future with visions of reduced rentals, more compatibility, superior software, improved turnaround, full buffered I/O, and "call by name" file addressing. May we forever be free from the constraining influence of knowing the absolute address of any field, record, or file. STOP. A word of caution is in order lest the land of milk and honey turn sour.

In the last few years we have begotten a whole generation of programmers who have never come into intimate contact with a machine. They have programmed primarily in a higher order language and have been insulated from the hardware by a solid phalanx of operations managers, machine operators and monitor programs. While it wasn't necessary to teach each programmer the intricacies of machine language programming, many programmers are even uninformed about the characteristics of the I/O devices available to them.

In the past the I/O devices were mostly tape and cards. It wasn't too difficult to understand that the tape record gap phenomena meant longer records gave fewer gaps per file, and hence ran faster. The required action was almost as straight-forward. All programs that processed this tape were first listed. Then the record length and packing were chosen to be as long as possible while still allowing the tape to be handled by the program with the tightest core constraint.

The card read case was almost as straightforward. The job was programmed and run. If the computer had a fully buffered card reader with a demand clutch, all was well. If the reader had a dog clutch (like the 1401) someone listened to the machine while it was operating. If the reader ran intermittently the read speed was one-half rated—400 cards per minute. Either the noise, the unexpected performance, or the resulting maintenance problems called the programming deficiency to attention and a fix was ordered. Either the program was slaved to the reader by using read release, a multiple point clutch was ordered, additional core space was allotted the input file so that several cards were read into the blocked space before any were processed, or a card-to-tape pass was made under the control of a highly polished utility program that kept both devices running at rated speed and perhaps did other useful functions as well. If talented programmers were available, they redesigned the application to move some of the processing to a later program and improved the I/O balance of the pair.

Historically, poor performance due to an improper I/O balance has been rather easy to diagnose. The cure has similarly been easy to prescribe (although usually quite laborious to install). A few words of warning are appropriate to those about to embrace disc files or similar devices for the first time. At one time we called these units random access devices. More recently we have been encouraged to call them direct access devices. Unfortunately, we should call them cyclic storage devices since they are neither random or direct, but more nearly cyclic in nature. (Old 650 programmers take note.)

A typical disc file rotates once every 25 milliseconds. The manuals state that the average delay experienced by the electronics while waiting for the record to appear under the heads (rotational latency) is 12.5 milliseconds. The manuals fail to state that they assume an infinitely long wait between consecutive references to the disc. Given an extraordinarily long wait between accesses, the mathematical average of an enormous number of observations will tend to be one-half the revolution time, e.g. 12.5 milliseconds. However, these assumptions are seldom met in real life, where the latency experienced is precisely some multiple of the revolution time. The multiple may be zero if the time required for processing is less than the complement of the read time. But, if the time required for processing exceeds the elapsed time from the read-complete-interrupt to the beginning-of-record by so much as a microsecond, add one full revolution of 25 milliseconds!

An example is in order. Given: four records per physical track and an application which required updating a record and rewriting it in the same physical location. The program would read the record (after experiencing a delay due to latency in the range 0 to 25ms). After the record was in core, an interrupt would be set. You have exactly 18ms to answer the interrupt, do the processing, *and* get the write command to the head of the queue, or you lose one full revolution. In one case the time per transaction is 25 milliseconds plus initial latency and seek. For long processing times, an integral number of full revolutions is inserted.

A similar problem occurs in the case of a seek followed immediately by a read or write. The manuals state that the track-to-track seek takes 30 ms and the maximum is 145ms. They are quoting design performance on head mechanism. In actual practice most seeks are followed by a read or write. In the event seek-read is given as one sentence, the operation takes the seek time plus the complement of your current position rounded to the next full revolution. Sorry, but that is just the way it works.

Again, an example will clarify the point: Suppose you are writing records that fill up a track and you have just completed a write. If you immediately issue a seek-write to the next cylinder the mechanical motion is complete in 30ms, but the rotational latency eats up 20ms more. The average time for this transaction (which is also the max and the min) is exactly two revolutions: 50 ms.

If the unsuspecting programmer is processing short records and the file is sequential, the performance can be *much* poorer than tape. In the past, some programmers have found it necessary to write one less-than-full-track record per track to leave some time for processing the interrupt before a full revolution was lost due to latency. The elapsed time—after the read is complete and the last instant is past for issuing the subsequent write without losing a full revolution—has been dubbed the "re-instruct" time. You won't find it in any manuals. You and your friendly maintenance man must figure it from the circuit schematics. It isn't very important; if you are wrong your throughput only suffers by 100%

While you're at it, ask your friendly maintenance man if your disc has any special warmup circuits and how does he know they work? One popular disc has a thermostat that causes it to seek at one-half speed when it is cold. At least one thermostat was found to malfunction so that it had morning sickness all day! Since the CPU is such a fine timer, you might find it informative to use the CPU and clock some disc operations. The programs are rather easy to write, fun, and you may end up getting all the performance you are paying for.

One disc specialist recently recommended (at a national conference) that we write programs in a device-independent manner. Perhaps that advice should be leavened somewhat. If it doesn't make any difference, program device-independent. But where a major task (or the control program itself) is involved, consider tuning the programs for the charactistics of the device. Some of the finest brains in the country have constructed time-sharing systems containing scheduling algorithms that ignore the cyclic nature of the secondary storage device. Some of the recent literature even implies device-independent programming has no drawbacks.

I don't advocate a return to machine language programming, nor do I counsel we all act as if we had a 650 or an SS80. However, I do think that every analyst should be aware of how his devices work and write some programs to calibrate the software-device combination as a unit. If the software fails to fully exploit the device characteristics, the analyst has two choices: modify the software until acceptable performance is obtained, or program to exploit the combination at hand. If the software precludes ever re-instructing the disc in time to avoid an unnecessary delay, then adjust the functions allocated to the several passes of long jobs to exploit the processing time forced by latency delays.

A frequent misconception involves multiprogramming and device-independent coding. Some think that all difficulties will disappear once multiprogramming becomes popular. Multiprogramming is supposed to allow the CPU to be productively used when one program stalls due to an I/O enforced delay. Just one caution about multiprogramming: it is no cure for inefficient design; it only makes the flaws harder to find.

R. L. PATRICK

INTERNATIONAL BIOMEDICAL CONFERENCE

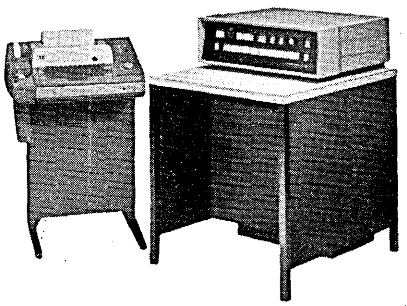
To be or not to be . . . the question from April 19 through May 4 referred to automated data processing in hospitals. Elsinore, Denmark, home of the most famous of all binary statements, was the host city of an International Conference and Symposium on Computer Assisted Analysis of Biomedical Information, including cybernetics in medicine, computers and patient management, man-machine communications, medical education through computers and the interface problems involved in all of their related areas. Appropriately, the organizing committee headed by Professor A. Tybjaerg Hansen of the University of Copenhagen structured formal presentations during the first week and allowed the remainder of the time for workshops and more informal discussions.

Elsinore this spring was perfectly characterized by Shakespeare. Its climate (32° F., an inch of snow, fog, wind and rain, and more fog) was conducive to academic concentration. The meetings were remarkable in the medical computer field in that the speakers had all been screened to assure that what they presented was achievement and not armchair plans. Indeed, Mr. Erling Dessau of the Danish government's "Datacentralen" toured the United States and Europe to personally substantiate the areas of endeavor that would be profitable for discussion at this, the first major European-based conference on the subject. Two years of planning by Mr. Dessau, his engineering consultant, Mr. E. Borg, and his assistant, Dr. J. Hilden, contributed to participants being able to cull from the conference proceedings "a grand plan" for an adaptive total system concept—a medical data processing science package—that can be implemented on the European Continent or elsewhere.

Denmark's Minister of Education, K. B. Anderson, discussed the challenge in training scientists and administrators for the job, noting that engineering advances now left only the personnel problem as the major obstacle. Dr. Henry Yellowlees of the Ministry of Health in London, realizing the same problem, did not react with the same enthusiasm—which could mean a slower developmental pace in England. Mr. A. Marchman of the Copenhagen County Hospital Association emphasized that hospital

Here's how we designed our small, real-time control computer—the H21

FIRST IN A SERIES—



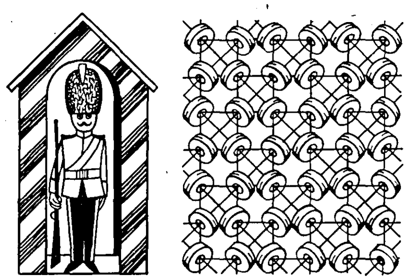
WORD LENGTH — small, scientific computer manufacturing costs are almost linearly proportional to word length. What is the optimum word length? Here are the critical considerations: accuracy and efficiency of data representation; a desirable instruction repertoire; efficient and simplified programming that goes with a directly addressable memory; and suitable architecture for supporting advanced software.

We chose an 18-bit word for our H21 real-time control computer. It gives a data resolution of one part in 262,000 —and packs three alphanumeric characters into each word. The extra bits provide for a larger, more powerful instruction set. And a single word instruction directly addresses a full 8192 word core bank making programming straightforward and efficient . . . no cumbersome, memory wasting addressing schemes, such as paging, double word instruction modes, relative addressing, etc. are necessary.

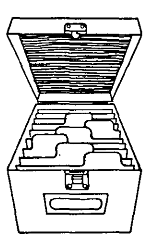
18BitS

PARITY—it adds a bit to the word length. But it's well worth the investment. Past experience has shown parity to be valuable in ensuring proper system operation and safety. It's also a time-saving maintenance tool. It's a standard feature in the H21.

MEMORY GUARD—a new concept in real-time systems. This feature allows critical system programs (executives, monitors, etc.) to be guarded. Once guarded, a program is protected against accidental modification by undebugged, unguarded programs. Since each word carries its own guard bit, we now have a 20-bit word length . . . and a new dimension in system utility and reliability.



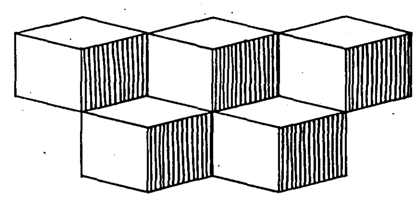
HARDWARE INDEXING—everything an index register can do, programmers can simulate with subroutines. But the tedious and time-consuming programming effort, and the extra memory required, result in false economy. Who cares how much extra memory you have to buy after you've bought the machine? We care . . . we include a "full use" hardware index register to ensure program efficiency.



BULK MEMORY—a moving head disc file is cheaper than a head per track. And *less reliable*. And *slower* . . . (moving head disc files have long access times, normally 10 times that of fixed-head discs or drums). In high-performance, real-time systems, fast bulk memory is desirable to simplify system programming. Also core

memory requirements are reduced since fewer programs have to reside permanently in core.

COMPUTER INTERFACE—manufacturing costs could have been pared by building a minimal interface—singular I-O connector, low power bus drivers, etc. But this only defers the cost, multiplied several times, to the user at the time of system tie-in. Therefore, we include multiple I-O connections, husky bus drivers (75ma) and a generous set of clocking and control signals. The H21 interface even packs and unpacks characters into or from memory. The results . . . simple and economic interfaces for real-time systems.



PRICE—the lowest for computers with this capability. For just $21,000 you can get a central processor with 2K memory, and an I-O typewriter with tape punch and reader. An 8K system (that's 8192 words) costs only $32,000. And the delivery is good . . . try us.

If you'd like to get immediate information and complete H21 specifications, call or write to Control Computer Department, Honeywell Inc., Fort Washington, Pa. 215-643-1300.

Honeywell

CIRCLE 64 ON READER CARD

staff is 70% of increasing costs. Operations Research oriented Charles D. Flagle of Johns Hopkins noted that the survival of hospital institutions is in question and implied that only computers can save them. Concentration on the methods of proper planning and procedure was given by Sweden's Professor Tore Dalenrus and Dr. Paul Hall.

The American contingent generally presented the more elaborate systems. Dr. Homer Warner of the University of Utah, experimenting with a CDC 3200, suggested time-sharing as the economic means of solving the multiplicity of different types of hospital service and research problems, many of which must of necessity be real-time on-line operations involving analog input. System Development Corporation's effervescent Anne Sommerfield vividly showed time-sharing advances and capability by a trans-Atlantic hook-up from Elsinore to Santa Monica, California. Dr. Josiah Macy, seconded by Professor D. H. Bekkering of Utrecht, Holland, emphasized the lack of adequate commercially available hybrid devices to solve medical problems economically. Dr. Macy pleaded for adequate development with analog components to preprocess and make best use of digital computer capabilities. The stated advantages of time-sharing and hybrid concepts produced, to be conservative, heated discussions.

Newly appointed General Electric "Medinet" General Manager Jordan J. Baruch described a new GE special-purpose medical computer system that can handle "adaptive" needs. The system is to be operational in 1967. The multi-million dollar effort on the part of GE heralds the welcomed first major effort on the part of a commercial concern in the medical computer service field. The research from the U. S. P.H.S., sponsored by Bolt Beranek and Newman, on the Massachusetts General Hospital project now under Dr. Octo Barnett has given Mr. Baruch the foundation for his master plan.

Dr. Mogens Jorgensen of Copenhagen County Hospital described the first all-medical computer data system in Denmark. This is to be an IBM 1800 system. European developments tended to be on a smaller scale than the American but perhaps showed evidence of more precise advance planning and fuller utilization. Of great interest is the zeal and calculated approach of the Scandinavian group in planning their romance with computers in medicine. It will be something to watch.

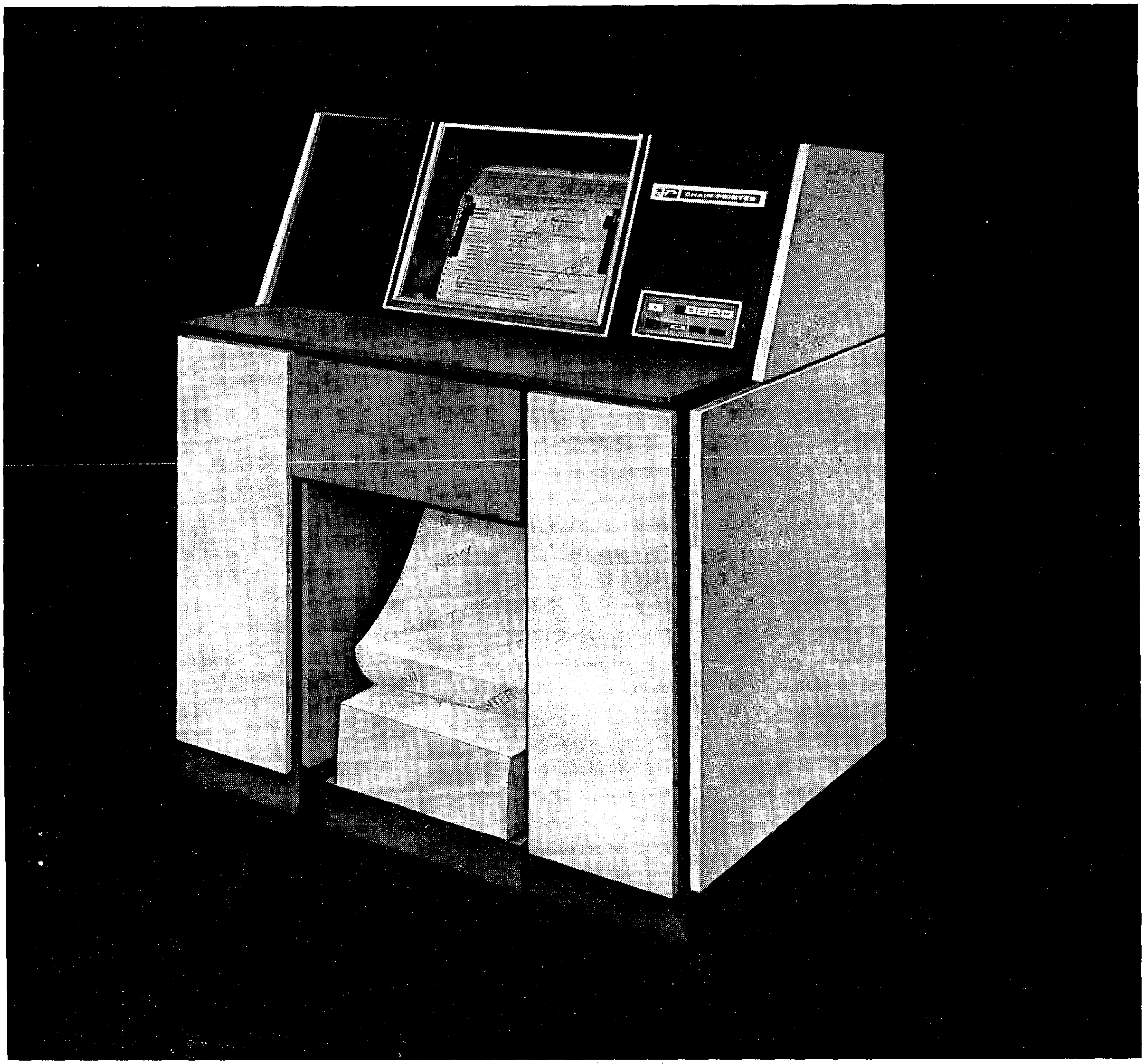
Medical laboratory systems under computer control, because of the increasing costs of performing laboratory tests, were in solid evidence. Dr. W. Kirkham of the National Institutes of Health Clinical Center, presented the most conceptually advanced. A system developed by Dr. Gunnar Jungner of Gothenburg, Sweden, promises to be fully operational by the year's end. Dr. F. Guigan of Paris startled the meeting by showing a film of his private clinical laboratory in which an IBM system controls his chemical laboratory tests. This system, funded entirely without government or academic funds, makes Dr. Guigan perhaps the first physician to "own" his own computer as another of the necessary tools in the practice of medicine.

A laboratory data storage and retrieval system operational in Columbia, Missouri, was described by Dr. D. Lindberg. A full hospital data storage and retrieval operation in Puerto Rico was described by Dr. A. Lassus.

Dr. Antoine Remon of France, who is now organizing a meeting on analysis of medical signals by computers, discussed his electroencephalographic techniques. Dr. Ross Addy of UCLA showed some computer analyzed brain wave data on Gemini astronauts. Electrocardiographic analysis was discussed by Dr. Hubert Pipberger, using a CDC 3200 system for research, and the undersigned, using a CDC 160-A system for service operation. However, the absence of CDC at the conference or in the European reports was interpreted by some as indicating that at least in Europe CDC will not emphasize medical computing. An IBM 1620 has been ingeniously programmed by Dr. O. Arvedson of Sweden to do a very creditable analysis of vector electrocardiograms. Dr. Max Weil of Los Angeles showed how interrelations of various vital signals, again using a 1620, could aid in the management of a shock ward.

The close to 100% attendance of all sessions was a vivid display of the wise investment made by the NATO Science Committee. That organization subsidized some of the expenses through a grant proposed by the International Federation for Medical and Biological Engineering director, Dr. J. F. Davis, who had campaigned for over three years for such a conference on "The Continent." Judging from some of the work now in progress and the evident impact of the conference, the medical computer field in Europe is accelerating towards systems that can lead to the goals of better medicine for all.

—C. A. Caceres



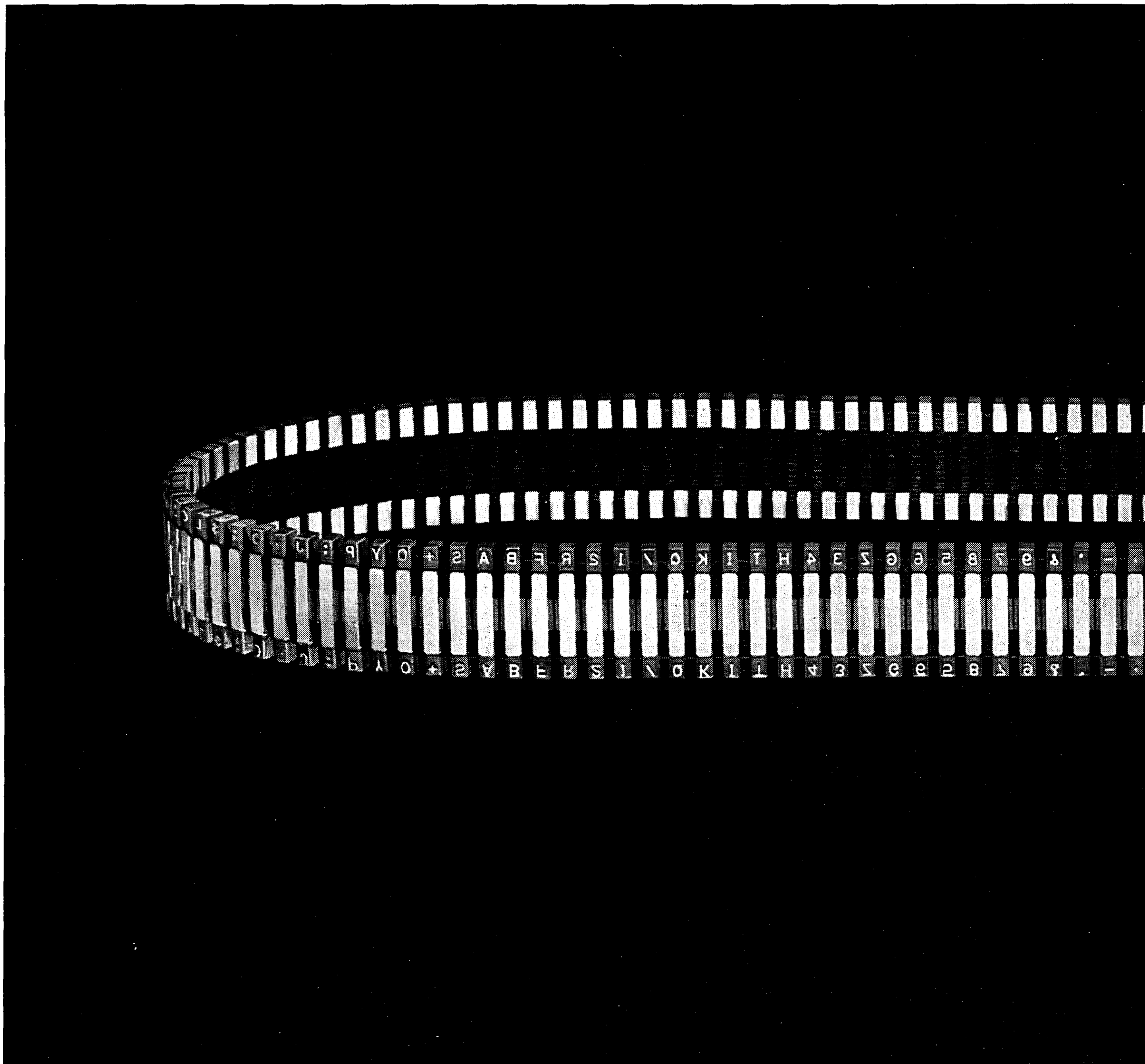
How can Potter offer a chain printer priced so low?

This new Potter printer provides the combined benefits of high reliability and lowest cost of any line printer now available. Potter made it all possible by taking a completely fresh approach to printer design and construction . . . producing a 600-line-per-minute unit with only a fraction of the parts used in a conventional drum printer.

Take a look at these features:

- Speed to 600 lines-per-minute; up to 192 characters in 80 to 132 columns
- Precise vertical registration
- Sharp character definition—up to six copies
- Integrated circuit electronics
- Minimum maintenance—fewer parts to replace or service

POTTER
® INSTRUMENT COMPANY, INC.



The answer's a radical new design starting with the chain.

The chain? It's completely different from any you've ever seen. A continuous rotating belt with individually attached, easily removable type slugs.

This newest of line printers is available to you at an unbelievably low price. So send this coupon today. Or better yet, phone or wire us for complete specs and price. You'll be glad you did.

PI-107C

Send me full details on the new Potter Chain Printer.

Name____________________

Title____________________

Company____________________

Address____________________

City____________________

State____________________

151 Sunnyside Blvd. • Plainview, N.Y. 11803 • (516) 681-3200 • TWX (510) 221-1852 • Cable-PICO
In Europe: McGraw-Hill House, Shoppenhangers Road, Maidenhead,
Berkshire, England • Maidenhead 20361

CIRCLE 42 ON READER CARD

news briefs

INTEREST GROWS IN PURSUIT OF SOFTWARE PATENTS AND COPYRIGHTS

Legal protection of computer software under available copyright procedures was recommended by John F. Banzhaf III, president of Computer Program Library, speaking at a recent Los Angeles ACM meeting.

Other forms of protection, under the laws of trade secrets and patents, he said, do not presently offer adequate security. If computer programs are classified as trade secrets, difficult points of their secret nature, limited access, and proven ownership must be established in case of suit. And as individuals are usually responsible for the disclosure, suits rarely return the value of the program to the plantiff.

The granting of patents for computer programs (none have yet been obtained) would give the developer a 17-year monopoly, even if others developed the program independently. The Patent Office says programs are mathematical techniques and therefore may not be patented; lawyers disagree, say a novel and creative program or one utilizing known methods in a unique way should be patentable.

While the debate continues, the copyright laws offer protection with a minimum of effort; this should encourage small software companies who want to develop their programs for sale or rent. All that is necessary to procure a copyright is to have a new program developed with a "modicum" of creativity. The owner must affix a notice to whatever media is used (card comment, tape label), advising others that a copyright is claimed. The program must then be published and available for general distribution. Registration with the Copyright Office can be done when, if ever, proof of copyright is needed. A copyright is valid for 28 years and can be renewed once for the same length of time.

Banzhaf also called attention to a bill now before Congress to revise the 1909 copyright law. Lobbies from other media, such as textbook publishers, fearful of the eventual obsolescence of books, have urged that the bill be written to forbid the processing of any copyrighted material by computers. At the hearing, only three representatives of the computer industry spoke against this measure, which could mean the end of most information retrieval projects.

Meanwhile, Applied Data Research, Inc., in Princeton, recently announced that it has an application in on its computerized flowcharting system, AUTOFLOW. If granted, the patent could be a precedent. The system, which accepts assembly or higher level languages and produces a flowchart for on- or off-line printing, is said to have a design which does not duplicate manual or other procedures. Also, as far as ADR knows, the specific output can only be produced by this process.

Patent attorney Morton Jacobs, who is handling the ADR effort, noted that although the U.S. has resisted, Australia has granted a patent on a software program and the British Patent Office has also said they would accept applications for them. Giving promise are two indirect but relevant cases in the U.S.: Hawaii currently has a suit pending in which an infringement is claimed on the program of a patented special-purpose computer. Also, when Burroughs last year applied for a patent on a computer improvement involving logic design, the examiner noted that one could program a computer to achieve the same results, and since a program isn't patentable, he claimed, neither was Burroughs' invention. But, the Board of Appeals disagreed with the arguments and reversed the decision.

To all those waiting for a precedent before applying for program patents, Jacobs issued this reminder: patent statutes allow only one year from the first time an invention is in "public use or on sale" (including any publication) to file a patent.

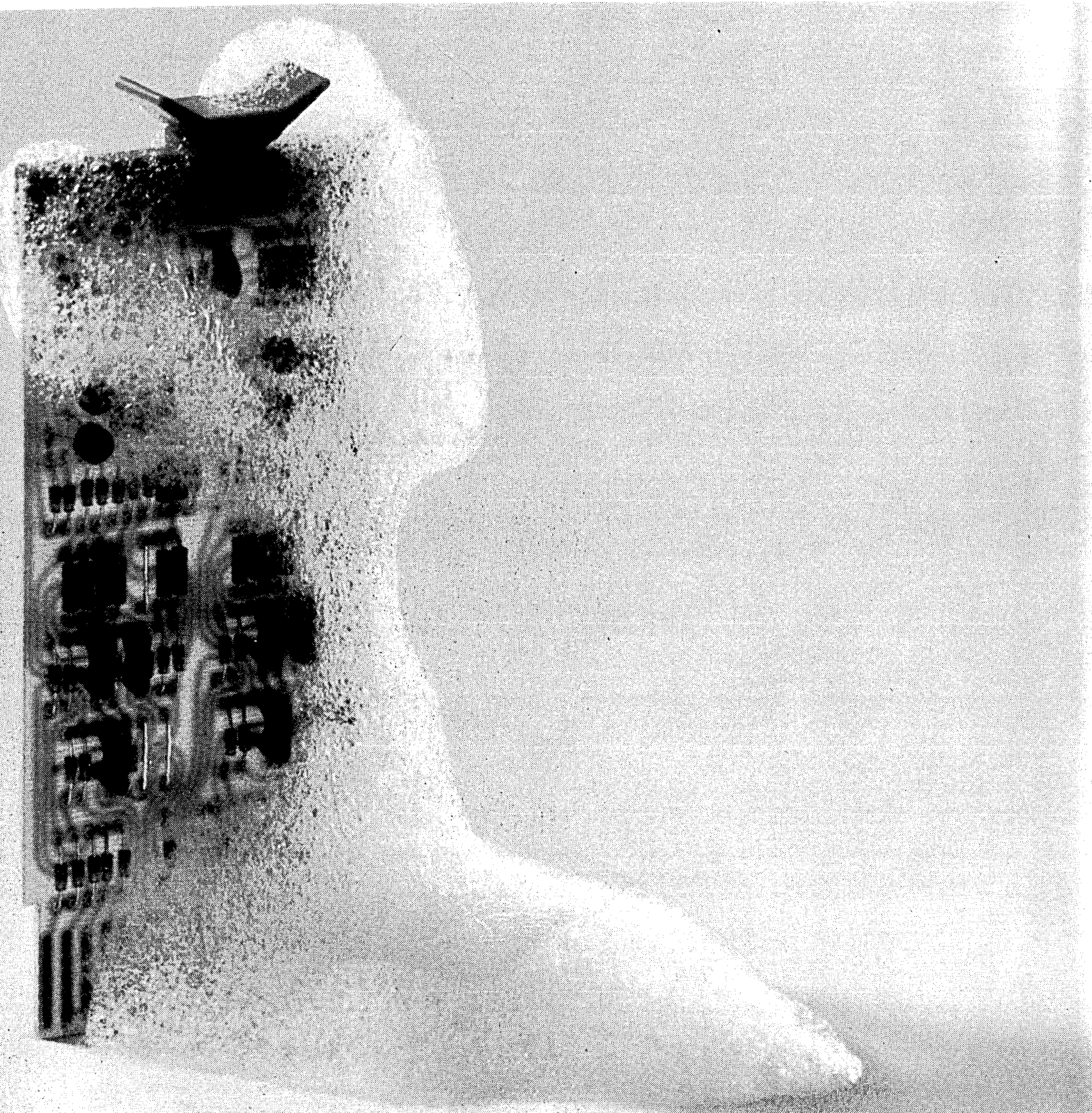
POST OFFICE ORDERS $26 MILLION IN EQUIPMENT

The Post Office Department is buying $26 million in data processing equipment from Control Data and Honeywell for what will be, it is claimed, the world's largest electronic source data gathering complex. CDC has captured a $22.7 million contract to supply eight computers and about 6,000 online input and/or output devices to link the 75 major U.S. post offices with two main dp centers in the New York and St. Louis areas. These centers will compile and transmit management reports on mail volume, workload, manpower fluctuation, and attendance records to the main offices, regional centers, and Washington headquarters.

The two centers will each have a 3300 system; six 1700's will be placed at three locations around the U.S. to handle message switching between the offices and centers. The on-line devices to go into the 75 offices and their 1250 branches and stations (accounting for 60% of total mail volume han-

VOICE/HANDWRITING TRANSMISSION SYSTEM FOR SCHOOLS

A device for transmitting handwritten material together with voice communications over telephone lines has been developed by the Sylvania Electric Products subsidiary of General Telephone & Electronics. Low cost and two-way voice transmission, giving the students a chance to ask questions, were cited as advantages over closed-circuit TV. The instructor writes on an eight-by-six-inch surface with a stylus and the transmitted image remains on the screen until an "erase" button is pushed. Field tests will be conducted this summer and production is scheduled to start in September.



Rub-a-dub-dub

If you're going to guarantee every digital Flip Chip™ module for ten years, you worry about reliability.

This particular module was routinely run through 120 standard tests, component by component, spec by spec. (The tests took 25 seconds on one of our PDP general purpose computers, a machine mostly made of modules just like this.)

Then, we duplicated the laboratory environment. We dropped the module from a table, blew smoke at it, spilled coffee over the components. We left the module on a radiator overnight.

All components still okay.

Somehow the module got left in a shirt pocket and subjected to a further unplanned test — wash, rinse, wash, rinse, spin dry.

Know what happened? The coffee stains washed off.

Write for a catalog.

digital
MODULES · COMPUTERS

DIGITAL EQUIPMENT CORPORATION, Maynard, Massachusetts 01754. Telephone: (617) 897-8821 • Cambridge, Mass. • Washington, D. C. • Parsippany, N. J. • Rochester, N.Y. • Philadelphia • Huntsville • Orlando • Pittsburgh • Chicago • Denver • Ann Arbor • Los Angeles • Palo Alto • Seattle • Carleton Place and Toronto, Ont. • Reading, England • Paris, France • Munich and Cologne, Germany • Sydney and West Perth, Australia • Modules distributed also through Allied Radio

CIRCLE 44 ON READER CARD

news briefs

dled by the 34,000 U.S. post offices) include: "several thousand" badge readers for employee time accounting; special CDC-developed transacters for badge reading, punched card input, and short standard push-button inquiries; and various kinds of electronic scales for piece counting of mail. Each of the main offices will have a keyboard terminal for supply-order and other transactions and a medium-speed lineprinter to receive responses and management reports.

The purchase of the CDC equipment will mean a savings of more than $7 million a year over present operations, and is about $2 million less than annual costs under lease would have been.

The $3.3 million Honeywell contract is for seven H-1200's which will replace 13 1401's in six postal data centers and the headquarters. These centers handle all payroll and accounting, which amount to $20 billion in transactions yearly. The equipment will not be on-line to the rest of the complex, but will receive accounting data transmitted from the two main centers onto mag tape.

The first CDC 3300 system will be installed by Oct. 1; a regional communications complex will be complete by May 1967, and the total system will be installed by November, 1968. The H-1200's will be installed by December of this year.

STRIKE OF PRODUCTION WORKERS HITS SDS

In one of the rare cases of strikes against a computer manufacturer, some production employees at Scientific Data Systems walked out last month.

The bargaining unit at SDS consists of about 500 members of the International Association of Machinists. Of this group about 200, according to the company, are away from their job with the majority classified as electronic assemblers—a catch-all job title that covers a large proportion of the production staff.

Recognition as the bargaining agent was won by the IAM last December, after failing two years before, and negotiations for a contract began in January. The questions at issue, however, are cloudy. The company has made an offer but claims that the union has not yet made specific demands. A federal mediator was reported to be encouraging negotiations.

RCA REAFFIRMS DECISIONS, MAKES NEW ANNOUNCEMENTS

RCA is for monolithic integrated circuits, IBM compatibility, time-sharing, and on-time software deliveries. (Did someone leave out motherhood?) During a press conference at the recent Spring Joint Computer Conference, RCA's EDP leaders reaffirmed their 1964 decisions to produce the Spectra 70 line of IBM-compatible computers, using monolithic i.c.'s in three models. They also plan to use them in the smaller models, 15 and 25, and would have from the outset if they had known the yield and uniformity problems would be resolved so well. (European plants, which started production later, are using i.c.'s in these models.)

The future will bring more processors and I/O devices, particularly in the display and random-access storage area. The firm is making a gradual move into the time-sharing market, evidenced by their show announcement of a time-sharing software package to go with the 70/45 or 55, free of additional charge. The next move is modifications of the hardware in present systems for time-sharing, but no systems competitive with the larger IBM 360/67 and GE 645 seem to be in the offing.

The Primary Operating System for the 70/35, 45, and 55 was also an-

nounced as ready to go, two weeks ahead of schedule. Systems for the 25 and 15 are already out. Next on the agenda are the Tape Operating System (first delivery in July) and the Tape, Disc Operating System (December). No date has been announced for the most advanced system, the Disc Operating System, which will most closely match the capabilities of the full IBM 360 Operating System.

Asked if the much-publicized IBM lateness with its hardware and software had helped RCA, William Lonergan, head of product planning, noted that few orders had come their way (or anyone else's for that matter) and that actually RCA was somewhat hindered by customer attitude, which is if IBM has 2000 people on software and RCA has only 200, how can it expect to come out on time either?

Lonergan emphasized that the Spectra 70 compatibility (not in software) with System 360 has met with favorable reaction from the industry and has netted them some orders from big users. The government, he said, is pushing such standardization; "the lack of standardization doesn't hurt the manufacturer; it does involve the user in hundreds of millions of dollars in unnecessary expense."

RCA's marketing objectives are primarily the large multi-system user and areas of application growth. James Butler, head of market planning, said that the firm, being selective, has netted one of every six of its bids, 95% of which have competed with IBM systems.

IBM OFFERS MARKET RESEARCH SERVICE

IBM is following GE and others in the foray into the data-bank business. As a starter, its new Information Marketing Division is offering to industrial firms market research reports compiled automatically from two computer data banks: the continually updated census file on about 390,000 businesses (licensed from Dun & Bradstreet) and an I/O model of the national industrial economy. It is aimed only at companies whose products and services are sold to the industrial market, and does not include such capital goods industries as computers.

Subscribers to the service, which costs from $3500-10K per use, will supply IBM with marketing information and receive various reports breaking down the firm's sales performance and potential according to types of industries, plant employment size within industries, sales territory, and plant employment size and types of industries within each territory.

The Information Marketing Division will also handle the offering of QUIKTRAN through IBM time-sharing centers. Many of the future data-bank services will be coupled with the time-sharing service.

PROCESS SYMPOSIUM INCLUDES MULTI-COMPUTER SYSTEMS

The 8th Symposium on Process Automation, held April 19-20 in Newport Beach, Calif., was attended by some 150 from the petroleum, chemical, steel, mining, paper, electrical, and plant construction industries. With meetings chaired by Dr. W. R. Biles of Shell Oil and D. E. Johnson of Shell Development, the symposium was sponsored by Beckman Instruments, Consolidated Electrodynamics, Control Data, and SDS Data Systems.

A four-computer system at Union Carbide was described by John C. Cugini. Three of the machines are used as basic process-control units, while the central computer serves for development and debugging as well as a scientific computing facility. About eight years went into software specifications and detailed coding.

Integration of the computers and software at Caltech was discussed by Dr. Gilbert D. McCann, who explained that it is now possible for their center to process simultaneously data from real-time experiments, time-share student consoles, and handle scientific calculations as background.

An application at Chrysler Corporation called dynamic manufacturing control was reported by John J. DiCicco. A part of the project amounts to real-time quality control, covering 1287 checks per car. Recently, analog inputs have been added for checking such conditions as wheel alignment and the force needed to operate windows: computer output indicates when the car is acceptable. Similar systems are being installed in all Chrysler assembly plants.

Direct digital control was represented by the application at Owens-Corning Fiberglas, where there are now two operating installations. Each computer can control five furnaces, Paul D. Griem, Jr., said, and resolution and stability are excellent. Manual/automatic switches allow standard operation of the processes if the computers are down but this has happened very seldom.

Other applications discussed were those at the Mission Control Center of NASA/Houston; a pending installation at Champion Papers (there are now 22 process computers being used in the paper industry); the AEC Savannah River Plant, and Southern

news briefs

California Edison's Etiwanda Steam Station.

Advice on picking a vendor for a process-control installation was offered by Dr. Thomas M. Stout of Profimatics, Inc., emphasizing the importance of the project schedule and, consequently, the importance of vendor performance in providing hardware and software on time.

Those who left after the last technical session missed an interesting panel discussion on automation and its interface with society, held Wednesday morning. Panelists were Benjamin Aaron, UCLA; Paul Schrade, United Auto Workers; and E. L. Shaner, Shaner Corp. Their discussion included comments on the recent report to the President by the National Commission on Technology, Automation and Economic Progress. Spurred by questions from the audience, the panel covered a variety of topics: preventing inflation (allowing unemployment is a poor way to stabilize prices), the government as "the employer of last resort" (a cheap way of doing useful public work such as urban renewal and hospital service), psychological tests for employee selection (which the company's executives flunked), and unionization of professional people such as engineers and teachers (not very successful because professional groups will adopt the goals without embracing the tactics).

● Bullock's dept. store in Los Angeles is getting 12 CRT inquiry units for on-line credit verification. Linked to an NCR 315, they'll enable clerks to phone a CRT operator, who keys in the information and gets a response in 3-4 seconds. When touchtone phones become available, clerks can key in their own interrogation. Bullock's gets the CRT's in July, and a 315-RMC (rod memory computer) in September—to add to the present 315. The system, slated to go on-line in September, is for on-the-floor credit authorizations; for check approvals, further identification will be needed. They used the SCERT package to see what NCR configuration they needed. But for curiosity they also glanced at other vendors' gear, found the 315 RMC was internally faster than the 360/50—and were pleased to get out of reprogramming.

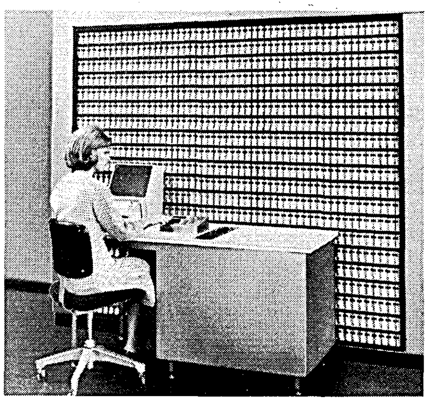
● Western Air Lines has chosen IBM to supply equipment for handling reservations, communications, and other company-wide data processing. The $6.2 million order calls for two 360/65's, backed by 300 megacharacter mass storage. One processor will be on reservations and message routing full time, the other assigned to general processing and back-up. Some 500 agent sets will be used, with CRT displays at major cities.

● The Numerical Control Society drew an attendance of over 200 at their Third Annual Meeting and Technical Conference at New York April 12-13. With the theme of the practical impact of numerical control, the conference emphasized capital investment in this area as a means of increasing profit and, often, the only method for maintaining a position within an industry. Norman W. Hopwood presented a paper noting that Ford Motor Co. plans to extend numerical control, now being used for some automotive body work, to such areas as product engineering, styling and manufacturing engineering and tooling. The conference included a luncheon address by Seymour Wolfbein, economic advisor to the Secretary of Labor, indicating the increased importance of automation during the present labor shortage.

new products

document retrieval

The Selectriever system can hold up to 200,000 microfilm images on tab or aperture cards and up to 20 million on microfiche (100 images/card). Request for any document is through a keyboard, paper tape, or computer interface, and average access time is



about six seconds. Hole-punched (for coding) cartridges store the cards, usually 100/cartridge. The document can be viewed on a closed-circuit TV display and a hardcopy printout can be made. The system can transmit images to up to 48 remote locations equipped with keyboards and displays. MOSLER SAFE CO., New York, N.Y. For information:

CIRCLE 150 ON READER CARD

recorder-i/o unit

A combination mag tape data recorder and computer I/O device, the model 700 consists of a color-coded keyboard and a buffered tape drive. The latter is an IBM-compatible unit that reportedly can be interfaced with any computer. It reads tape at 450 (80-character) records/minute, and writes at 200/minute. Records generated on the 700 are checked with a read-after-write feature for both parity correctness and bit-for-bit equality of tape data against core buffer contents. Manual key-entering takes care of header and trailer records, as well as variable data. MOHAWK DATA SCIENCES CORP., Herkimer, N.Y. For information:

CIRCLE 151 ON READER CARD

disc memories

Modular systems of varying sizes and speeds include the small L210 series, consisting of 15 off-the-shelf models with capacities up to 2 million bits. Average access time range from 8 to 25 msec in this head/track line. The L416 uses integrated circuits, holds more than 24 million bits that are accessible in an average 8 msec. For rugged environments, the L207 will hold more than a million bits accessible in an average 4 msec. Disc diameter is 6½ inches, and transfer rate is 9 million bps. LIBRASCOPE GROUP, GENERAL PRECISION INC., Glendale, Calif. For information:

CIRCLE 152 ON READER CARD

airborne computer

A 28-pound, 24-bit machine, the NDC-1051 has a cycle time of 2 usec, and typical instruction time of 8 usec. Up to seven index registers are available for each subroutine. Core memory is expandable from 2K to 8K. Using some integrated circuitry, the unit is less than one-half cubic foot in size. NORTRONICS DIV., NORTHROP CORP., Hawthorne, Calif. For information:

CIRCLE 153 ON READER CARD

portable recorder

For field use, this 6-pound unit records on half-inch mag tape from a 12-key numeric keyboard that includes space and error keys. Up to 20,000 characters are recorded on a reuseable cartridge in a 5-track format. Character word lengths are controlled by a space key, which records a special character between words. Power is supplied by a rechargeable NiCad battery, allowing at least three cartridges

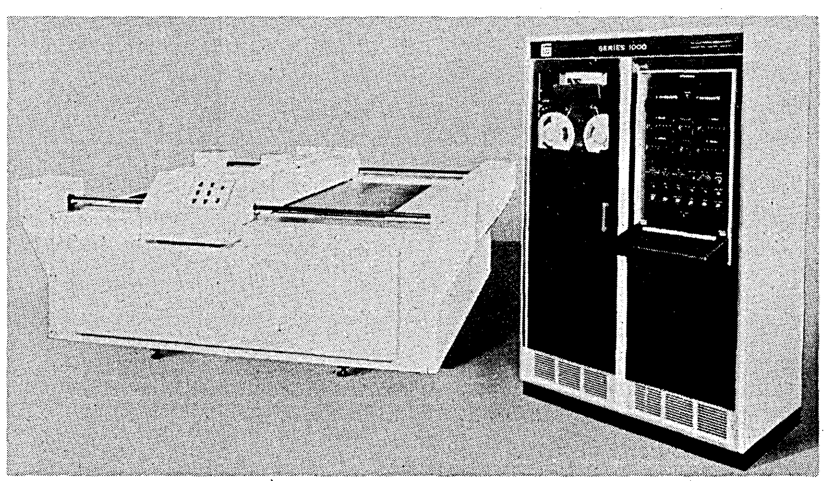
PRODUCT OF THE MONTH

The 2000 system, essentially a computer-controlled drawing table, also permits on-line operator inquiry, computation, and table control. The stored-program system is applicable to drafting, design, and display of complex geometric patterns, high-speed contouring, curve fitting, and new numerical control techniques. With a newly developed optical exposure head, the system is able to produce extremely high precision printed circuit artwork masters from engineering schematics.

The new model 75 table, in sizes from 5 by 8 to 5 by 24 feet, is normally coupled with the system, although others are available. Programs can be entered for storage or plotting through paper tape, card, or buffered mag tape readers, or manually through a typewriter. Closed-circuit TV displays can be used to show the operator the table output, so that he may issue commands from the keyboard or call up a digital printout of the graphic data.

The computer now used is a DDP-116 although interfaces are being developed for all gp digital computers. A medium-size computer may control up to 20 or 30 tables. Software includes FORTRAN IV, symbolic assembler, and compiler, service, and utility routines. Special packages for computer-aided design are being developed. GERBER SCIENTIFIC INSTRUMENT CO., Hartford, Conn. For information:

CIRCLE 154 ON READER CARD



CIRCLE 51 ON READER CARD

new products

to be recorded before recharging is required. DACOL DIV., HERSEY-SPARLING METER CO., Los Angeles, Calif. For information:

CIRCLE 155 ON READER CARD

punched-card file

The Gold Star line consists of nine files of varying capacities, both floor and desk-top models. They feature a single all-welded tray that is interchangeable throughout the system. Drawers are of the full- and three-quarter-suspension design. WRIGHT LINE, Worcester, Mass. For information:

CIRCLE 156 ON READER CARD

core memories

The RF family of memory systems include the RF-1, -2, and -3, each with an access time of 600 nanoseconds. Capacities range from 512 to 16K words in lengths from four to 36 bits. Full cycle time is 1.8 usec, half cycle is 1 usec. Operation modes are clear-write, read-restore, write only, read only, and read-modify-write. AMPEX CORP., Redwood City, Calif. For information:

CIRCLE 157 ON READER CARD

readout tube

Using rectangular neon readout tubes controlled by internal all-transistor, decoder-driven circuitry, the TNR-50 series is available in eight models to handle 8-wire BCD input. Input signals can be as small as 3.5 volts. Numerals are .610-inch high, and life expectancy is said to be 100,000 to 200,000 hours. TRANSISTOR ELECTRONICS CORP., Minneapolis, Minn.

CIRCLE 158 ON READER CARD

drum synchronizer

Providing speed/phase and indexing control of a storage drum, the model DS12 permits the use of more than one drum with a computer or display system. It synchronizes drums with a time displacement error between them of less than 200 nanoseconds, thus obviating the reference track on a drum to determine the clock rate of a computer or display system. SEQUENTIAL ELECTRONIC SYSTEMS INC., Elmsford, N.Y. For information:

CIRCLE 159 ON READER CARD

ferrite memory

Monolithic ferrite memory is available in stack or plane form, and is said to have a full cycle time of 500 to 600 nanoseconds. The stacks contain 1,024 (32-bit) words within the volume of a 2-inch cube. Currently set for destructive readout operation, it is also being studied for NDRO uses. RCA MEMORY PRODUCTS, Needham Hts., Mass. For information:

CIRCLE 160 ON READER CARD

portable facsimile unit

The Telecopier is a 46-pound, non-xerographic device for transmitting and receiving documents over any distance by conventional telephone lines. It can transmit any text or graphic page of 8½ x 11 inches within six minutes. A short message, such as a signature for verification, will take 30 seconds. Transmission can be ef fected by placing a conventional phone receiver into the unit's acoustic coupler, or the device can be plugged into a common carrier data set. The scan rate of 180 lines/minute corresponds to a scan density of 96 lines/inch. XEROX CORP., Rochester, N.Y. For information:

CIRCLE 161 ON READER CARD

gp computer

Part of the 500 family, the B 500 is available with 9,600 or 19,200 characters of core. It features a 3-address, fixed-word-length instruction. COBOL programs developed for the recently-announced B 2500 and 3500 reportedly can run on the 500. The latter also has "upward compatibility with the B 2500 and B 3500 through emulation." BURROUGHS CORP., Detroit, Mich. For information:

CIRCLE 162 ON READER CARD

digital plotting system

The DPS-6 system is distinguished by the fact that the only programming required for plotting continuous lines up to 42 inches long is the end points. No second tier subroutine is necessary. The system which can be computer-controlled, includes a vertical or horizontal plotter and a choice of off-line readers. The plotter has a dynamic accuracy of ±0.05% of full scale. An optional core storage buffer allows up to 10,800 bits between gaps. MILGO ELECTRONIC CORP., Miami, Fla. For information:

CIRCLE 163 ON READER CARD

SAVED
$2,631
PER MO.

"ADVANTAGES TO US ARE **ACCURACY, ECONOMY, EASE OF CONTROL**"

33%
PRODUCTIVITY INCREASE

NEARLY
75%
THROUGHPUT INCREASE

"OPERATORS ATTAIN **HIGH PRODUCTION** WITHOUT PUNISHING EITHER THE EQUIPMENT OR THEMSELVES"

WITH MDS DATA-RECORDERS

new literature

TAPE TO TAPE EQUIPMENT: How data can be transmitted and received at speeds of 75 cps with Telespeed 750 is detailed in eight-page brochure. The 750 can be used as terminal equipment and operates on any 5, 6, 7 or 8-level code including ASCII. Specifications cover floor and table units. TELETYPE CORP., Skokie, Ill. For copy:
CIRCLE 130 ON READER CARD

OPTICAL SCANNER: 16-page booklet covers technical principle of scanning and the place of OCR in modern dp applications. Discussed are the methods of scanning, critical areas of form design, printing tolerances and paper selection. THE STANDARD REGISTER CO., Dayton, Ohio. For copy:
CIRCLE 131 ON READER CARD

GP COMPUTER: Eight-page booklet describes the 1020 and lists general features such as direct-access keyboard, high-speed tape punch, tape reader, and typewriter output which prints out answers in the same language and units that were entered. Computer is designed so that an engineer or scientist, with no prior computer experience, can learn to operate it without having to learn a machine language. PACIFIC DATA SYSTEMS, Santa Ana, Calif. For copy:
CIRCLE 132 ON READER CARD

PROGRAMMED CURRENT PULSE GENERATOR: Eight-page brochure provides technical description of model 1700, covering two basic modules that make up the equipment. Section on the 16-step program generator module includes a diagram that shows the ability of the unit to repeat individual steps, step pairs or step quads in the test sequence; another diagram illustrates a thin magnetic film wire test program; and a block diagram shows the logical arrangement of the program generator. COMPUTER TEST CORP., Cherry Hill, N.J. For copy:
CIRCLE 133 ON READER CARD

PROJECT MAC PROGRESS: Second report of MIT's R&D program on machine-aided cognition and multiple-access computer systems is described in 211-page book. Report outlines broad spectrum of research being carried out as part of Project MAC. Order No. AD-629 494, *Project MAC Progress Report II, July 1964 to July 1965*. Cost: $6, microfiche $1.25. CLEARINGHOUSE, U.S. DEPT. OF COMMERCE, Springfield, Va. 22151.

TAPE STORAGE SYSTEM: System designed to increase tape storage capacity while minimizing tape damage and dust problems is described in eight-page brochure. System consists of storage cabinets, library storage units, Compustoralls, light- and heavy-duty truck and a desk rack. WRIGHT LINE, Worcester, Mass. For copy:
CIRCLE 134 ON READER CARD

IMPACT OF COMPUTERS IN ACCOUNTING: Five-booklet series includes survey of CPA's past experience and present intentions in dp, compilation of information sources, discussion of specific computer applications in accounting, examination of the relationship among CPA's, banks and service bureaus, and an analysis of trends in software and hardware characteristics. Cost: studies 1, 3 and 5, $2; 2 and 4, $1. AMERICAN INSTITUTE OF CERTIFIED PUBLIC ACCOUNTANTS, New York, N.Y.

AIR CONDITIONERS: Six-page brochure describes system for computer rooms, shows schematic of piping for air cooled condenser, and lists general specifications and modified versions of the equipment. BLAZER CORP., East Rutherford, N.J. For copy:
CIRCLE 135 ON READER CARD

INTEGRATED CIRCUIT LOGIC MODULES: Descriptions and specifications for SDS T Series line of integrated circuit logic modules are provided in 42-page brochure. T Series modules include buffered AND, OR, NAND, and NOR gates, flip-flops, and circuits such as clock oscillators, Schmitt Triggers and one-shots. SCIENTIFIC DATA SYSTEMS, Santa Monica, Calif. For copy:
CIRCLE 136 ON READER CARD

NC EQUIPMENT: Semi-technical explanation of how tape controls operate

a real time computer system

at half the cost of any other

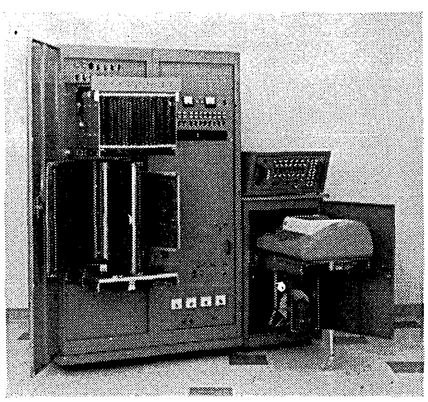
Lear Siegler, Inc. announces the System 8000, a comprehensive family of computer devices and interfaces which provides a cost breakthrough in data processing. This has been accomplished by:

- **Making the processor 8 bits wide (System 360 and ASCII compatible)**
- **Building in the I/O hardware so there is no need to buy multiplexers or expensive controllers**
- **Using integrated circuits throughout, mounted on a printed master board**
- **Adding multi-processing hardware to permit graceful expansion**
- **Offering the best storage protection in the industry**
- **Capitalizing on 10 years' experience in EDP systems building**

Many of the LSI System 8000 features are normally found only in a large scale computer system, yet the minimal configuration 8800 computer with a 2K byte memory, 6 I/O subchannels, can be purchased by Original Equipment Manufacturers in small quantities for about $13,500.

Available with complete utility support software, the LSI System 8000 may be purchased by the OEM as the 8800 processor only; the 8800 processor with memory; with device controllers; as a complete system with peripheral devices; or with applications programs.

Let one of our representatives review



your complete system needs with you element by element—and *demonstrate* to you how the LSI System 8000 can make the system you want feasible at one half the cost. Phone or write *today.*

LSI 8800 Processor—*Random access core memory; 1.5 μs full cycle time; 600 ns access time; 2048 bytes to 65,536 bytes, directly addressable . . . Extensive I/O capability: Multiplexer channel (6 to 254 priority subchannels) —Mx mode 20,000 bytes/sec. and Burst mode 200,000 bytes/sec; Selector channel—1,000,000 bytes/sec. . . . Variable field length . . . 86 instructions . . . LINGO Symbolic Assembler . . . TRACE (Debugging routine) . . . Utility programs for all announced peripherals . . . Mounts in a standard 19" rack and requires only 32" of height.*

Announced Peripherals and Interfaces—IBM System 360 interface; magnetic tape; disc; drum; communication lines (low and high speed); tape readers and punches; and special telemetry and process control devices.

LEAR SIEGLER, INC. LSi

DATA AND CONTROLS DIVISION
532 Broad Hollow Road, Melville, L. I., N. Y. 11746
Tel. 516-293-9000

CIRCLE 57 ON READER CARD

new literature

and step-by-step sequence of programming procedure is given in 18-page brochure. Positioning tables which convert production and assembly machines or machine tools to numerical control are also described. SUPERIOR ELECTRIC CO., Bristol, Conn. For copy:

CIRCLE 137 ON READER CARD

TAPE PUNCH: Six-page booklet discusses engineering factors in tape punching design elements of a single revolution clutch, tape punch specifications and method of punching. Diagrams show how the punch mechanism works during the four stages of the punch cycle. OHR-TRONICS, INC., New York, N.Y. For copy:

CIRCLE 138 ON READER CARD

HIGH-SPEED COUNTER: Two-page bulletin describes model PR-42 totalizer, which features counting speeds to over 1 msec, use of integrated circuits, and BCD and 10-one decimal electrical outputs. Optional six internal decimal electrical outputs. Specifications and optional features are listed. UNITED COMPUTER CO., Tempe, Ariz. For copy:

CIRCLE 139 ON READER CARD

ON-LINE SYMBOL MANIPULATION: System enables user to arbitrarily define symbols and rules for operating with these symbols and then to instruct the computer on-line to selectively apply the rules. The system consists of a small set of elementary symbol manipulation operators which can be programmed on-line to carry out more complex symbolic processes. The 181-page report describes this development and shows how the system can be applied to algebra. Order No. AD-628 135, *On-Line Computer Symbolic Manipulation.* Cost: $5, microfiche $1.25. CLEARINGHOUSE, U.S. DEPT. OF COMMERCE, Springfield, Va. 22151.

DIGITAL TAPE MEMORY SYSTEM: Description, applications and specifications of model TM-13, which include the ATM-13 (airborne), BTM-13 (buffered), and GTM-13 (geophysical), are presented in eight-page brochure. Tapes are available in 7-track IBM or 9-track ASCII formats and have continuous character rates to 625 kc, burst rates to 4.0 mc. AMPEX CORP., Redwood City, Calif. For copy:

CIRCLE 140 ON READER CARD

 CIRCLE 59 ON READER CARD

boston pops

THE SJCC REVIEWED

It seemed as if it was going to be a great conference. The weather in Boston was clear, sunny and warm. But on Tuesday, the first day of the Spring Joint Computer Conference, the temperature started into a tailspin; spring hadn't quite arrived after all.

Some 5,000 attended the 16 sessions of not-so-new material and wandered through the hotel-auditorium area—a madness laid out by Salvadore Dali during a nightmare—to see the gear, gadgets, and gimmickry offered by a record 97 exhibitors.

The technical sessions were marked by the recurring theme, time-sharing, and by panels of critics who argued the relative merits and demerits of the papers presented. The latter met with some success, and many attendees felt the practice should be continued—but strengthened by more precedents of bravery.

The question on time-sharing was not "why bother?" But "what is being done and should be done with it?" Papers in this area ranged from SDC's data management system for time-shared file processing to the time-sharing hybrid facility at United Aircraft. Some debate on definitions arose at the time-sharing panel discussion. The true system, asserted Ivan Sutherland of ARPA, not only enables a user to state whatever arbitrary procedures he wants but also provides him with direct access to his own file of procedures. With one stroke, then, airline reservation and on-line banking systems are not time-sharing.

The session on display applications research started with a standing-room-only crowd in a room that held 1900, and standees remained for more than an hour as slides, movies, and closed-circuit TV screens were viewed. Also well attended was an afternoon panel session on hybrid computation. Interest in this topic could have carried the session well into the evening if the conference hadn't come to a close. And if we may doff our editorial hat to some Canadians, the paper "Hybrid Simulation of a Free Piston Engine" by R. E. Gagne and E. J. Wright was tagged by an observer as the best presentation in the session on analog hybrid techniques.

In the area of information retrieval, the panel on the Evolving Library dealt with on-going projects, like INTREX, and with the problems that stand in the way of the development of a nationwide information retrieval network. J.C.R. Licklider noted these problems (e.g., lack of sufficiently sophisticated programming, inadequate computer memories, uncertainties about who will use the system, high costs), but argued that work should go forward anyway because of the tremendous need of researchers and scholars for automated retrieval.

It was intended that the optical information processing session would be tutorial, familiarizing computer specialists with some new techniques. But it seems that unless the audience was sophisticated in this area, the highly technical papers—one of which had been given a few weeks before to an optical processing group—did not fill the bill.

A single session was given over to programming languages, and the panel of critics seemed pleased with the scattered papers presented. One panelist mused that the promising proposal for a computer-design compiler (by G. Metze and S. Seshu of the Univ. of Illinois) is an independent development of something the manufacturers have been doing behind closed doors for some time. Also lauded was William Sassaman's paper on a program for machine-to-compiler language (FORTRAN) translation. "Here's someone with the courage to do it and it works." It is, the panel said, a better case for language translation than the natural language people have been able to come up with.

"On-line" was the phrase for the exhibits. CRT displays of at least 11 manufacturers and more than 70 Data-phones dotted the floor.

Among first showings were NCR's 315 rod memory computer, GE's 115, which was developed abroad by Olivetti-GE, and DEC's new CRT system built around the PDP-8. RCA had a 70/45 on hand and demonstrated emulation of the 1401 on the 70/35; the firm also touted a new 32K-bit monolithic ferrite memory stack with full cycle time of 500-600 nsec and a new 5-usec i.c. memory system. By virtue of a new licensing agreement, Honeywell had boxed Bunker-Ramo CRT's in red cabinets and put new numbers on them (300 series). Control Data out-IBMed IBM with a lovely two-story exhibit.

Honeywell's new acquisition, Computer Control Co., seemed to assert its independence by a showing of much of its product line and a let's-get-away-from-it-all champagne breakfast at Prudential Center's Top of the Hub. And Ferroxcube Corp. held a private seminar to present the merits of its new FX-12 core memory system.

As the conference closed, on a cold and rainy Thursday night, attendees hustled to get their hands on tickets to the Boston Pops concert or the final playoff game of the Lakers-Celtic basketball teams. What other city could offer such cultural diversions on the same night? Certainly not San Francisco (topless waitresses), where the Fall Joint conference convenes in November. Nor even Atlantic City (a Miss Information Processing contest?), site of the '67 SJCC. After that, the '67 FJCC swings to Anaheim (Fantasy

Land), Calif., where it looks as if the conference will be lucky to house all the attendees within a 5-mile radius. Maybe they'll televise the sessions so that you can follow it all from your motel room. Or from the bar downstairs. At least the decentralized accommodations would make the industry less vulnerable to a direct hit. ■

world report

BIDDERS RE-ENTER NADGE CONTRACT TALKS

Revised bids for the Nato air defence system, Nadge, went in at the end of May. As forecast earlier in Datamation, the original spec has been cut to keep within a fixed budget. Three consortiums headed by Westinghouse, ITT, and Hughes lopped about $60 million from proposals; but all three were reportedly reluctant to make the changes that involved pruning back on radar coverage, and ITT considered dropping out. Defence systems negotiators that inhabit the Nato environs of Paris tip Westinghouse as favourites for the contract worth $300 million. Other members of the consortium include IBM subsidiaries in France and Italy and Plessey from the U.K.

100 COMPUTERS FOR AIR TRAFFIC CONTROL?

The Plessey Co. disclosed details of their work on a British computer-based air traffic control system. Although this project has been reported from time to time, neither the firm nor the sponsoring government department has been prepared to say much. Now it transpires that a subsidiary of Plessey's called Automatic Telephone and Electric has been building computers for air traffic control for eight years. With a defence contract thought to be worth $30 million, AT&E has been nursing the biggest single computer contract put out by the government. Even now the traffic control complex involving 100 computers is unlikely to be ready for another two or three years, by which time hardware will be obsolescent. Compatibility with other developments such as Nadge and Eurocontrol is out of the question unless someone is prepared to pay for very expensive interface gear.

The British effort is also out on a limb on software, with adherence to a subset of Jovial called Coral as a real-time programming language. Earlier hopes that Nadge would go the same way have diminished and the Nato advisers are expected to recommend PL/I.

$100-MILLION BOOST GIVEN TO FRENCH COMPUTER FIRMS

Almost a year ago the first proposals for Anglo-French cooperation among Citec, ICT and English Electric-Leo-Marconi were made. It is now certain that de Gaulle's government will support an industry independent of the U.S. and of everyone else. To put Gallic electronic firms on a viable basis for computer work, a lump sum of $100 million has been tentatively earmarked by the department for industry and technology. Undeterred by the stubborness of "mon generale," board chairman Sir Gordon Radley of EELM has taken his wares elsewhere and is talking to German firms. Although not prepared to reveal which companies are interested in an Anglo-German combine, the obvious choices are Telefunken and Siemens. The latter is a particularly good candidate since, like English Electric, they have licensed designs and manufacturing rights from RCA for their own labels of Spectra 70. Telefunken, however, has a neat range in peripheral equipment for automatic document handling and character reading of post office bank cheques, a set of machinery that would usefully complement English Electric's range.

(Continued on page 109)

Voltage variations cause computers to make mistakes...

cause downtime, too!

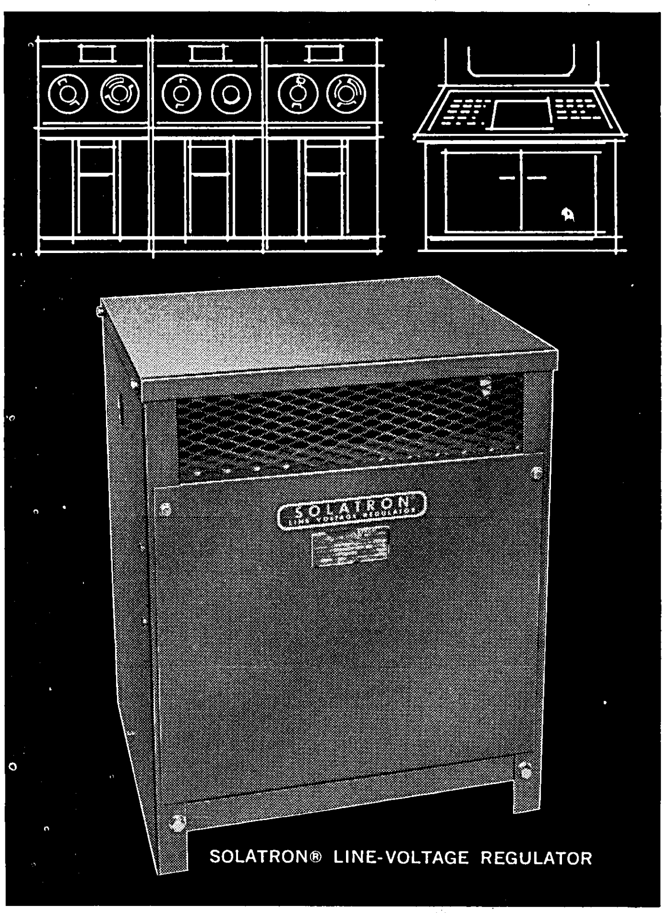
Voltage surges cause damage to component parts, p.c. cards. Voltage dips cause memory loss, digit drops, loss of parity.

Voltage variations outside the limits of your equipment cause costly mistakes. Elevators, motors, plant equipment and other voltage-demanding equipment surrounding your plant or building are the culprits.

Protect your equipment and data with the Solatron® voltage regulator. Special 3-phase computer models provide ± 1% voltage regulation, correction begins in first ½ cycle.

Write for the Solatron catalog. Sola Electric, Division of Sola Basic Industries, 1717 Busse Rd., Elk Grove Village, Ill. 60007. (312) 439-2800. In Canada: Sola Basic Products, Ltd., 377 Evans Ave., Toronto 18, Ontario.

Ask for our new Solatron catalog, No. VR-201.



SOLATRON® LINE-VOLTAGE REGULATOR

SOLA ELECTRIC

DIVISION OF SOLA BASIC INDUSTRIES

CIRCLE 60 ON READER CARD

Revolutionary Electronic Calculator

- Unmatched speed, versatility
- Simple to operate
- Single keystrokes provide all these functions

+	−	×	÷	$\sqrt{X}$	X^2	e^x	$\log_e X$

- Two independent accumulators for random data entry and retrieval
- **LOW PRICE — FROM $1690 to $2095**

Additional keyboard units from $450

- Time sharing units also available

Write for complete details

WANG LABORATORIES, INC.

DEPT. FF-6, 836 NORTH ST., TEWKSBURY, MASS. 01876

TEL. (617) 851-7311

CIRCLE 61 ON READER CARD

COMPUTER SYSTEMS

GENEVA, SWITZERLAND

Rapidly growing highly automated international investment organization with sales volume of over 500 Million Dollars per year owned entirely by its executives seeks a highly qualified computer specialist to join the corporate staff in Geneva. He will report directly to the vice-president and take responsibility for the development and implementation of computer systems for recently installed tape and disk IBM 360 System. He should have an excellent education, preferably with a masters degree, and a minimum of 5-years experience in the development of large scale computer systems. At present he should be working at a supervisory level.

Salary $15,000 - to $20,000

Immediate profit sharing

(21% of annual salary in 1965)

Opportunity for equity participation after one year.

Send complete resume to:

Box D 1206, 125 W. 41 St, N.Y. 36, N.Y.

(Continued from page 107)

ECONOMIC MODELLING IN RUSSIA

Economic model building is very much the vogue in Europe at present, and it seems that the Soviets are making progress with the technique. In London during a visit to a meeting of IFIP technical committees, Professor A. Dorodnyicin of the Moscow Academy of Sciences said that the building of a computer model for simulating the whole economy was still more of an ideal than a near-reality. The Russians are establishing computer-based economic planning centres on an industry-by-industry basis. The chemical sector is probably the most advanced both in planning and industrial control, according to Dorodnyicin, and the larger machines in use are alleged to be comparable with 7094's.

The professor's own field is numerical analysis, and his computer centre in Moscow has 400 people, mostly postgraduates, working in this field. Their work is divided on a 50-50 basis in developing programming languages and systems packages for industry. For the long term, the Soviets are planning a computer grid to speed up the planning process. British government advisers are skeptical about the practicality of such a scheme for Russia because, they say, the slowness of the decision-making apparatus would off-set advantages of more rapid data handling.

ICT RUMOURED TO BE IN MERGER MOOD

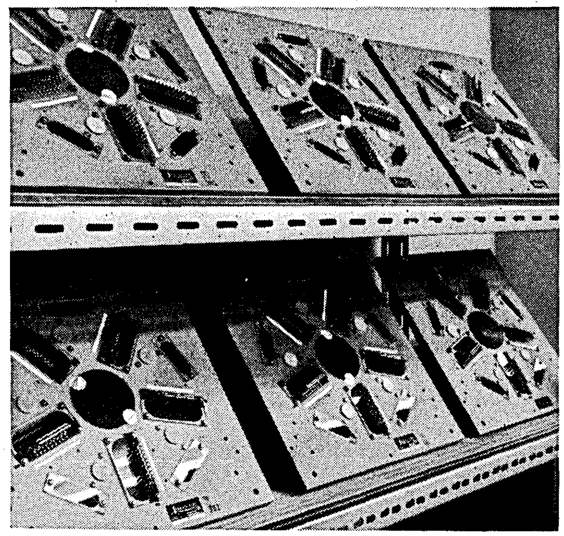
Big mystery at the moment is the identity of the quiet buyer of ICT stock. Toward the end of May the firm's shares started a steady and inexplicable climb after two years in the doldrums. One firm of London City analysts put it down to purchasing for an overseas bidder through a nominee, and rumors of take-over moves promptly escalated, adding weight to persistent reports of an interest from General Electric.

Listed as a second choice for cooperating with, rather than taking over, ICT was the giant Dutch Philips concern. Slowly working their way into the market, Philips would find ICT a useful entree into the industrial control field, so far outside ICT's current province. Politically it would seem an acceptable solution, for Philips has made big investments in the U.K. through electronic component, instrumentation, and communications subsidiaries, and is a major sponsor of university research in computer sciences and radio astronomy.

BITS & PIECES

On the opening of the Prague Computer Fair, ICT announced two orders from Hungary for 1904 systems worth $1 million. Strong rumours are of a deal between IBM and the Polish government for 100 1401's. 10's and 40's at half original list price...Following the third Australian Computer Conference, attended by more than 900, a move is underway to form a National Users Assn., concerned more with business dp. The conference, it seems, was too scientifically oriented. Aussies look for formation by year end...Elliott Automation has introduced the 920M micro-miniature processor. They're believed to have 200 orders for the 920M, including 150 from the military...IBM 360's worth $1.5 million have been cancelled by Martins Bank, England, because initial specs were inadequate to handle the job. Replacements are NCR 315's.

Librascope's new Series L210... when value is the object



Librascope's new line of computer disc memory systems, designated the Series L210, offers the greatest cost savings in the industry.

Available in 15 different off-the-shelf models, the Series L210 provides the user low-cost disc memories with great flexibility in choice of access times, bit capacities, and number of recording heads. Their modular design enables a choice of storage capacities up to 2 million bits and a wide variety of combinations of recirculating registers and data tracks. Each memory system utilizes a single magnetic disc, 10 inches in diameter, in a compact package that measures less than 1 cubic foot and weighs 35 pounds.

Economically priced, 60 days delivery, and developed by the company which offers the largest line of disc memories in the computer industry... superior is the word for the Librascope Series L210. For complete details, write for our technical bulletin.

SERIES L210 MODELS

	ACCESS TIME (Milliseconds)	TOP PLATE	BOTTOM PLATE
L110-8-1	8	A	C
L110-8-2	8	B	C
L210-8-1	8	A	A
L210-8-2	8	A	B
L210-8-3	8	B	B
L110-17-1	17	A	C
L110-17-2	17	B	C
L210-17-1	17	A	A
L210-17-2	17	A	B
L210-17-3	17	B	B
L110-25-1	25	A	C
L110-25-2	25	B	C
L210-25-1	25	A	A
L210-25-2	25	A	B
L210-25-3	25	B	B

Head Plates A = 72 data heads including spares
9 clock heads including spares
(in separate port)
B = 16 recirculating registers;
5 clock heads including spares
C = Blank Plate

COMPONENTS DIVISION
GENERAL PRECISION INC.
LIBRASCOPE GROUP
808 Western Ave., Glendale 1, Calif.

CIRCLE 69 ON READER CARD

GSA OPENS WAY TO REDUCED COMPUTER RENTAL

"IBM had no choice; the federal government would have purchased whatever equipment it couldn't lease back." According to one source, this is how GSA finally extricated Uncle Sam from the clause in the IBM lease contract that prevents assignment of computer ownership to anyone else. Beginning July 1, IBM is expected "voluntarily" to sell some federally-leased equipment to third parties, who then will lease it back to the government at reduced rates. Success comes after a 2-year GSA effort. The Brooks Bill, with its emphasis on purchasing, was the clincher.

Current government rental payments are about $260 million a year -- $60 million for EAM, the rest for ADPE. Roughly half of these units are eligible for leaseback, says a GSA official. According to a previous estimate, the new arrangement could cut rentals a minimum of 10%, producing a total saving of at least $13 million annually.

Leaseback would apply only to gear "that isn't going to be kept long enough to justify purchase," the GSA official adds. How long is "long enough"? He refused to speculate, but others say GSA regards 18 months to 2 years as a maximum leaseback period, which probably excludes everything but punchcard and early-generation computers.

GOVERNMENT FUNDING FOR CAI RESEARCH MOVES UP

Federal expenditures for computer-assisted instruction will more than double in fiscal '67, predicts Lou Bright, recently-appointed research director of the U.S. Office of Education. That would mean a $5-6 million outlay, assuming Congress gives USOE all the money requested. About $2 million more probably will be invested in related kinds of computerized assistance, some of which are pretty sophisticated. Harvard Univ. College, for example, received a $1.7 million grant last month to set up a computerized crystal ball capable of helping students choose the right careers. Basically, the computer, through a remote I/O station, will ask the student about his academic record and interests, correlate this with stored models, and decide the best match.

Bright, former director of instructional technology at Westinghouse, predicts that CAI will become "economically attractive" in about 3-4 years; within 10 years, he expects computerized instruction systems to be in 5-25% of all schools.

FCC LOOKS AT DATA TRANSMISSION NETWORKS

The FCC's Common Carrier bureau chief Bernard Strassburg reports that an "informal study" of long-distance data transmission should be finished in two months. Conclusions and recommendations regarding the need for regulating the new Western Union utility net and similar ventures will then be presented to FCC commissioners. WU president R.W. McFall shed more light on his company's proposed computer network in a keynote speech at the recent Industrial Communications Assn. conference in Montreal. Three kinds of data transmission service will be offered: low-speed message and exchange service at up to 200 words/minute; intermediate, in the 4 KC range, for voice, fax, and data transmission up to 4800 wpm; high-speed, in the 48 KC range and up.

You'll never go stale.

We won't let you. At SBC the programming challenge can be different every day.

One day you might be helping to develop a time shared monitor or helping to forecast an election. The next, you could be working on stock market financial analyses or converting a currently-operating application to System/360.

Never a dull moment. Because you'll be working in an exciting, creative atmosphere with stimulating programmers. You'll be working on interesting and important projects.

For strictly selfish reasons we want to keep things that way. We lean over backwards to make people happy, to help them grow and advance. That's how we became one of the most respected groups in the business. That's why we're still growing so fast.

If you have some programming experience and want an opportunity to work with a full range of IBM System/360s, you have good reason to write The Service Bureau Corporation, 425 Park Avenue, New York, N.Y. 10022 or call collect (212) PLaza 1-1771. SBC has offices in over 70 locations.

A subsidiary of IBM SBC® An equal opportunity employer

CIRCLE 91 ON READER CARD

books

Computer Software, by Ivan Flores, Prentice-Hall, 1965.

Dr. Flores' newest book is frankly a college text, designed for an advanced course in digital computer programming. Its usefulness to the working programmer with broad experience is therefore limited, although programmers who lack exposure to systems programming concepts might benefit by reviewing the sections pertaining to buffering, input-output control and interrupt management. The remainder is of questionable value, and indeed contains some underlying ideas that this reviewer finds difficult to accept as either accurate or at all current. Some of these ideas are discussed below.

As a text, with the reservation that there are some inaccuracies and outmoded concepts used, the book appeals to this reviewer. Better ones will be developed in the future, but we must begin somewhere, and this is at least a fair beginning. In its treatment of systems programming problems and concepts, it is far and away the largest forward step since McCracken's *Digital Computer Programming*, which was published in 1957. The material is logically well-arranged and there are copious diagrams and examples to aid the student in understanding the text. The author is particularly to be congratulated for the clarity of his style, which stays at the student level without sacrificing accuracy, and manages to be informative without being pedantic. Some passages seemed to be over-terse, in the sense that terms were used that had not been adequately defined, but one must remember in these instances that the book is a follow-on to Flores' previous book, *Computer Programming*, actually published later.

Again as a text, the drawbacks are minor, but annoying. The author has adopted the convention of using cursive script to depict the names of systems, subsystems and systems programs. The result is unnecessarily confusing and does not contribute to understanding. The layout of the book in many sections also is confusing, almost helter-skelter. In general, the problem sets given at the end of each chapter

the surprising role of programming at Xerox

or

(how to quietly put your skills to work on the mainstream of some very unusual corporate and scientific problem-solving...decidedly upstream.)

The first surprise generally comes with the comment that throughout the corporation's many operating divisions, as well as within the more centralized business and scientific computing groups, Xerox already employs a healthy number of programmers (upwards of 100). Not neophytes. And we have ample room for more. Also not neophytes.

The second surprise surrounds the kind of work we'll invite you to do, and the way we encourage you to do it.

To begin with, we've toppled the concept that a lot of people have—that computers are merely data processing machines, no matter how wondrous. We've had the good fortune to participate in (maybe precipitate) a thorough organizational awakening to the fact that a computer in a scientific environment should be used to enhance the *insights* of scientists and engineers—not just be used to *process* a problem they may have. And the same goes for non-technical, decision-making management.

If these be platitudes, they're platitudes in action.

And so you'll find many of our "programmers" acting as *consultants* to managers of fundamental and applied research, advertising, marketing, manufacturing, finance, etc.

This is not routine programming. And a routine programmer wouldn't be up to it.

In addition, there's some interesting work in progress on time-sharing systems. The software aspect is a challenge all its own.

You'll find enough modern EDP equipment here so that your creativity isn't likely to be inhibited by a lack of hardware. To give you a few examples, we've recently installed a 7044 at our Scientific Computing Center. Then there are two 7010s sharing almost a billion characters of random access storage, supported by 1460s and 1401s, all in *one* of our installations.

One last possible surprise. If you thought Xerox was in the office copier business, you were not entirely correct. This will be more apparent when you visit us and we discuss your approach to problem-recognition in fields like optical technology, laser studies, behavioral science, remote imaging, and a few additional subjects that are peculiarly relevant to the real business of Xerox—graphic communications.

Most, but not all, of our current openings are in Rochester, New York.

Please forward your resume, in confidence to Mr. David E. Chambers, Dept. YVF-119, Xerox Corporation, P.O. Box 1540, Rochester, New York 14603.

XEROX

An Equal Opportunity Employer (M&F)

Xerox will conduct Chicago Interviews (June 21-24) during Data Processing Management International Conference. Please check local papers for details at that time.

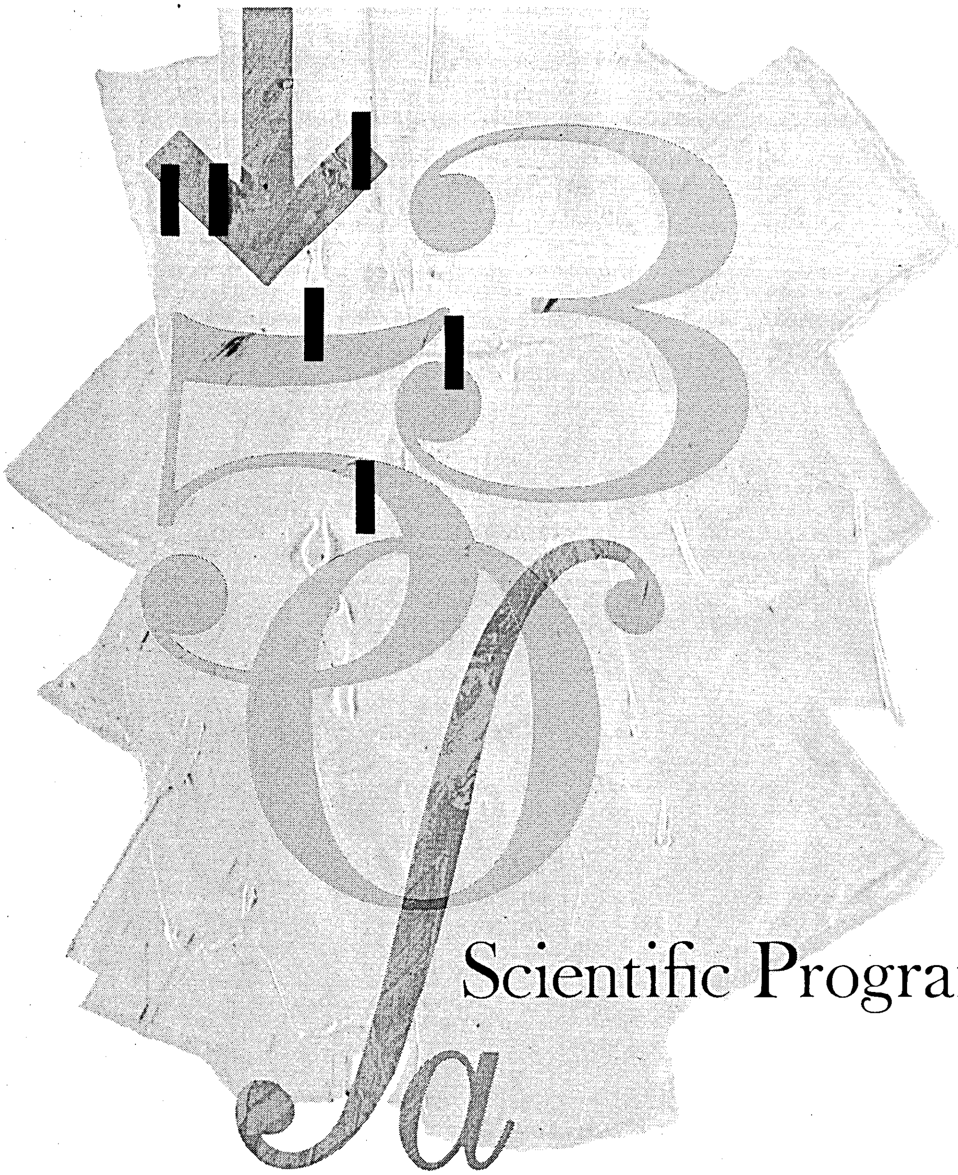
give the student the opportunity to examine what he has learned—if he is a particularly mature self-student or if he is under classroom discipline. The book is not a self-study aid for the novice, however, since many of the problems are of the "essay question" type, in which the responses must be discussed for maximum value.

The questionable aspects of the book appeared to this reviewer to consist of sins both of omission and commission. In the former category lies the failure of the book to deal at all with multi-programmed or multi-processor systems ("deal with" means here to mention, at least, so that the student will not be misled into the notion that once he has mastered this text he knows all there is to know about systems programming), real-time interrupt-driven systems as opposed to batch processors, and most particularly compilers. The latter failure derives from the author's surprising assertion that, "It is estimated that over 99% of translation uses assemblers." He does not mean, obviously, that 99% of computer program steps are written in assembler language. He is, rather, referring to the practice of compiling into symbolic form and then subjecting the symbolic program thus prepared to an assembly pass. This technique is no longer valid, although some compilers are built to prepare a separate assembler output in parallel with the production of object code, if desired. The symbolic assembly listings produced by compilers, particularly on systems with adequate debugging facilities, have little if any utility, however, and consequently are for the most part mere vestigial remains. Another remark associated with assemblers can only be described as quaint. It is, "Most small machines . . . rely heavily upon assemblers although they often call them Autocoders." Of course, "Autocoder" was originally coined as the name of an assembler (for the IBM 705) with macro-instruction capability.

In the area of input-output systems, the book gives the impression that the desired way to implement such a system is to provide each program assembled or compiled with its own I-O subroutines, through the language processor. Each program thus is free-standing or nearly so, minimizing core requirements for the monitor or executive at run time. This system philosophy is valid for 1401 and similar systems, and was good for machines as large as 1410. However, on large-scale systems, where there is room in core for a permanent I-O system, and particularly where multi-programming is utilized, I-O systems should be kept apart from the job programs. As a potential consumer of the products of Dr. Flores' courses, this reviewer protests the perpetuation of outmoded concepts. On the other hand, it should be noted again that the over-all treatment of I-O programming is quite thorough and well done.

There is in any profession a large gap between what is found in the textbooks and what is practiced in the field. This statement is particularly applicable to computer programming, which is both a young profession and a very rapidly moving one. The thinness and fugitive character of Dr. Flores' bibliography illustrates the statement—he is a conscientious scholar, but the pertinent material just doesn't exist. The present book is an able and commendable attempt to help fill the need, but the author is shooting at a moving target from a fixed gun emplacement. Perhaps one day the field will move slowly enough for the mechanics of book production to catch up with at least the important principles.

—Richard H. Hill



Scientific Programmers

New research laboratory for high-energy particle physics is offering career opportunities to programmers in the following areas:

APPLICATIONS Responsibilities will include development of computer methods and programs for analysis of experimental data. Will perform engineering calculations for the design of experimental devices, in addition to theoretical model calculations and similar assignments.

Applicants should have a Master's Degree in Computer Science, Mathematics, Statistics or Physics — or a Bachelor of Science Degree with appropriate experience.

SYSTEMS Assignments will involve the development of real-time analysis and control programs, advanced assembly routines, special purpose compilers and system simulators.

Applicants should have a Master's Degree in Computer Science, Mathematics or equivalent, with related experience.

Here is an opportunity to associate with a new international research center. Liberal benefits are the same shared by professional employees of Stanford University.

Send résumé in confidence to G. F. Renner, Professional Employment Manager, Stanford Linear Accelerator Center, P.O. Box 4349, Stanford, California.

STANFORD LINEAR ACCELERATOR CENTER

An Equal Opportunity Employer

CIRCLE 95 ON READER CARD

The shortest distance between two points is often imagination

There's a tried and true way . . . but sometimes there's an untried and new way. To conceive and consider the latter is to invent, to create, to imagine. Such original thinking is an important part of Bellcomm's daily work. This Bell System company is helping the National Aeronautics and Space Administration plan the systems needed to journey to the moon—a project for which much fresh thinking is needed. Bellcomm has rewarding openings for experienced, imaginative thinkers in such fields as physics, mathematics, engineering, flight mechanics, propulsion, man-machine relationships, computer programming, aerodynamics and aeronautical engineering in general. If you believe that you qualify, Bellcomm will give your résumé thoughtful study. Address it to Mr. N. W. Smusyn, Personnel Director, Bellcomm, Inc., Room 1405-E, 1100 17th Street, N. W., Washington, D.C. 20036. Bellcomm is an equal opportunity employer.

Bellcomm, Inc.
A Bell System Company

ELECTRONIC DESIGNERS

The demands of our space launch vehicle programs require the design of entire new generations of control electronics and test equipment. We need designers with abilities to meet such challenge, for example, as the autopilot for a new generation of Atlas and Centaur. Sophisticated electronic and control systems play a vital role in our present and future plans. We offer outstanding fringe benefits including a Savings and Stock Investment Plan. And we offer you the opportunity to live in vacationland San Diego.

IMMEDIATE OPENINGS

TEST EQUIPMENT CIRCUIT DESIGN
BS, EE, and one to five years' experience in design of test equipment for sophisticated electronic and electro-mechanical systems including advanced autopilot development.

GUIDANCE AND CONTROL SYSTEMS CIRCUIT DESIGN
BSEE or MSEE and one to five years' experience in solid state circuit design in the areas of guidance, flight control and digital sequencers. Work will involve the design and analysis of analog and digital circuits for use in guidance systems, flight control systems, flight control sequencers, and associated power supplies.

COMPUTER CONTROLLED CHECKOUT EQUIPMENT SYSTEMS DESIGN
BSEE or MSEE and one to five years' experience in automatic test equipment and computer programming. Work will involve analyzing test and checkout requirements, designing interface electronics, and producing software for electronic computer controlled checkout equipment.

Send resume at once to: Mr. J. J. Tannone
Supervisor, Professional Placement and Personnel
5540 Kearny Villa Road, San Diego, California 92112.

GENERAL DYNAMICS
Convair Division
SAN DIEGO

An Equal Opportunity Employer

CIRCLE 101 ON READER CARD

CAREERS

You are invited to utilize our select personnel service if you are in the

TOP 20%

SORRY

— no time for mediocrity. We are in a position to help those individuals who are able to ask for and obtain the best career opportunities. If your abilities or potential are such as to place you in the top 20% of your field, our unique service will enable you to

CHOOSE THE AREA
you prefer to live and work in
FROM COAST TO COAST

Investigate not just a job, but a challenging career opportunity in any aspect of computer based systems or management science.

A SMALL SAMPLE OF CATEGORIES RANGING FROM $10 — $30,000:

- Software development
- Programming research
- Scientific computation/Analysis
- Technical representative
- Marketing/Sales
- Operations Research
- Systems design
- Management consulting
- Real time/Communications systems
- Digital systems engineering
- Process control

(Managers, Seniors, Intermediates)

Our clients assume all expenses.
Write in full confidence to
Joseph Albert or phone 212/OR 9-7314.
Indicate salary and personal requirements.

Career Consultants in the Data Processing Field

ALBERT ASSOCIATES

103 PARK AVENUE, NEW YORK, N. Y. 10017

CIRCLE 102 ON READER CARD

datamart

Address all replies to box number advertisements as follows:

Box..............
DATAMATION
F. D. Thompson Publications, Inc.
141 East 44th St.
New York, N. Y. 10017
Classified Advertising

PROFESSIONAL SERVICES

UNGERLEIDER & CO.
Representatives for
EDP Equipment & Services
P.O. Box 1180 — Area Code 703
Alexandria, Va. — 768-6700

USED EQUIPMENT

Before Selling or Returning IBM EAM or EDP Equipment, Contact us For Premium Prices. GMA LEASING 138 NEPPERHAN AVENUE, YONKERS, NEW YORK 10701. Phone 914 — YO 9-0807.

We will buy your IBM Data Processing Equip. outright. Or sell, rent or lease IBM Data Processing Equipment to you with full IBM maintenance contract. Global Tab. Equip. Corp., a subsidiary of International Typewriter Exchange, 1229 W. Washington Blvd., Chicago, Ill. 60607, SE 3-1200.

PHILCO 2000 MODEL 210 FOR SALE, 32K Memory, 15 Tape Drives Peripheral include Card Reader, Card Punch, Printer, Cal-Comp Plotter and Paper Tape System. 1000 Reels Magnetic Tape. System is under Philco Maintenance Contract. A large scale computer system at a 1401 price. Inquire Box—6-1

HELP WANTED—Educational Institution

ACADEMIC POSITION IN COMPUTER SCIENCE Opening for key person in new undergraduate program. Advanced degrees and/or experience required. Rank open; academic year salary to $15,000 depending on qualifications. To start September 1, 1966. Also 1966 summer teaching opportunity. Write Dr. D. H. Baker, Chairman Physics Department, Northern Michigan University, Marquette, Michigan 49855

DATAMATION

Classified Advertising

The classified section is open for the following advertising categories: Used equipment; positions wanted; help wanted, educational institutions; maintenance services; professional cards; hobby products; business opportunities and educational courses. Rates are based on total number of insertions used within each contract year.

For further information please contact: DATAMATION Magazine, Classified Advertising Dept., 141 East 44th Street New York, N. Y. 10017—212-MU 7-5180.

ONEONEONE
11111111111111
ONEONEONE
11111111111111
ONEONEONE
2222222222222
TWOTWOTWO
2222222222222
TWOTWOTWO
2222222222222

Lockheed has on order two separate

Hybrid Computer Systems

System No. 1 consists of two fully expanded EAI 231R-V Analog Computers, and a CDC 3200 Digital Computer. This system will be operable in Summer of 1966.

System No. 2 consists of four fully expanded Ci 5000 Analog Computers and a CDC 6400 Digital Computer. This system will be delivered in the Spring of 1967. At the time of delivery, this will be the largest and most powerful Hybrid Computer in the USA (and, hopefully, the world).

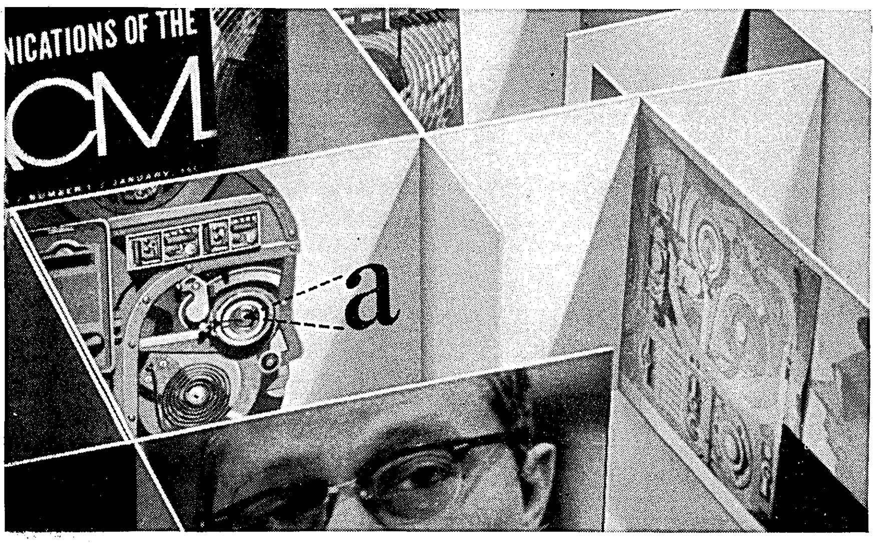
Experienced Hybrid Computer Programmers are needed now to start writing the Systems Programs necessary to operate the computers.

Scientific Digital Programmers with real-time experience are invited to write K. R. Kiddoo, Professional Placement Manager, P. O. Box 504, Sunnyvale, California. An equal opportunity employer.

LOCKHEED
MISSILES & SPACE COMPANY
A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION

CIRCLE 103 ON READER CARD

Programmers—
You only get one chance
to pioneer a new technology...



RCA GRAPHIC SYSTEMS DIVISION

Do you want to start at the beginning—the *ground floor* of a whole new area of technology—the "communications explosion" in graphic arts? The field of recording and reproducing graphic and textual information.

A field that brings together electronics, optics, photochemistry, electrostatics, mechanisms and data processing for ingenious new concepts that will revolutionize graphic reproduction.

In this new RCA division, you will have the opportunity to prove your creative ability, to test your imagination and to advance with a new and growing technology.

Openings exist at all levels for those who have a minimum of two years programming experience. Experience should include assembly language programming on binary computers, real-time or diagnostic programming, and experience in the development of systems software. A BS degree in engineering, mathematics or science is desirable. Experience in the Graphic Arts would be helpful, but is not necessary. If you are interested in this ground-floor opportunity, send a complete resume to:

Mr. E. V. Ward, Dept. GS-6
RCA Graphic Systems Division
U. S. Highway No. 1
Princeton, New Jersey 08540

An Equal Opportunity Employer M & F

RCA **The Most Trusted Name in Electronics**

CIRCLE 104 ON READER CARD

ambitious?

go where you can GROW!

180-fold in 20 years!

TEXAS INSTRUMENTS INDUSTRIAL PRODUCTS GROUP IN HOUSTON, TEXAS is engaged in the development of special purpose computers, strip-chart recorders, automatic semiconductor test equipment, and other laboratory instruments. The work is essentially non-defense and offers stability with excellent advancement opportunities. Openings are immediately available for engineers interested in design and development of

COMPUTER PERIPHERAL EQUIPMENT

Disk Memory Project Engineer

If you have a BS or MS in EE or ME with exposure to disk or disk memory development and servomechanisms, this could be the opportunity you are looking for. To qualify, you should have at least 5 years' applicable experience and supervisory ability.

Disk Memory Design Engineer

This is an excellent opportunity to design advanced computer peripheral equipment such as disk memory, tape transport, card reader, or other devices. You should have a BS or MS in EE with 3 to 5 years' experience.

Test Engineers

In this assignment, you will assist in systems checkout, installation and customer service of digital data systems. You should have a BS or MS in EE.

At TI, you will find the right climate for career development and the opportunity to use your creativity and professional ability to the fullest. Send your confidential resume today to Bob Thompson, Dept. 125-H.

TEXAS INSTRUMENTS
INCORPORATED
P. O. Box 66027
Houston, Texas 77006
An Equal Opportunity Employer

CIRCLE 105 ON READER CARD

Address an envelope as shown above. Enclose your resume and drop it in the mail. We'll send you, without delay, complete information about professional opportunities with Computer Sciences Corporation.

The "CSC Story" is one of spirited growth, both in company size and in diversity of assignments. It is the story of an organization totally oriented to integrated computer systems, both scientific and executive. Since we produce no "hardware," our programming specialists enjoy total conceptual involvement with problems ranging from management systems to trajectory analyses. We are, in short, problem solvers for an impressive and growing roster of clients in business, industry and government.

If you are now at a senior level of programming responsibility (or know you have what it takes to get there) and have solid experience with large-scale computer applications, we believe you will find our story vitally interesting. If you have an advanced degree and supervisory or managerial experience, so much the better. Our growth has created opportunities at various levels.

And with CSC, you can virtually choose your own location. We have offices in seven major metropolitan areas – Los Angeles, New York, Washington, D.C., Boston, Houston, San Francisco and San Diego – and serve the Pacific Northwest through an installation in Richland, Washington.

□ □ □

Get the complete story. Address that envelope today. It could truly be the start of something big!

We regularly conduct interviews in major cities throughout the U. S. Your prompt inquiry will enable us to schedule an early interview

AN EQUAL OPPORTUNITY EMPLOYER

COMPUTER SCIENCES CORPORATION

650 NORTH SEPULVEDA BOULEVARD, EL SEGUNDO, CALIFORNIA 90245

CIRCLE 106 ON READER CARD

SCIENTIFIC PROGRAMMERS

Opportunities in Florida

These openings are for real-time, data reduction applications associated with range operations in support of the Gemini and Apollo space programs at the John F. Kennedy Space Center in Florida—where Federal Electric Corporation is engaged in implementing KSC's central scientific computers to the task of data recording, reduction, transmission and real-time display of thousands of measurements telemetered from the vehicle, spacecraft and ground support equipment.

Requirements include a degree in mathematics and/or related fields with a minimum of 2 years of programming experience on large-scale computer systems. Experience in symbolic and FORTRAN languages required.

Please forward your resume, in confidence to Mr. W. Zunz or Mr. H. B. Arnold, Federal Electric Corporation, 8660 Astronaut Blvd., Cape Canaveral, Fla.

ITT service

FEDERAL ELECTRIC CORPORATION

An Equal Opportunity Employer

INFORMATION SYSTEMS SCIENTISTS AND ENGINEERS

Bendix Research Laboratories has excellent career opportunities for B.S., M.S., and Ph.D. graduates with 2 to 15 years experience in one or more of the following key areas:

- **ARTIFICIAL INTELLIGENCE,** pattern recognition, trainable systems, adaptive logic.
- **COHERENT OPTICAL PROCESSING,** spatial filtering, optical correlation, electro-optical systems and components.
- **DIGITAL COMPUTER DESIGN,** systems analysis, logic and circuit design, real-time computer control.
- **ANALOG COMPUTERS AND SYSTEMS,** information theory, control theory, circuit and servo analysis, correlation techniques.
- **REAL-TIME COMPUTER PROGRAMMING,** mathematical analysis, scientific computing.

Assignments involve research and development in automatic extraction of information from photographic records, image processing and analysis, adaptive and trainable control systems, digital and hybrid computing techniques, and advanced real-time computer control applications.

Interested individuals are invited to call collect or to send a resume to our Personnel Director.

Research Laboratories Division
Southfield, Michigan • (313) 353-3500
An equal opportunity employer

THE Bendix CORPORATION

CIRCLE 107 ON READER CARD

REAL-TIME SYSTEMS PROGRAMMERS

(Southern California)

Immediate opportunities are available for Senior Programmers with real-time experience. Openings encompass advanced studies of airborne command/control systems, development of the data processing portion of an advanced radar surveillance system, a re-entry evaluation system and a fire control system.

Applicants must possess the ability to transform functional requirements into operational program specifications. Additional requisites include: U. S. citizenship, Bachelor's degree in Mathematics, Physics or E. E. and an absolute minimum of three years of applicable experience.

To assure prompt consideration, please airmail confidential resume to:

MR. D. HAMLIN

HUGHES

HUGHES AIRCRAFT COMPANY

FULLERTON R & D
P. O. Box 3310
Fullerton, Calif., 92634

Equal opportunity employer — M & F

people

■ George Vosatka is a new vice-president of Informatics Inc., Sherman Oaks, Calif. He recently resigned as west coast vp of Computer Usage Co.

■ E. Gordon Perry Jr., a co-founder of Recognition Equipment, Inc., Dallas, Texas, has been appointed senior vice president of advanced research.

■ James R. Bradburn succeeds Arnold K. Weber as division vp-general manager of RCA-EDP. Weber, reaching retirement age, remains a vp.

■ Milton E. Mohr, former vice president and general manager of the Defense Systems Div., Bunker-Ramo Corp., has been elected president and chief executive officer.

■ Karl Schroedel, formerly with IBM, has been named manager of the new Emcon data processing program being instituted by Emery Air Freight Corp., Wilton, Conn.

■ Harvey Cohen has been named manager, advanced programs, Scientific Data Systems, Santa Monica, Calif.

■ Lawrence A. Goshorn has joined Data Machines Inc., Newport Beach, Calif., as director of computer engineering. He was formerly with General Electric where he worked with process control systems.

■ Fred W. Bauer has been named manager, computer system planning, at the ElectroData Div., Burroughs Corp., Pasadena, Calif.

■ Richard L. Beattie has joined the Rockwell Manufacturing Co., Pittsburgh, Pa., as director, corporate systems and data processing. He was previously in charge of systems and procedures work at U.S. Steel Corp.

■ Robert W. Naylor has been appointed systems and procedures manager for the Polymer Corp., Reading, Pa. Most recently, he was dp manager for the Spencer Chemical Div. of Gulf Oil.

REXALL

Our EDP area is expanding into a nationwide IBM System/360 based telecommunication network serving manufacturing, distribution operations within this diversified corporation. Several exciting opportunities are immediately available for

Systems Analyst Programmers

(Business-Scientific)

Candidates should have background in commercial applications, strong analytical problem solving interest and a minimum of 3 yrs. experience with magnetic tape and/or random access computers. Limited travel. Possible re-location. Interviews can be scheduled in your area. Inquiries will be held in complete confidence. Please send summary of experience and salary history to

REXALL DRUG & CHEMICAL CO.

Personnel Dept.
P.O. Box B-157, Terminal Annex
Los Angeles, California 90054

Equal Opportunity Employer

CIRCLE 113 ON READER CARD

CAREER MEMO

To **PROGRAMMERS/ANALYSTS/ENGINEERS**
From **EVERETT KELLEY ASSOCIATES**

If your present position **lacks** professional **motivation** . . . NOW is the time to let us program your professional future . . .

Consult **our** staff of experienced specialists who are at your disposal. They will open doors and arrange favorable interviews with selected clients. Utilize your total professional capability in:

- Scientific Programming
- Real Time Systems
- Software Development
- Operations Research
- Applied Systems
- Systems Design
- Consulting
- Digital or Logic Design
- Circuit Design
- Commercial Programming
- Mathematics
- Development Engineering
- Communications
- Sales/Marketing

Salary range: $8,000-$30,000. All expenses paid by client companies (fees, interviewing and relocation). Submit your resume in strict confidence, including salary requirements and geographic preference, directly to Mr. R. L. Keilholtz or Mr. Donald Wayne, or write for our composite resume form.

National Employment Association Service Member

EVERETT KELLEY ASSOCIATES

Consultants to the Computer Industry

121 So. Broad Street (Suite 1300)
Philadelphia, Pa. 19107

CIRCLE 112 ON READER CARD

Why do Programmers and Data Processing Professionals select FOX-MORRIS PERSONNEL CONSULTANTS?

1. **FINANCIAL IMPROVEMENT** — Our select group of blue chip clients offer unexcelled starting salaries in the $10-30,000 range. (All fees & employment costs paid by client companies).

2. **CHALLENGING PROJECTS** — Assignments in such areas as Software Development, Management Information Systems, Operations Research, Scientific & Commercial Programming Management.

3. **PERSONALIZED CONFIDENTIAL SERVICE** — Our National Data Processing Division is professionally recognized as the most complete, effective, & confidential service in the placement industry. (Affiliate offices coast to coast).

For full details, reply in strictest confidence by letter or resume, or call collect, W. B. McNichols, Manager-Data Processing Division, 215 — LO 3-7922.

FOX-MORRIS ASSOCIATES
Personnel Consultants
1500 Chestnut Street Philadelphia, Penna. 19102

CIRCLE 111 ON READER CARD

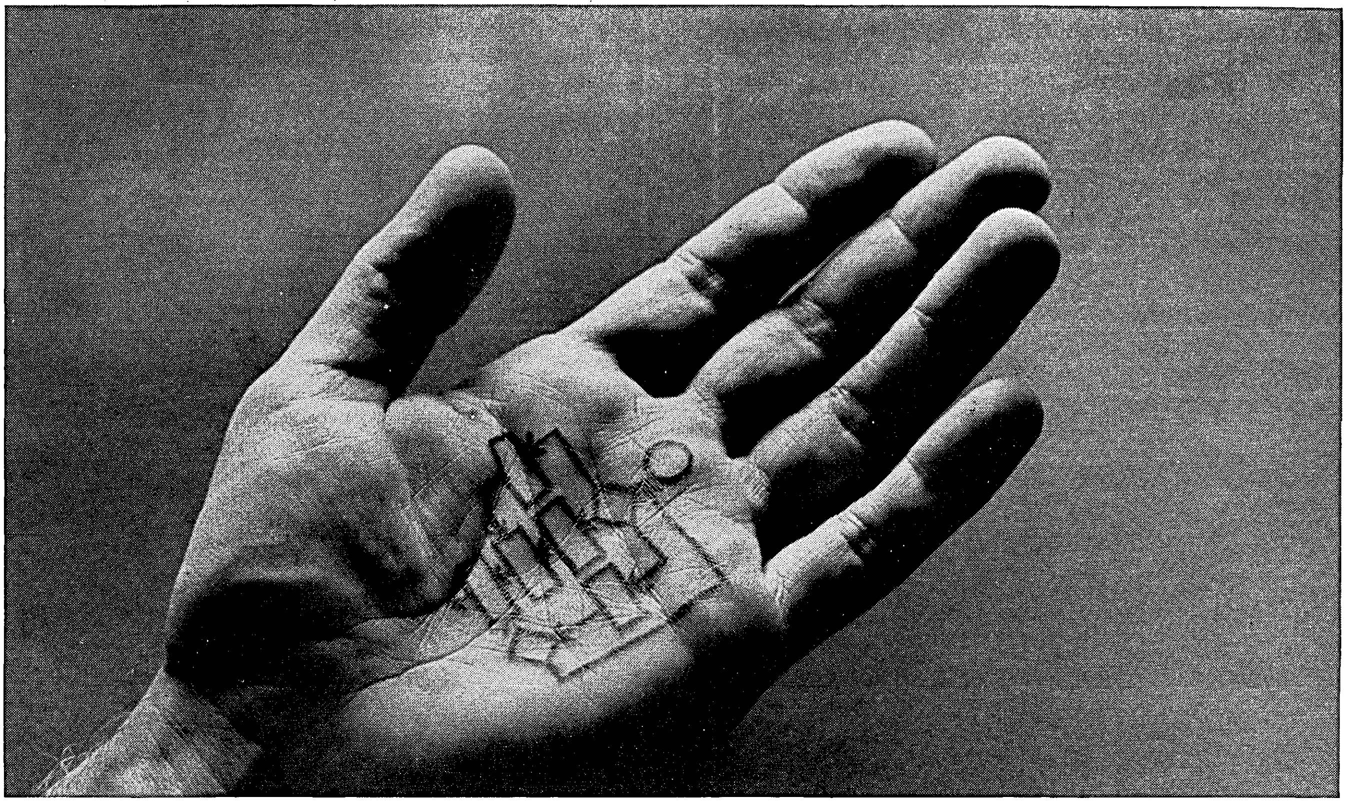
PROGRAMMERS/SYSTEMS ANALYST

Full or Part-time. Earn $10,000 to $20,000 a year. An International data systems organization desires experienced professional Systems Programmers and Analysts with many years experience on any computer hardware. We offer unequaled earnings, a great deal of personal freedom and a variety of assignments in the U S A, United Kingdom and Western Europe. Send resume or letter in complete confidence to:
Mr. Bruce Rademacher, V.P.
The Programmers' Co-op
670 North Michigan Avenue
Chicago, Illinois 60611

— OR —

Mr. J. Doyle, V.P.
Data Systems Associates, Ltd.
119 Oxford Street
London, W. 1. (England)

CIRCLE 110 ON READER CARD



Griffing, Inc.

CAREER opportunities are available within a broad scope of positions with nationally recognized leaders in Research and Development, Operations Research and Data Processing fields.

FOR EXCEPTIONAL professional and financial advancement possibilities, we invite you to explore the areas most appropriate to your experience and professional objectives.

- BUSINESS PROGRAMMERS
- SYSTEMS APPLICATIONS
- SYSTEMS PROGRAMMERS
- OPERATIONS RESEARCH
- REAL TIME SYSTEMS
- SCIENTIFIC PROGRAMMERS
- DIGITAL/LOGIC DESIGN
- SYSTEMS ANALYSTS
- SOFTWARE SYSTEMS
- MATHEMATICIANS

We have an unexcelled reputation for matching your professional capabilities and goals to the right position, junior, intermediate or senior, and for conducting negotiations on the highest ethical level. All expenses paid by our clients. Courteous, confidential attention to your inquiry. Write:

GRIFFING, INC.

Computer Staffing Consultants

519 Shoreham Bldg. Washington, D.C. (202) RE 7-4754

CIRCLE 114 ON READER CARD

HARVARD UNIVERSITY

COMPUTING CENTER

Is Seeking Experienced

SYSTEMS PROGRAMMERS

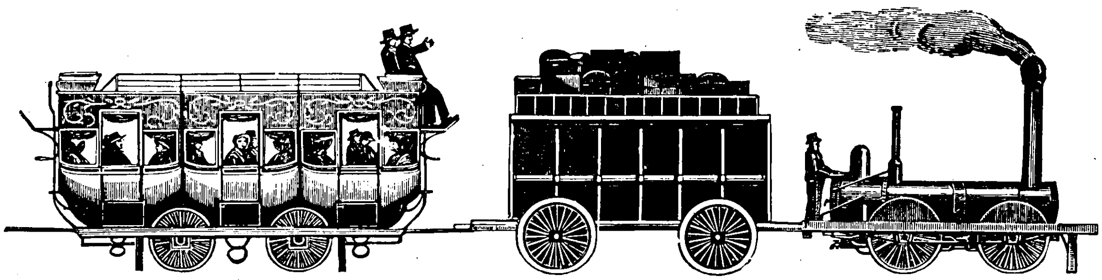
- **For Software Development on the computers we will install in the next two years. These computers range in size from the SDS 92 to the IBM 360/67 to the IBM 360/91.**
- **For Software Development and Maintenance on our operating IBM 360/50.**
- **For Software Maintenance on our two IBM 7094's.**

We offer liberal benefits, an opportunity for continuing education, and attractive salaries.

Resumes may be submitted in complete confidence; each will be acknowledged and should be addressed to W. D. Thompson, Room 635, Personnel Office, 1350 Massachusetts Avenue, Cambridge, Mass. 02138

An Equal Opportunity Employer

CIRCLE 115 ON READER CARD



COME TO AUERBACH AND WORK ON PIONEER PROJECTS

If you're a programmer, engineer, mathematician, or scientist with experience and ability in information sciences, there's a demanding (and rewarding!) assignment for you at AUERBACH Corporation.

Typical AUERBACH projects involve advanced work in data management systems, associative memory utilization, system simulation and evaluation, multi-processing systems, operating systems and digital communications.

This is the kind of work you'll find yourself thinking about at 11 o'clock at night or early Sunday morning, not because you *have* to, but because you *want* to. It's that exciting.

Positions available in Philadelphia, Washington, D. C. and New York City. Interested? Send a résumé including salary history and requirements to:

Rollin Trexler

AUERBACH **AUERBACH CORPORATION**

®

1634 Arch Street, Philadelphia, Pa. 19103

An Equal Opportunity Employer

CIRCLE 125 ON READER CARD

(Continued from page 19)

applications. Elements needed include an optical interface for the computer, the negative(s), projection optics, and mechanical selector; access time would be in microseconds, he claims. Storage capabilities plus up to 50% higher resolutions than microfilm forms enhance IR possibilities for MRP. In photo transmission, the best example of implications is that in the Mariner Mars probe, the Aeroflex system, weighing 10 pounds, would have enabled the digitized transmission to earth of 50 photos three times faster and with four times more resolution than one photo was actually transmitted.

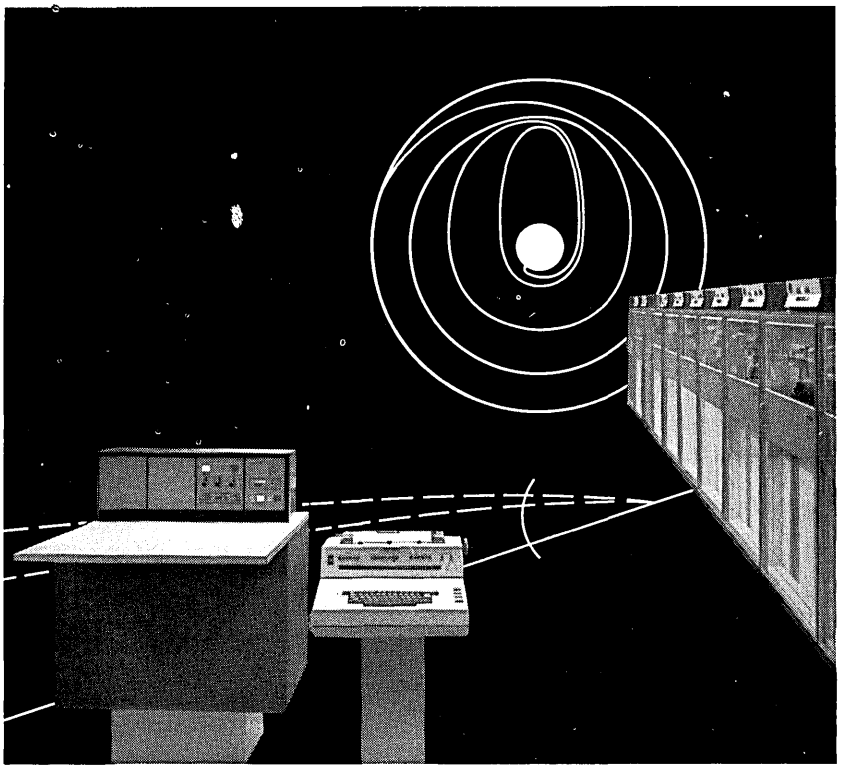
Aeroflex plans to manufacture some products based on the system, especially in the computer and information system area, will do it alone and under contract to other manufacturers. They're also open to licensing agreements.

AND THEN THERE WAS THE NINE

The epidemic of computer announcements has spread to Digital Equipment Corp., which plans to come out with three new systems before the end of the fall. The first, a medium-scale PDP-9, will be shown in operation at WESCON Aug. 23. To be offered at that time for "immediate" delivery (meaning probably 3-6 months), the 9 is said to be cheaper than comparable 16 and 24-bit systems, e.g., the CDC 1700, IBM's 1800.

RUMORS AND RAW RANDOM DATA

Information Development Co. has beaten out CSC and CUC, will provide the software for the Sigma 2, next in the SDS line. ... Latest tally reported for installed GE 625's and 35's: 72. ... Ultronic Systems has suspended their on-line municipal bond calculation service, Bondmaster, for a few months pending some system changes; they're using an RCA 3301. Meanwhile, competitor Municalc moves ahead with 16 on-line customers. ... Gerber Scientific Instrument Co., Hartford, Conn. will soon be announcing a first-of-its-kind data center for automatic artwork generation using the GSI 2000 computer-controlled drawing table and offering full programming support. ... Western Union is considering establishing an on-line service using Dept. of Commerce business facts as a data base. And we hear that four of the computers for the Fair Lawn, N.J. complex will be 1108's or 494's. Meanwhile, GE has developed a data base for industrial materials. A program called EMPIS (Engineering Materials and Process Information Service) gives names of 10,000 raw materials, 500 machine parts & their 6 million variations, 1000 possible finishes and test methods. ... Allen-Babcock Computing's time-sharing service goes on the air next month in Palo Alto. Featuring a modified 360/50, PL/I and a megabyte bulk core, it will serve 60 terminals initially, 20 of them in L.A., where another 50 is due next year. Background time will also be available at about ½ the usual rates. ... B 8500 #2, 15 megabucks worth, goes to U. of Wisconsin. ... CSC will order two 1108's, get back into the service bureau biz. Univac also cracked the college market with an 1108 order at the U. of Utah. ... IBM is making available a 360 version of the 7000 series direct-coupled system. Called ASP (Attached Support Processor), it links a /40 or /50 to a /60 or /75, allows intermixing of 7090/94 emulator and OS/360 programs. ... Due soon: Scientific Control Corp.'s fifth 24-bitter, the 655, featuring 1.75 usec cycle, one I/O channel for $27,800.



Scientific Programmers:

How would you like to tackle some far-out problems on a third generation, large-scale computer?

Fact is, most of our work is way out . . . determining orbit velocities and trajectories for interplanetary space flights, the "angle of attack" for a supersonic transport. Things like that. We've got the equipment (a new IBM Series 360 with Models 40 and 65) to do the job. Now, we need Scientific Programmers to accept the challenge.

You'll work on projects like Apollo and LEM; on a guidance system for Titan III; on avionics systems for supersonic aircraft; on guidance, navigation and control systems for land, sea and undersea vehicles; and on other projects too secret to mention here.

If you're a qualified Scientific Programmer, and meet the requirements for any of the positions listed below, send us your resumé today.

SR. SCIENTIFIC PROGRAMMERS—Responsibilities include the development of large-scale digital computer programs for orbit determination and simulation of highly complex space and missile guidance systems. B.S. or M.A. in Math or Physics, plus experience on large-scale computers required. Locations: Los Angeles and Milwaukee.

SCIENTIFIC PROGRAMMERS—Analyze and prepare computer programs for solution of engineering and scientific problems utilizing the IBM System 360. Scientific applications include design automation, missile trajectory simulation and missile flight test data reductions. Degree in Math, Physics or Engineering required. Minimum of two years' experience plus operation knowledge of large-scale computers. Locations: Milwaukee, Los Angeles, Boston, Houston, New York and Cape Kennedy.

PROGRAMMER (SCIENTIFIC/REAL TIME)—Analyze and develop digital computer programs for solution of engineering problems related to inertial navigation systems and components. B.S. in Math, Physics or E.E. required, with experience in machine language and Fortran. Locations: Boston and Milwaukee.

SEND RESUMÉ TO: R. W. Schroeder, Dir. of Scientific & Professional Employment, Dept. #5753-DM, AC Electronics Div., Milwaukee, Wis. 53201. Your resumé for one of the above positions will be reviewed immediately, and a reply made within a matter of days.

AC ELECTRONICS
DIVISION OF GENERAL MOTORS
AN EQUAL OPPORTUNITY EMPLOYER
GM

CIRCLE 117 ON READER CARD

LET A PROFESSIONAL HELP YOU MAKE YOUR PROFESSIONAL CAREER GO

•
•
•

AND GROW!

And that's the reason top companies get top executives and EDP Specialists through Brentwood. Where professionals handle professionals. Where you'll talk to men who talk your language . . . men with degrees in engineering, physics, personnel practice. Men skilled in matching the right man and the right job . . . in the best interest of both! Let us help you put grow-power in your career! Start by sending us a resume . . .

BRENTWOOD

Where Professionals Place Professionals

COMPUTER CAREERS

- ☐ Applied Systems
- ☐ Compilers
- ☐ Assemblers
- ☐ Automatic Languages
- ☐ Utility
- ☐ Commercial Programming
- ☐ Scientific Computation & Analysis PhD in — Numerical & Mathematical Analysis
- ☐ Real Time — Operational
- ☐ Operations Research
- ☐ Systems Design
- ☐ Information Retrieval
- ☐ Diagnostics
- ☐ Digital and Logical Design

Fees are paid by the companies we serve.

Write in confidence, or call collect: Mr. F. X. Jones (201) MArket 2-0915

BRENTWOOD
PERSONNEL ASSOCIATES
786 BROAD ST. NEWARK, N. J.

CIRCLE 119 ON READER CARD

advertisers' index

000000001	000000010	000000011	000000100	000000101	000000110	000000111	000001000
000001001	000001010	000001011	000001100	000001101	000001110	000001111	000010000
000010001	000010010	000010011	000010100	000010101	000010110	000010111	000011000
000011001	000011010	000011011	000011100	000011101	000011110	000011111	000100000
000100001	000100010	000100011	000100100	000100101	000100110	000100111	000101000
000101001	000101010	000101011	000101100	000101101	000101110	000101111	000110000
000110001	000110010	000110011	000110100	000110101	000110110	000110111	000111000
000111001	000111010	000111011	000111100	000111101	000111110	000111111	001000000
001000001	001000010	001000011	001000100	001000101	001000110	001000111	001001000
001001001	001001010	001001011	001001100	001001101	001001110	001001111	001010000
001010001	001010010	001010011	001010100	001010101	001010110	001010111	001011000
001011001	001011010	001011011	001011100	001011101	001011110	001011111	001100000
001100001	001100010	001100011	001100100	001100101	001100110	001100111	001101000
001101001	001101010	001101011	001101100	001101101	001101110	001101111	001110000
001110001	001110010	001110011	001110100	001110101	001110110	001110111	001111000
001111001	001111010	001111011	001111100	001111101	001111110	001111111	010000000
010000001	010000010	010000011	010000100	010000101	010000110	010000111	010001000
010001001	010001010	010001011	010001100	010001101	010001110	010001111	010010000
010010001	010010010	010010011	010010100	010010101	010010110	010010111	010011000
010011001	010011010	010011011	010011100	010011101	010011110	010011111	010100000
010100001	010100010	010100011	010100100	010100101	010100110	010100111	010101000
010101001	010101010	010101011	010101100	010101101	010101110	010101111	010110000
010110001	010110010	010110011	010110100	010110101	010110110	010110111	010111000
010111001	010111010	010111011	010111100	010111101	010111110	010111111	011000000
011000001	011000010	011000011	011000100	011000101	011000110	011000111	011001000
011001001	011001010	011001011	011001100	011001101	011001110	011001111	011010000
011010001	011010010	011010011	011010100	011010101	011010110	011010111	011011000
011011001	011011010	011011011	011011100	011011101	011011110	011011111	011100000
011100001	011100010	011100011	011100100	011100101	011100110	011100111	011101000
011101001	011101010	011101011	011101100	011101101	011101110	011101111	011110000
011110001	011110010	011110011	011110100	011110101	011110110	011110111	011111000
011111001	011111010	011111011	011111100	011111101	011111110	011111111	100000000
100000001	100000010	100000011	100000100	100000101	100000110	100000111	100001000
100001001	100001010	100001011	100001100	100001101	100001110	100001111	100010000
100010001	100010010	100010011	100010100	100010101	100010110	100010111	100011000
100011001	100011010	100011011	100011100	100011101	100011110	100011111	100100000
100100001	100100010	100100011	100100100	100100101	100100110	100100111	100101000
100101001	100101010	100101011	100101100	100101101	100101110	100101111	100110000
100110001	100110010	100110011	100110100	100110101	100110110	100110111	100111000

Boeing Needs 100111000 Computer Technology Specialists

That's right—there are presently some 312 positions in various levels for both analog and digital engineers and programmers. If you are a qualified graduate in engineering, a physical science, mathematics, production management or business administration, and interested in advancing your career, check these Boeing assignments:

Manufacturing & Business Data Processing Systems—Assignments involve programming in such areas as production control, manpower forecasting, finance, facilities, quality control, material inventory control and management information systems.

Engineering Computing Systems—Work involves programming engineering applications (structural analysis, digital simulation, fluid dynamics, propulsion systems analysis, etc.) with emphasis on the integrated system approach. Use of geometric mathematical models is also involved.

Computer Methods & Standards—Responsibilities include: development of computer software, establishing computer standards, evaluation and selection of digital computer equipment.

Analog Computation & Flight Simulation—Assignments include developing and applying simulation techniques to the solution of complex aircraft problems, using such techniques as adaptive design, mathematical models and hybrid methods.

Systems & Operations Research—Systems Research positions involve studying and developing analytical models in support of technical management for evaluation of alternate airplane or system design concepts. Operations Research assignments include research in management sciences involving decision-making and operational problems, and assisting in the formulation and solution of these problems.

These positions offer an unprecedented opportunity to advance your career with Boeing in Seattle, made possible in part by Boeing's $3 billion company backlog. Another growth and stability factor is the recent announcement of the 747 jetliner, which will be the largest commercial jet in the history of aviation, seating up to 490 passengers.

To investigate these career assignments, please send your resume today to: Mr. Arthur Widmark, Commercial Airplane Division, The Boeing Company, P.O. Box 707-CCY, Renton, Wash. 98055.

BOEING

COMMERCIAL AIRPLANE DIVISION
SUPERSONIC TRANSPORT DIVISION

An equal opportunity employer

CIRCLE 121 ON READER CARD

advertisers' index

the forum

The Forum is offered for readers who want to express their opinion on any aspect of information processing. Your contributions are invited.

INFORMATION PROCESSING . . . A BIT EXPENSIVE?

On April 25-29 representatives of the standards organizations of nine nations met in Paris to battle over one of the tiniest things in existence — one single information bit.

This particular bit is important, because it's the one required to make the 7-bit ISO (International Standards Organization) character code match the 8-bit environment of most of the computers and mag tape units in use. And it's the bit needed to fill out the eight tracks capable of carrying information on the new ASCII-conforming nine-track tapes. The decision made in Los Alamos, September 1956, that the IBM Stretch would have a 64-bit word to handle eight 8-bit characters may not have been based on much more than intuition, but most of us felt a useful magic in powers of two. This carried on through IBM's plans for an 8000 series and eventually into their System 360.

At the root of the argument over where to put this eighth bit is 360 hardware. Communications people and users have said that the 128 combinations of the 7-bit ISO code gave all the characters which could be defined safely now. With this statement, heads went into the sand and were unable to hear IBM protesting that they had to manufacture 8-bit machines, particularly for binary and packed numeric considerations. Perhaps this short-sightedness by others contributed to IBM's selection of EBCDIC as the basic System 360 code.

This problem is very difficult. It took the experts four days to understand each other in Paris.

Although blended in hardware, there are really two separable problems:

1) Mapping the 7-bit ISO code into what is called an 8-bit environment, or format
2) Assigning those 8-bits and parity to standard 9-track magnetic tape

The critical problem is that of environment, which applies to much more than magnetic tape (on which the problem first arose).

In this near vacuum, IBM made an early choice of bit format . . . they had to make *some* choice. It involved duplicating the 7th bit and inserting it between the 5th and 6th bits, so that bits 6 and 7 were displaced to become bits 7 and 8 of the environment.

Recently the heads came out of the sand. Everyone except IBM and RCA decided they didn't like IBM's choice; they wanted to simply add the 8th bit as zero. IBM's method was difficult for IBM to defend, both for lack of strong arguments and because they had made a deliberate choice of non-preference for the ISO code. After an overwhelming vote, the 8th bit as zero became the U.S. position (for ASA X3) for the ISO/TC97/Subcommittee 2 Paris meeting.

However, the U.S. maintained the environment-to-track assignment of 360 units. This was the trouble. No one worried or denied that under these conditions IBM could write binary or packed numeric tapes which could be read perfectly by equipment designed to the proposed ASA pattern. Just one simple problem, though . . . they read in the wrong numbers! Thus every magnetic tape would have to be labelled physically to the end of data-processing time as either IBM or ASA, and translated on either end. This problem extends to any media using these environments.

I feel the U.S. position on track assignment was unsupportable. It is likely that X3 might not have sponsored this had there been more time to study adequately a surprisingly simple compromise proposed by Eric Clamons to ECMA, which supports the ASA environment. He suggested adopting the ASA environment and letting the environmental bits-to-track assignment for the ISO magnetic tape standards be wherever IBM hardware puts them.

There was nothing sacred about the existing track assignment. Manufacturers who might have implemented it for ISO code would not have done so in large volume, nor is it difficult to change the interface wiring. IBM could not object because we're given to understand there is no ASCII software for the 360. Reliability arguments can not be used easily against this compromise; the bits to be reassigned are in track positions not previously considered dangerous to reliability. Europeans don't believe that the present jumbled bit assignment on magnetic tape has merit anyway.

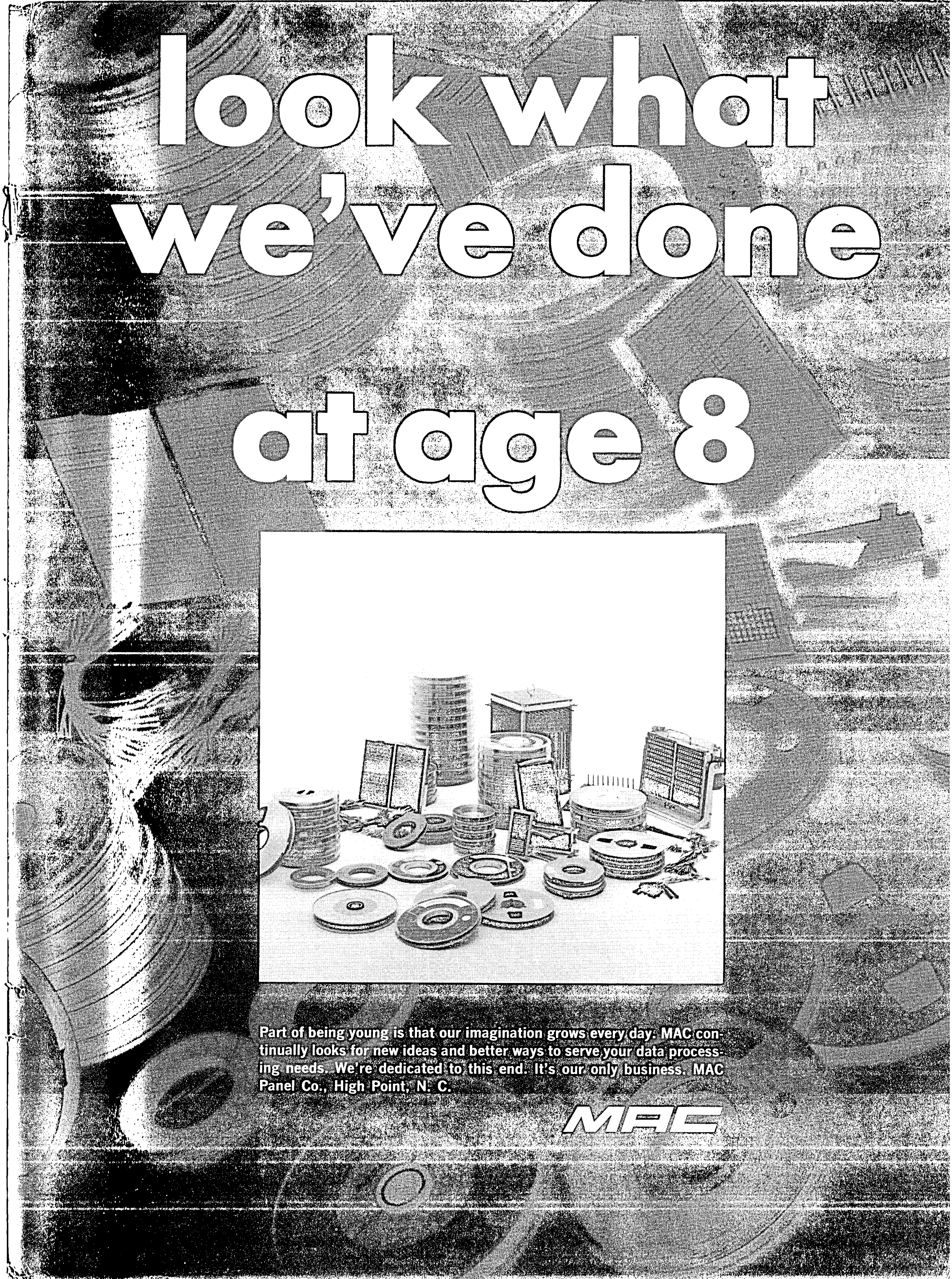
As a result of the Paris meeting the revised draft standard for 9-track tape contains all three options; one must be chosen. The ECMA option is unquestionably superior, for it satisfies the real reasons behind the other two proposals. It satisfies the large amounts of existing IBM and RCA hardware. It satisfies X3's desire for a sensible expansion method. How then can we move to this compromise as the national standards bodies address themselves to selecting one of these three options?

The first necessity is to create an environment standard entirely separate from those for magnetic tape, discs and other mass storage. The revised magnetic tape draft standard should then reference this environment standard. This will rectify the present ASCII standard, which erroneously excludes binary and packed numeric considerations. It would be inadvisable for X3 to yield to IBM hardware influence without first getting separate agreement on environment. Since full translation is required between EBCDIC and ISO code, in either the IBM or ASA environment, IBM can hardly use the EBCDIC environment to countermand the ASA choice in environment.

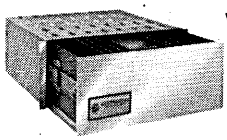
Both ASA and IBM have justifiable arguments for their positions, but the user will suffer unless both groups compromise. Now is the time for statesmanship in the information processing world.

— R. W. BEMER

FOR MAC PANEL CIRCLE 2 ON READER CARD→


look what we've done at age 8
Part of being young is that our imagination grows every day. MAC continually looks for new ideas and better ways to serve your data processing needs. We're dedicated to this end. It's our only business. MAC Panel Co., High Point, N. C.
MAC

Now you can throw out less versatile storage techniques. A Ferroxcube core memory costs as little as $1,190.



We haven't been a leading core memory manufacturer all these years for nothing. We learned how to mass produce core memories and thereby sell them to you at prices competitive with less reliable, less versatile storage techniques.

Aside from price (we'll get back to that in a moment), consider the advantages of core memory systems. Speed. Random access. Non-dissipative. And they're non-volatile. We could go on and on. We won't because you've probably always wanted to design your system around core storage anyway. Only the cost stopped you.

Now you can buy a Ferroxcube 128 x 8 core memory system complete with stack electronics, data register and timing for a paltry $1,190. That's our FX-12. Its capacity ranges up to 512 x 8. The FX-14 picks up there and goes on to 4,096 x 32. Prices are comparably low. Moreover, the FX-14 is available with almost any choice of interfacing elements. Buy only what you need to interface with what you already have.

In brief, Ferroxcube core memories make both functional and economic sense. Write or call for Bulletin M661.

Ferroxcube

FERROXCUBE CORPORATION OF AMERICA
Saugerties, New York 914-246-2811

Boston 617-899-3110 · Chicago 312-261-7880 · Dallas 214-255-0441 · Los Angeles 213-837-1484 · Minneapolis 612-888-4681 · New York Area 201-267-5888 · Phoenix 602-265-1792 · Philadelphia 215-667-4685 · Washington, D.C. 703-893-4900

CIRCLE 3 ON READER CARD