The best new idea in core memory packaging is a big one:

...and you can access it in 500 nanoseconds, full cycle it in 1.5 microseconds.

If you're designing digital systems for computing, automatic control, data communications or the like, you'll be glad to hear we've found a way to make your life easier. And your equipment more reliable.

Ampex RF core memories have improved the whole concept of memory system packaging. The large PCBA board you see above, dotted with all-silicon discrete and integrated circuits, is the nucleus of this new family of memory systems.

Peak performance and reliability at minimal cost are the major benefits you receive. MTBF for several sizes of the RF, for example, exceeds 5000 hours. Maintenance is simple on this wide-open PCBA.

The Ampex RF family offers a range of capacities from 2,000 to 590,000 bits, word lengths from 4 to 72 bits. Commonality of the three basic systems minimizes your training and spares logistics. The RF's modular packaging brings additional benefits: compactness—and a capability for expanding capacity.

The extra plus you receive is speed.

Access time is 500 nanoseconds; half-cycle, 850 nanoseconds; full cycle, 1.5 microseconds.

All units of the RF family are rack-mountable. Prices are low. We'll be glad to send you complete information.

Write Ampex Corporation, 401 Broadway, Redwood City, California 94063.
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.
More than 500 scientists have one or another of the PDP-8 family computers in their laboratories. Physicists, chemists, life scientists, social scientists, mathematicians. For such a small family of machines, that's an enormous family of users.

There are good reasons, of course.

Scientists like to talk to each other. They like to exchange programs and ideas with other scientists — not accountants.

Then, too — scientists like to be able to change their minds. Family-of-8 computers are approachable, variable, easy to talk to, personal machines. They are easy to re-instruct halfway through an experiment, and they respond. For those who know how an investigation will begin — but not necessarily how it will end — they are ideal.

That's also why so many scientific instrument and systems makers build in one of the Family-of-8. That, and the proven reliability, and the price.

Lastly, there are PDP-8 type computers for almost all types of investigations and for greatly varying budgets. All use the same set of instructions. All use the extensive PDP-8 programs. When we say they are compatible machines, we don't just mean format compatibility. We mean programs. All programs. All instructions. Without exception and without modification.

It started with the PDP-8 itself, the most popular computer ever made for the scientific community. 4K memory, expandable. 12 bit word. 1.5 µsec cycle time. Fortran. Approachable. 30-day delivery of basic machines is now possible. $18,000. A ruggedized, portable version is also available, and, of course, expanded versions, too.

The new $10,000 PDP-8/S is a near cousin. We call it the SMALL-8 because of its compact size. But it has the same general purpose, same real-time on-line computation, same size memory, same size word, same instructions as the PDP-8. Same Fortran. Same everything, in fact, except physically smaller, slower (36 µsec add time), and less expensive.

The LINC-8 is an ingenious combination of two computers: the famous MIT inspired LINC, and the PDP-8. Two complete software packages. Built-in A to D conversion. Built-in oscilloscope display. Dual magnetic tape unit. Relay buffer. It is a completely integrated laboratory data handling system. $38,500.

The DISPLAY-8 is a display terminal to large computers. It is the only standard display terminal with a built-in small computer as an integral part. The PDP-8 is the buffer to a large machine or a generator for the display when on its own. The DISPLAY-8 proves how easy it is to use small computers on the business end of time sharing. $55,000 to $150,000.

And modules. DIGITAL is one of the world's leading suppliers of logic modules, each electrically, physically, and logically compatible with each other — and with each DIGITAL computer. For interfacing. Many scientists consider this an important reason for buying DIGITAL'S computers. Module prices start at $4.75.

A 350-page handbook describes the 101 FLIP CHIP™ modules and what you do with them. A 500-page Small Computer Handbook contains a computer primer and full descriptions of the Family-of-8 computers. Write for either, or both.

And if you have bigger problems than these, we have bigger answers. PDP-8. PDP-9 Multianalyzer. And the soon-to-be-here PDP-10.

PDP-8 computer family: approachable, friendly, personal. $4.75 to $150,000.
Now...save programming steps on every plot

Before: 450 program steps. Now: 300
Before: 1000 program steps. Now: 700
Before: 600 program steps. Now: 500
Before: 54 program steps. Now: 14

With the new Milgo Digital Plotting System, you output only the end points on lines to 42" long—the plotter does the rest...with no deterioration of the plotter's normal dynamic accuracy. There is never a second tier subroutine to compute the length of a line! Result: reduced computer programming, reduced computer output time, reduced plotting time.

The Milgo DPS-6 includes a choice of off-line readers, plus either a vertical or horizontal plotter. And the system provides for all standard digital inputs plus straight analog. It accepts magnetic tapes recorded in either gapped, gapless or long record format. An optional core storage buffer allows up to 10,800 bits between gaps.

Send for a brochure-full of additional features on the Milgo DPS-6. Write or call Milgo Electronic Corporation 7620 N.W. 36th Avenue, Miami, Florida 33147.

SEE IT OPERATE AT FJCC

CIRCLE 6 ON READER CARD
A real-time, time-sharing systems computer

and a way to measure volts on 5 nanosecond pulses-

If you're in data acquisition, you can get either or both from Raytheon Computer.

Using a new disc-oriented, real-time monitor, the Raytheon 520 can simultaneously acquire and process real-time data, control a data system from up to 20 remote display-control stations and compile, assemble and execute FORTRAN IV and FLEXTRAN programs on a job or batch basis. And the new NANOVERTER™ input device for high speed data systems includes a remarkable 5-nanosecond sampling device, and a 12-bit analog-to-digital converter for ± 2% accuracy at 45KC throughput.

With the monitor the 520 can respond to real-time interrupts, transfer data to core or disc via a direct memory access channel, transfer programs from disc to main memory and then shunt processed data to disc, magnetic tape, printer or other storage or output device.

The 520 monitor makes use of two unique features—direct memory access and dynamic memory protect including a memory map.

Direct memory access switches main memory in four micro­seconds between external devices—either peripheral equipment or another computer—without interrupting the 520 central processor.

Memory protect prevents inadvertent loss or output of stored real-time or batch processing data during interrupt program runs or job program compiling, assembly or execution. A special memory map keeps track of occupied and available memory locations in 2000-word segments and automatically assigns available memory to new programs.

Besides FORTRAN IV and FLEXTRAN, 520 software includes Real-Time FORTRAN IV. This separate and distinct processor is based on Raytheon's exclusive one-pass FORTRAN IV which is language compatible with the widely-used FORTRAN IV (version 13). Real-time FORTRAN IV simplifies the programmer's handling of real-time problems with features like RECURSIVE, PRO­TECT, CONNECT AND COUNT TIME Statements, and useful debugging aids like TRACE mode, Memory Map and DUMP.

The 520's one microsecond main memory boosts data acquisition word transfer rates to IMC. Besides the NANO­VERTER, other real-time systems hardware includes the Multidevice Controller for interfacing as many as 512 external data systems devices and establishing up to 1024 levels of priority interrupt, and the unique Multiverted,™ which combines up to 96 channels of IC multiplexing, a 50-nanosecond sample and hold amplifier and analog-to-digital conversion in a single 5 1/4 inch chassis.

The Raytheon 520 is currently being specified and delivered for real-time and hybrid systems in the $100,000 class and up. Find out why by writing today for Data File C-132. Raytheon Computer, 2700 S. Fairview Street, Santa Ana, California, 92704.
Support!

Usually, when you buy a reel of precision magnetic tape from somebody, they thank you and wish you lots of luck.

When it comes to using it, you're on your own.

Not so at Computron. We have a selfish interest in making sure that Computape gives you a maximum performance in every application. That's why qualified data recording engineers are available, in every Computron regional office across the country, to give practical, technical advice and assistance to Computape users.

We support Computape users all the way... and vice versa.

We would like to tell you more about Computape and Computron engineering support. Write today for the full story. CIRCLE 8 ON READER CARD

Visit our exhibit at Fall DPMA—Booth No. 8-9
22 THE AMTRAN SYSTEM, by Robert N. Seitz, Juris Reinfelds, Paul L. Clem Jr., and Lawrence H. Wood. Facilitating computer use by non-programmer scientists and engineers, new conversational system also provides programmers with numerical analysis and Fortran-type programming operations.

28 PERPETUAL USER STUDIES, by Lauren B. Doyle. Without much better data on what users do with the information they retrieve, planning is handicapped for management of information on a national scale.

31 PRODUCTIVE GRAPHIC DATA PROCESSING, by William J. Quirk. Boeing-Huntsville has made effective use of graphics for man/machine interaction, finding a suitable division of labor between engineer and computer.

33 CREDIT CHECKING BY COMPUTER, by William Cole. Credit-granters in a 4-county region are supplied appropriate histories of their applicants through a local phone number and a disc-oriented 1410.

41 THE TEXT90 SYSTEM, by V. S. Mercer, F. Eugene Franklin, and R. S. Lowenstein. Cutting lead time in publishing, system speeds documentation, allows writers to incorporate changes with ease.

49 A PUT-LIST FOR ENHANCED COMMUNICATION, by Sam A. & Anne H. Rosenfeld. The new lexicographers bridge the technico-linguistical chasm.

51 PRECISION MAGNETIC TAPE, by John M. Ricci. With emphasis on the base materials used for magnetic tape, the author explains in detail the nature of the medium, includes tables for exploring the cause of dropouts.

65 BYPASSING PROFESSIONAL PROGRAMMERS, by Benson H. Scheff. A user-oriented programming system (DIMATE) aids the engineer in directing operation of his tests on automatic test equipment.


91 THE 1966 FALL JOINT COMPUTER CONFERENCE. General information on the meeting-by-the-bay includes list of exhibitors, summaries of technical sessions.

123 COMPUTER CHARACTERISTICS, by Roger T. Baust.

automatic information processing for business industry & science
Size is allowable only if the compiler is fast. This one, from Digitek, is. Here is an all core FORTRAN IV G Level compiler produced for IBM for their System 360 product line with 40K bytes total size / high compilation speed / good object code efficiency / highly optimized subscript calculations / efficient use of multiple registers / multiple in line diagnostics / advanced debugging aids / predictable performance / excellent vehicle for future development / that's big news.
Our mistake. This FORTRAN IV compiler was produced for Compagnie Europeene D'Automatisme Electronique for the SDS 92 product line in Europe. Therefore, we should say, petit. Only 8K 12 bit words of core are required / no backup storage required / one pass / IBM FORTRAN IV Version IX / most arbitrary restrictions eliminated / no reserve words / in line symbolic diagnostics / small object program size / compile and execute 300 statement programs / good compile and execution speeds / Quel fortune.
for ALL of your plastic card needs

The increasing demand for plastic credit and identification cards can only be met with automated equipment that produces cards of all types in volume quantities, rapidly, and at a low cost per unit.

Only Dashew can provide this service. The Dashew 465 Databosser® is the world's fastest automatic embossing, stamping, and code punching system. Utilizing punched tabulating cards as input, the 465 can selectively emboss, print, and code punch plastic cards containing varying information, and output them in quantities up to 3000 per hour.

Dashew's total capability is unmatched in the industry; your plastic card problems can be handled from design to mailing. This single-source responsibility means reduced handling, maximum security of records, and greater speed and efficiency.

No matter where you are, Dashew is only a 'phone call away. Service centers are conveniently located in Los Angeles, Chicago, and Toronto.

Remember — Dashew, and only Dashew, is your one complete source for plastic card service!

---

**Calendar**

<table>
<thead>
<tr>
<th>DATE</th>
<th>TITLE</th>
<th>LOCATION</th>
<th>SPONSORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct. 27-28</td>
<td>ECHO Meeting</td>
<td>American Hospital Assn.</td>
<td>Electronic Computing Hospital Oriented</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chicago, Ill.</td>
<td></td>
</tr>
<tr>
<td>Oct. 31-Nov. 3</td>
<td>Users' Meeting</td>
<td>Vacation Village Hotel</td>
<td>UARIDE Automatic Information Display Equipment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>West Mission Bay</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>San Diego, Calif.</td>
<td></td>
</tr>
<tr>
<td>Nov. 2-4</td>
<td>Electronics Research &amp; Engineering Meeting</td>
<td>Sheraton-Boston Hotel Boston, Mass.</td>
<td>IEEE New England</td>
</tr>
<tr>
<td>Nov. 4-5</td>
<td>Users' Meeting</td>
<td>Lawrence Radiation Labs.</td>
<td>DECUS Digital Equipment Users Society</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Laboratory Auditorium Berkeley, Calif.</td>
<td></td>
</tr>
<tr>
<td>Nov. 7</td>
<td>Workshop on User Groups</td>
<td>Del Webb Town House San Francisco, Calif.</td>
<td>ACM, JUG, and CAP Assns.</td>
</tr>
<tr>
<td>Nov. 7-9</td>
<td>Conference: Automatic Support Systems</td>
<td>Colony Hotel Clayton, Missouri</td>
<td>IEEE</td>
</tr>
<tr>
<td>Nov. 8-10</td>
<td>Fall Joint Computer Conference</td>
<td>Civic Center San Francisco, Calif.</td>
<td>AFIPS</td>
</tr>
<tr>
<td>Nov. 14-17</td>
<td>Course: Transmission, Display of Management Information</td>
<td>Twin Bridges Marriott Motor Hotel Washington, D.C.</td>
<td>American Univ,</td>
</tr>
<tr>
<td>Nov. 15-17</td>
<td>Symposium: Ship Control Systems</td>
<td>Navy Marine Engineering Laboratory Annapolis, Md.</td>
<td>U. S. Navy</td>
</tr>
<tr>
<td>Nov. 15-18</td>
<td>Users' Meeting</td>
<td>Americana Hotel Miami Beach, Fla.</td>
<td>GUIDE International</td>
</tr>
<tr>
<td>Nov. 17-18</td>
<td>Conference: Computers in Humanistic Research</td>
<td>Texas A&amp;M Univ. College Station, Texas</td>
<td>IBM Corp. &amp; Texas A&amp;M Univ.</td>
</tr>
<tr>
<td>Nov. 28-30</td>
<td>Users' Meeting</td>
<td>Jung Hotel New Orleans, La.</td>
<td>COMMON</td>
</tr>
<tr>
<td>Dec. 5-6</td>
<td>Users' Exchange Meeting</td>
<td>Room 158 Matomic Bldg. Washington, D.C.</td>
<td>Transportation Planning Computer Users' Group</td>
</tr>
</tbody>
</table>

---

**Dashew Business Machines**

Santa Monica — 2219 Main Street 213-392-3984
Chicago — 319 North Albany Street 312-533-1400
Toronto — 90 Thorncliff Park Drive 416-421-9585

CIRCLE 90 ON READER CARD
Statement Service Co. Uses Addressograph® Methods to Increase Clerical Output 1/3 to Save Valuable E.D.P. Machine Time to Reduce Form Costs

"The use of Addressograph methods has increased clerical productivity by at least one-third", reports Mr. Wylie Adams, President of Statement Service Co., Los Angeles. Their services include computation of earnings, writing checks, maintaining payroll records and tax reporting. Mr. Adams gets optimum performance from his electronic accounting machines because he uses an Addressograph machine. This Addressograph machine automatically imprints each client's name, address, the bank name, and MICR encodes bank and account numbers. Single continuous forms of blank checks are used for all clients, eliminating the need to change forms. The result? Major savings of labor and the cost of forms. And valuable E.D.P. machine time is saved, providing more earning power for the company. And Addressograph methods need only one easily trained operator. Increasing your E.D.P. output is a good reason to call your nearby Addressograph Representative listed in the Yellow Pages. Or write Addressograph Multigraph Corporation, Department T-6640, 1200 Babbitt Road, Cleveland, Ohio 44117.

Addressograph
DIVISION OF
ADDRESSOGRAPH MULTIGRAPH CORPORATION

October 1966
machines that make data move

HOW TO COLLECT, INTEGRATE, AND DISTRIBUTE DATA

If anyone symbol can represent the rapid changes of the "sizzling sixties," it's the computer. Data processing has won not only wide acceptance as a vital function of efficient business operations, but is growing more sophisticated with greater reliance on real-time operations.

In turn, this reliance on real-time processing has placed renewed emphasis on data communications. Data must be available quickly for management to make timely, accurate decisions. And, regardless how sophisticated your data system may be, Teletype sets remain the simplest, most reliable and least costly terminal equipment for collecting, integrating and distributing data.

The integration of communications within data processing systems has helped solve many business problems by:

- Assuring management of adequate, timely information to make accurate decisions,
- Eliminating costly errors caused by duplicate paperwork,
- Speeding distribution by cutting costly paperwork,
- Reducing customer complaints,
- Enabling management to communicate quickly with remote computer centers.

Getting data in time for decisions

Nothing can be as useless to you as information that arrives too late. Wrong decisions are made. Production is slowed. Deliveries are late. Customers are dissatisfied or lost. Yet, none of these situations need ever exist.

Using Teletype machines for communications within a data processing system assures you of getting information where you need it - when you need it. You'll be able to make better informed, more timely decisions that could spell the difference between profit and loss.

This problem faced a New Jersey food processor, who had been receiving sales and inventory statistics by mail from its two branch offices. By the time these reports were processed, the information was too old to use in reaching important management decisions. The processor had Teletype ASR (automatic send-receive) sets installed at all locations. Now, daily statistics are received in minutes and processed into up-to-date reports. This reduces inventory costs and enables the processor to close its books eight days earlier each month.

Getting data in time for decisions

Nothing can be as useless to you as information that arrives too late. Wrong decisions are made. Production is slowed. Deliveries are late. Customers are dissatisfied or lost. Yet, none of these situations need ever exist.

Using Teletype machines for communications within a data processing system assures you of getting information where you need it - when you need it. You'll be able to make better informed, more timely decisions that could spell the difference between profit and loss.

This problem faced a New Jersey food processor, who had been receiving sales and inventory statistics by mail from its two branch offices. By the time these reports were processed, the information was too old to use in reaching important management decisions. The processor had Teletype ASR (automatic send-receive) sets installed at all locations. Now, daily statistics are received in minutes and processed into up-to-date reports. This reduces inventory costs and enables the processor to close its books eight days earlier each month.
resulting from errors caused by duplicating data from one department to another. You can eliminate these situations with a system that speeds the handling and processing of data by including Teletype communications equipment.

Sales order information can be prepared on Teletype machines, reviewed, and transmitted directly to Teletype receiving sets in other departments. In addition to sending each department accurate information, Teletype sets can selectively “edit” this information. Thus, such data as order numbers can be sent to all departments, while cost data is directed only to accounting, billing and management departments.

This is what a metal products manufacturer did to cut order processing time 75 percent. By using Teletype ASR sets, minutes after an order comes in the data is sent to shipping and production departments—each receiving only the data it needs. A few of the resulting benefits include in-stock items shipped the same day, production orders scheduled three to seven days faster, overtime reduced, and errors greatly reduced.

Moving inventory faster Many companies are finding that profits are being eaten away by high inventory and distribution costs. They often find themselves having to justify high inventory on the grounds it’s needed to meet fluctuating customer requirements.

Yet, other companies have cut inventory costs while keeping a larger

selection of stock on hand. They have learned that an effective data communications system eliminates inventory that stands idle waiting for slow-moving paperwork. By using Teletype equipment to link business machines with existing channels of communications, they are provided with instant, accurate data collection, integration, and distribution. Thus, they can handle a larger volume of business faster with more efficiency and less error.

Due to the rapid decay of critical radioactive pharmaceuticals, a national drug company had a serious inventory problem. To solve it, the firm had Teletype machines installed at all of its 26 branches to provide the necessary speed, efficiency and written verification required to plan production and delivery of these drugs. Now orders are instantly received by a Teletype set, and prepared, packaged and shipped almost immediately.

Reducing customer complaints Today, customer service is often the deciding factor in who gets the order. Yet, rapid expansion has greatly strained the capacities of many companies to properly service their customers. This is why computers and data communications have become so important in speeding the order processing, production and shipping operations. And, regardless of the distance, Teletype equipment plays an important role in the gathering and forwarding of information needed for fast service.

Many banks are relying on data communications equipment to improve the efficiency of their customer services. A midwestern bank uses a Teletype ASR set to transfer funds to notify customers when loan payments are due, to speed transmittal of correspondence, and for many other related functions.

Solving your communications problems There are many other applications in which Teletype equipment helps improve business operations, such as using Teletype sets to link companies to a remote computer center on a time-sharing basis. You can see why Teletype equipment is made for the Bell System and others who require reliable, low cost communications.

Our brochure, “WHAT DATA COMMUNICATIONS CAN DO FOR YOU,” further explains how an effective data communications system can cut your costs while building your profits. To obtain a copy, contact: Teletype Corporation, Dept. 81K, 5555 Touhy Avenue, Skokie, Illinois 60076.
an operating olrt
Sir:
In the July issue (p. 83), you report Dick Brandon's comment that any online real-time systems planned for operation by 1970 must be in the first stages of implementation now. Your readers might be interested in knowing that American Motors' OLRT system was conceptualized in April 1963 and put on the air in October 1964.
I. Stephan Bloch
American Motors Corporation
Milwaukee, Wisconsin

sub-usec compacts
Sir:
In the August issue (p. 79), the SDS Sigma 2 computer was featured as the only machine in its competitive field to have a sub-usec cycle time. We take exception to that statement. The Advance 6130, mentioned in that group, has a 900-nanosecond cycle time—equal to that announced for the Sigma 2. This, however, is not the minimum time attainable.
J. O. Paivinen
ASI Computer Division
Electro-Mechanical Research Inc.
Minneapolis, Minnesota

management systems
Sir:
Robert V. Head's ill-tempered attack (August Forum, p. 124) on Professor John Dearden for his Harvard Business Review article (May/June '66) contributes little to the subject of real-time management information systems. While Professor Dearden's views were highly controversial, they were neither "crude" nor "grumpy."

Mr. Head seems to have a penchant for confusing noise with signal. One recalls that his excessive enthusiasm for the checkless society (March, p. 22, and May, p. 13) led him to feel that the views of the Messrs. Watson and Sarnoff represented unbiased support for his position on that subject.
If DATAMATION feels it is publishing quality articles, it ought to have its Head examined.
Charles Block
Chase Manhattan Bank
New York, New York

Editor's Note: We feel that Mr. Head did contribute to the subject of real-time management information systems: he pointed out in a lively (not ill-tempered) fashion some of the inadequate and false definitions, straw men and questionable rhetorical techniques used by a critic of real-time MIS writing in the pages of a respected journal. Mr. Head, by the way, declines to comment on this latest jab by his friend at Chase Manhattan, thus hopefully ending what one observer has labelled the Block-Head debate.

Acme Super-Visible System lets operators find...feed...refile cards gunfighter fast!
Super-fast because it's Super-Visible. Keeps the identification edge of every card visible to the operator's eye, in quick-flip hinged aluminum frames. Cards slip out, slip back in a flash, faster than most machines can use them. Guarantees you the full productive power of your investment in office automation. To see how, send coupon today.
COLLINS' TE-216A-4D DATA MODEM **DOUBLES** THE SPEED ON YOUR EXISTING VOICE DATA LINE. AVAILABLE NOW

Demonstrations of the new modem are being conducted in major cities. Write for date and place nearest you. Address communication to Manager, Data Equipment Sales, Collins Radio Company, Newport Beach, California 92663.

CIRCLE 14 ON READER CARD

COMMUNICATION/COMPUTATION/CONTROL

COLLINS RADIO COMPANY / DALLAS, TEXAS • CEDAR RAPIDS, IOWA • NEWPORT BEACH, CALIFORNIA • TORONTO, ONTARIO

Bangkok • Beirut • Frankfurt • Hong Kong • Kuala Lumpur • Los Angeles • London • Melbourne • Mexico City • New York • Paris • Rome • Washington • Wellington
The new ADVANCE 6130, ready for delivery at $34,500...

...we used to call it the “paper tiger”

Last July we announced the ADVANCE 6130, specially designed for real-time data acquisition and control applications.

At that time we couldn't promise immediate delivery and frankly called it our “paper tiger”.

Right now our tiger is all hardware and purring smoothly. Software is also ready with FORTRAN, symbolic translator, and a real-time and batch processing monitor.

With a 900 nanosecond memory cycle time and 16-bit data word (plus parity and memory protect bits), the all integrated circuit 6130 computer can show its teeth in outperforming all competitive machines, including those most recently announced.

The ADVANCE 6130 will be uncaged for the first time at the Fall Joint Computer Conference, San Francisco, November 8-10, Booths 119-121. Should you like more information beforehand, please call or write: Computer Division, Electro-Mechanical Research, Inc. 8001 Bloomington Freeway, Minneapolis, Minn. 55420. Phone: (612) 888-9581.

COMPUTER DIVISION
miseries at martin
The big systems blues which have plagued IBM and CDC have hit GE's 600 series. Problems, including slow performance, excessive downtime, have caused the withdrawal (by Nov. 25) of three dual-processor 635's at the Martin Co. Uptime at one Martin 10-month-old installation has averaged only 70% and speed reportedly has been slower than the 7094. To blame: software complexity and overhead. But GE points out that three government 635's, all accepted, have been averaging 85, 92 & 99% uptime, with better times at other installations. Martin is in the throes of re-evaluating replacement gear, but we hear that 360/60-40 AST systems are on order at all three plants. Meanwhile, GE -- one of the few companies big enough to swallow such a disaster -- is moving "rapidly" to correct the problem.

ncr readies
third generation entry
NCR's new 615 series computers, we understand, will consist of the 615-100, 200 and 400. All will use rod memories and have 800-nsec cycle times, the 100 accessing one byte at a time, the 200 two bytes, the 400 four. Optional are 1401 and NCR 315 emulators. Instruction lengths are eight or four bytes; 63 index registers are in main memory; 256-character coding set. Some models will have integrated processor/peripherals in one cabinet, obviating need for raised floors. Also new: CRAM clusters, 3,000-lpm printer, disc files.
The mod 100, with 8-16K bytes, is for batch processing with limited real-time applications. System rentals are from $1500-6K. The 200 has 32-256K bytes, is for business and scientific computation, real-time environments, has optional multiprogramming. Rentals range from $4-25K. The 400 is a time-sharing model, has 64-512K bytes, rents from $7-55K.
Software will include Fortran, assembly system, Neat Autocoder and exec system. Deliveries are slated to begin sometime in 1968.

proposed tax law
furrows foreheads
Users and manufacturers alike are concerned about the proposed legislation that would remove the present 7% tax credit on capital expenditures, probably for 16 months. The Investment Incentive Tax Credit went into effect Jan. 1, 1962 -- leading computer manufacturers, among others, to point out to prospects that there was money to be saved by acting.
One point to consider in evaluating the possible effects of removing the credit: it doesn't apply to government and nonprofit organizations anyway.
A second area is lease vs. purchase. Here it might have some effect, because -- with the tax credit available -- there is a fair amount of money to be saved: 7% of the total price on an outright purchase. But there are two offsetting factors here. One is that the manufacturers are able to pass along
COBOL/AUTOFLOW*
Now Available!

COBOL SOLVES HALF YOUR DOCUMENTATION PROBLEMS.
WHAT ABOUT THE OTHER HALF?

Users are switching into COBOL because the language gives them more understandable code than assembly listings. This is a big step. It doesn't, however, do anything about the flowchart, the other fundamental piece of documentation required for a computer program.

Now, Applied Data Research proudly announces AUTOFLOW for IBM 360 COBOL Programs. This new ADR documentation system produces superior flowcharts directly from COBOL source language. This means that COBOL users can enjoy the same advantages of complete, accurate, up-to-date and economic flow charts which have proved so successful for assembly language users.


If you are using COBOL, why wait to find out what COBOL/AUTOFLOW could do to save you money and increase the efficiency and control of your computer installation? Write today for detailed information on COBOL/AUTOFLOW or other AUTOFLOW Systems listed below.

Other editions of AUTOFLOW include:

FORTRAN/AUTOFLOW for the IBM 7090/94
ADR's new IBM 7090/94 FORTRAN/AUTOFLOW directly accepts FORTRAN II and IV, FAP and MAP and produces flow charts on the HSP and S.C. 4020 display.

ASSEMBLY/AUTOFLOW SYSTEMS CURRENTLY AVAILABLE ARE:
IBM 1401, 1410, 1460 (Min. configuration 8K-4 tapes)
RCA SPECTRA 70 (except Model 15)
IBM SYSTEM 360 (except Model 20)

For your convenience, AUTOFLOW will be demonstrated at both:
1966 Fall International Data Processing Management Conference
Billmore Hotel
Los Angeles, Calif.
Oct. 23-25, 1966
Booths #32 & 33

ADC is an equal opportunity employer and offers challenging positions at all of its offices. Please write for employment information.
look ahead

some of the tax saving to lease customers, although not all of it ... and especially not all of it in the first year, as could be elected by the customer with outright purchase. The second factor has to do with the typical behavior of users: often they like to get the machine on rent, try it out for several months before making a purchase decision. Under these conditions, there is so much more money to be saved by exercising the purchase option early that the tax benefit seems minor.

There is still another way of looking at the problem though -- and some medium-sized users may have this viewpoint. Suppose you want to buy a nice new tape system in the middle range ... for, say, $300K. But you've got an older model that still seems to be running even if it takes multiple shifts to do the job. The tax credit would come to $21K. But this is real money -- $40K of profits at present tax rates. If your company is making about 5% on sales, that's some $800K worth of extra widget sales to come out even ... and 16 months may not seem so long.

For researchers in fields like biomed, geophysics and airframe testing, a time-series analysis computer is under development at Palo Alto, Calif. According to Time/Data Corp., the model 100 processor has wired programs that reportedly give it speeds comparable to such giants as the 7094, yet cost fractionally. Wired in are the basic algorithms of time-series analysis, such as spectral analysis, correlation, convolution, averaging, and histograms. The device can stand alone or work on-line to a general-purpose digital computer.

SHARE members, with IBM support, are appealing to ASA to reject the revised ASCII code, which was approved by a 21-5 X3 vote last month. While the technical argument is over two symbols missing from the central 54 characters (different symbols must be used for logical OR and NOT than those in the 60-character-set PL/I compiler), the real gripe is that ASCII is communications-oriented and downgrades programmers' preferences. At this late date, ASA is not expected to turn thumbs down on the code, but the programming community can still offer amendments.

Rumored to be doing $3-4 million of business, and in the black, is one-year-old Information Systems Co., an L.A. subsidiary of Lear Siegler. Heading the works is M.O. Kappler, ex-president of System Development Corp., who oversees a worldwide bodyslop operation and now is starting an on-line service bureau in L.A.

With a 4-disc 131K 360/40 due in December, Kap plans to go after medium-sized manufacturers. Through a terminal of their own choosing, they'll be able to develop a data base to generate marketing and accounting reports, perform materials and manufacturing control and engineering computation. First teleprocessing is due next February.

ISC also has a booming Far East Div., including 40-50 people in Saigon doing Pert and related project management work with a dual CDC 3100. A similar job, for another construction project, goes on in Bangkok with a single 3100.

Starting with a 490 communications processor a couple of years ago, Univac penetration of the NASA Manned Spacecraft Center is leading to a total installation

(Continued on page 159)
Just as we expected, Sigma 7 is 30% faster than we promised.

When we put the first Sigma 7 together, we found that its cycle time was 850 nanoseconds.

So why had we promised 1.2 microseconds? Because we wanted to wait and be sure. And 1.2 microseconds is impressive enough.

So much for cycle time. Sigma 7 is an integrated system of hardware and software, and raw speed is a poor way to describe how fast it gets the jobs done.

Take input/output. Most computers have to take time to do it. Sigma 7 doesn't. It has two processors — one for computing, another for input/output.

Sigma 7 was designed from the beginning to do real-time on-line control, conversational time sharing, batch processing, and high-speed input/output all at the same time. With full protection for everybody. And every job done as fast as the user wants it done.

We're delivering both hardware and software a little ahead of schedule. Two Sigma 7's in our plant are busy full time checking out software. When you get your software packages you know they'll run.

So far we're keeping all our promises. Except the one about the cycle time.

Sorry about that.
LEARNING A TRADE

One of Bill Mauldin's great World War II cartoons shows a line of infantrymen slogging along past a soldier, on his knees in the mud, constructing a crude path. Looking down at this muddy wreck, one of the footsoldiers says, "At least you're learning a trade."

Pushing aside his template and his Go board temporarily to scan the recruitment ads in the New York Times, Village Voice or Wall Street Journal, today's programmer must feel a delicious sense of being wanted, of learning a trade which is in high demand.

The feeling may be short lived. Higher level languages have helped to shove aside the programmer as middleman in the problem solving circle, and time-sharing, when it gets here, may hasten that delightful day when T. C. Mits poses his prosaic problems directly to the computer in everyday English.

Programmers who expect to float effortlessly up into systems programming and systems programmers who expect to stay there forever - may be disillusioned. As Ascher Opler points out (July, p. 105), systems programming, becoming increasingly complex, may leave mentally sluggish or lazy systems programmers behind. And as software costs skyrocket and hardware costs continue to collapse, it's natural to expect an attempt to find a way for hardware to take over some of the tasks now handled by software. Here's another frightening thought: the punks coming out of college today may know damn near as much as you do.

Lest these remarks trigger a wave of programmers leaping despondently from the tops of their Porsches, we'll hasten to add that there are solutions. You could go to real estate school. Or you can start to develop a sensible professional development plan.

There are books available. Most large universities offer graduate courses in information processing. Most of the software houses conduct short courses and seminars. Your local ACM chapter usually offers stimulating speakers, and DPMA chapters often sponsor reviews for the DPMA certificate exam, which is one way to find out how much (or little) you know. User group meetings may offer some brain-stretching sessions. The Joint Computer and DPMA Conference are possibilities, and DPMA has sponsored roving seminars on COBOL, may offer others. Soon a comprehensive programming correspondence course will be available.

While all of these can help you maintain a nodding acquaintance with the technology, there's no substitute for solid on-the-job experience. But you might ask yourself the question many employers ask as they review a resumé: Do I have seven years experience . . . or one year's experience seven times? What you may need is the solid foundation of edp theory which can help you translate today's experience into the ability to master new skills.

There are other considerations. Although you may now be performing more difficult and complex work than you were, say, five years ago, you may also have narrowed the scope of your skills. Or you may not have had a chance to develop skills in subtechnologies which have grown up around you. One way to look at it: are you ready to manage the full range of activities being conducted at the level at which you now work?

We hope it's clear that these remarks apply not only to the neophyte, but to the experienced professional as well. We know several experts of yesteryear who are experts no longer. And there's no assurance that today's expert will be one tomorrow.

And we hope that edp management is listening, too. The best way to attract and to keep top-level talent is to offer challenge and growth . . . the opportunity to really learn a trade.
The advent of third-generation, time-sharing computer systems with on-line remote terminals makes it technically and economically feasible for human beings to communicate directly with computers in a conversational mode. At the same time, as the computer becomes directly accessible to Mr. Everyman, there is great incentive to develop interactive conversational-mode languages which lean heavily upon large disc file libraries of pre-designed procedures and which permit the user to converse with the computer in the natural language of his field. In view of this technical opportunity, it is not surprising that a number of new computer languages, designed specifically for conversation-mode programming, are now under active development in many parts of the country.

Several of the new conversational-mode languages consist of streamlined and simplified blends of FORTRAN and ALGOL. However, this approach does nothing to simplify the programming process for the professional, and, in addition, it encourages scientists and engineers to waste both their time and that of the computer on a programming task for which, in many cases, they may have neither the background nor the inclination. These considerations have led the authors to feel that another approach to this problem consists of the development of new highly-advanced computer languages compatible with the conversational mode and which conform as nearly as possible to the natural language of the scientific world. This article describes a system which represents an attempt at such an arrangement for scientific computation.

This system is called AMTRAN, for Automatic Mathematical Translation. It is designed to permit the user to enter mathematical equations in their natural textbook format and to receive immediate graphical and alphanumerical displays of the results on a cathode ray scope and a typewriter. For example, a nonlinear differential equation such as

$$\frac{d^2 y}{dx^2} = y^3 + y \exp(-y) + 2x^2$$

can be entered as the series of slips

$$d^2 y/dx^2 \ y \ \text{POWER} \ 3 + \ y \ \text{EXP}(-y) + 2 \ x \ \text{POWER} \ 2.$$ 

and will be typed out by AMTRAN's special typewriter in the format shown in the original equation. This equation can be entered and solved within seconds to minutes, depending upon the speed of the computer. At the same time, the system also provides the flexibility required to enable an experienced programmer or a numerical analyst to solve problems of a nonroutine nature. Generally speaking, AMTRAN provides an order-of-magnitude improvement in convenience and turnaround time in mathematical problem solving.

The full AMTRAN system employs remote terminals (Fig. 1) which communicate with the computer over voice grade telephone lines. The terminals consist of a large keyboard, pushbutton math

---


Mr. Wood is a research physicist in the space sciences laboratory of NASA’s George C. Marshall Space Flight Center. A principal contributor to the development of AMTRAN hardware, he holds a B.S. in electrical engineering and an M.S. in physics.
two 5-inch cathode ray storage oscilloscopes for graphical and alphanumeric display, and a typewriter to provide a permanent record of displayed information, when this is desired. Of course, the usual plotting and printing capabilities can be used at a central location although these tend to be too bulky and expensive for desktop computer terminals. The typical cost of such a terminal runs $5,000 to $10,000, depending upon whether several terminals share a common multiplexer.

**general philosophy**

AMTRAN is a multi-level language. It can be used by the systems programmer at the level of bit manipulation or by the applied mathematician with no prior knowledge of computing, or by practitioners at any intermediate level. The system can be used in an on-line, conversational mode or in an off-line, batch-processing mode or in any combination of the two. The keyboards, cathode ray scopes and typewriters provide low-cost adjuncts to the usual card, printer, tape, and plotter attachments.

Three objectives have been of primary importance in the development of the AMTRAN system.

First, a scientist or an engineer with no background in computer techniques should be able to solve relatively straightforward mathematical problems with little or no instruction in the use of the AMTRAN system. For this purpose, the system has standard "convenience" operators in the language of classical mathematics, such as $\int$, $\frac{d}{dx}$, MINIMAX, etc., which suffice for a large fraction of the problems commonly encountered by the scientist or engineer.

Also, the AMTRAN language has been considerably streamlined to permit the user to "converse" with the computer in the natural language of mathematics. For example, the system provides automatic array arithmetic, automatic dynamic dimensioning of arrays, no declaration of variables, automatic assignment of working storage, implied multiplication, natural-English input and output, "picture" formatting, and other adjuncts to natural mathematics.

Second, the programmer and the more experienced user should be provided with the capability to construct their own programs and operators at the keyboard so that they can handle problems for which the standard set of operators is inadequate and so that they can take advantage of the extremely short turnaround times which are characteristic of conversation-mode programming. This requirement has been met by including ALGOL 60 programming capabilities with certain programming extensions—e.g., high-
level logical and transfer instructions, extensive list-processing and symbol manipulation capabilities, graphical input and output instructions, etc. Perhaps the most important feature is a simplified procedure-and-operator generation arrangement which permits the construction from the keyboard of general-purpose “super-instructions.” These can then be stored in a disc-file library. This means that the programmer is not restricted to 30 to 40 basic FORTRAN-level instructions, but can, in effect, draw upon a repertoire of hundreds or thousands of general-purpose mathematical and logical procedures as building blocks for his programs.

Third, the system must be economically competitive with batch-processing systems in speed and storage. This requirement will be met through an incremental compiler.

**hardware configuration**

As previously mentioned, a typical AMTRAN terminal consists of a large keyboard, one or two cathode ray scopes, a Polaroid camera for the scopes, and a special Selectric typewriter. A stylus or “electric pencil” will soon be available to enter graphical information to the computer.

The keyboard has two classes of buttons: labeled buttons which are permanently programmed and unlabeled buttons which are “programmable” by the operator. Sufficient space is provided around the unlabeled pushbuttons so that the user may label them as he wishes on paper overlays provided for this purpose. Since the number of pushbuttons is necessarily limited, they are used primarily for the more common functions and operators, such as the +, sin, and repeat operators, while mnemonic codes are used to call less commonly used operations such as the error function, or the Newton-Raphson method for solving differential equations.

Since the typewriter is used to call a great majority of operations, the question arises: Why use the keyboard at all? Briefly, when a typewriter is used to enter mathematical equations, entry becomes quite slow and prone to error. A conflict seems to arise in the user between the independence of the carriage return so that mathematical equations, entry becomes quite slow and prone to error. A conflict seems to arise in the user between the keyboard of general-purpose “super-instructions.” These can then be stored in a disc-file library. This means that the programmer is not restricted to 30 to 40 basic FORTRAN-level instructions, but can, in effect, draw upon a repertoire of hundreds or thousands of general-purpose mathematical and logical procedures as building blocks for his programs.

Third, the system must be economically competitive with batch-processing systems in speed and storage. This requirement will be met through an incremental compiler.

**硬件配置**

如前所述，AMTRAN 终端通常包含一个大型键盘、一到两个阴极射线管，一个 Polaroid 相机用于显示，以及一个特殊类型的 Selectric 打字机。不久将可用的“电笔”(electric pencil)将用于向计算机输入图形信息。

键盘有两种类型的按钮：有标签的按钮是永久性编程的，而无标签按钮是“可编程”的，由操作员决定。提供了足够的空间，围绕无标签的按钮区，用户可以将标签粘贴在纸张上提供的覆盖物上，用于此目的。由于按钮的数量有限制，它们主要用于更常见的功能和操作符，如正号、sin 和重复操作符，而偏移码用于调用更不常用的运算符，如误差函数，或 Newton-Raphson 方法来求解微分方程。

由于打字机主要用于调用大部分操作，问题出现了：为什么不使用打字机呢？简而言之，当使用打字机输入数学方程时，输入变得相当慢且容易出错。在用户之间似乎出现了一种冲突：在打字机键盘与“超级指令”之间。这些可以存储到磁盘文件中。这意味着程序员不受限制地使用30到40个基本FORTRAN指令，但可以使用数百到数千个一般用途的数学和逻辑程序作为构建块。

第三，该系统必须在经济上具有竞争力，使批处理系统在速度和存储方面。这一要求将通过增量编译器来满足。

**硬件配置**

如前所述，AMTRAN 终端通常包含一个大型键盘、一到两个阴极射线管，一个 Polaroid 相机用于显示，以及一个特殊类型的 Selectric 打字机。不久将可用的“电笔”(electric pencil)将用于向计算机输入图形信息。

键盘有两种类型的按钮：有标签的按钮是永久性编程的，而无标签按钮是“可编程”的，由操作员决定。提供了足够的空间，围绕无标签的按钮区，用户可以将标签粘贴在纸张上提供的覆盖物上，用于此目的。由于按钮的数量有限制，它们主要用于更常见的功能和操作符，如正号、sin 和重复操作符，而偏移码用于调用更不常用的运算符，如误差函数，或 Newton-Raphson 方法来求解微分方程。

由于打字机主要用于调用大部分操作，问题出现了：为什么不使用打字机呢？简而言之，当使用打字机输入数学方程时，输入变得相当慢且容易出错。在用户之间似乎出现了一种冲突：在打字机键盘与“超级指令”之间。这些可以存储到磁盘文件中。这意味着程序员不受限制地使用30到40个基本FORTRAN指令，但可以使用数百到数千个一般用途的数学和逻辑程序作为构建块。

第三，该系统必须在经济上具有竞争力，使批处理系统在速度和存储方面。这一要求将通过增量编译器来满足。
The AMTRAN software can be implemented on almost any scientific computer of any reasonable size and speed, whether old or new.

mode of operation

The user may elect to operate in a real-time mode in which instructions are executed as he enters them, or he may elect to operate in a suppressed-execution mode with execution occurring at some later time. However, in both cases, the list of entries made by the user is temporarily stored. If, at any time, the user wishes to permanently retain and assign a label to his list of operations, he may do this by entering CALL THIS, followed by the label. If he does not wish to retain a particular list of instructions, they are automatically erased when the Reset button is pressed.

The AMTRAN language has been extended beyond FORTRAN II in certain ways. The syntax has been streamlined and automated in an effort to eliminate as much human bookkeeping as possible and to retain only those operations necessary for mathematical definition and clarity. The simplifications are of value to the professional programmer and are necessary for the scientist or engineer if he is to converse with the computer in the language of mathematics.

In AMTRAN, the dimensioning of a variable is carried out automatically when the variable is first defined. Thereafter, the computer, using dynamic memory allocation, keeps track of the dimensionality of variables as they are manipulated during computation.

Another feature is automatic array arithmetic. For example, if the user enters an equation such as $\text{SAX}$, where $A$ has previously been defined to be an individual number and $x$ has been defined to be a one-dimensional array, the computer will calculate the individual number, $\text{SAX}$, and will then multiply this result by every number in the $x$ array. This permits the user to deal more nearly with the constants and functions of applied mathematics (in addition to speeding up the execution of array operations).

Perhaps the most important feature is the ability to rapidly and easily construct high-level instructions or operators which can then be embedded in other operators. These super-instructions are automatically compiled into object code. This "boot-strap programming" capability enables each user to construct high-level mathematical and logical instructions tailored to fit his own needs. Furthermore, these instructions are indistinguishable, as far as the user is concerned, from the intrinsic AMTRAN instruction set. For example, many of the instructions of FORTRAN and ALGOL can be simulated by console-programmed instructions in AMTRAN. A library of commonly-used instructions is available to all users. This operator or modular-programming approach also permits the user to build up and check out his program a block at a time.

Another feature will eventually consist of the ability to manipulate symbols with the same automatic dimensioning and automatic array operations which characterize the handling of data. These symbols consist not only of the alphanumeric and special characters but also, the basic operators and operands of the system, such as $\text{S}$, $\text{IF}$, $\text{GO}$, $\text{TO}$, etc.

Primitive symbol manipulation capabilities are present now. Fig. 3 shows the keyboard "island" which contains the most commonly used operands and operations. There is a number-entry group of buttons on the right-hand side and an elementary function group on the left with buttons in between which are also accessible to the user. A number of more commonly used classical analytical operators are present on the common-operator keyboard, such as $\text{S}$, $\text{IF}$, $\text{D} $; and operators which invert functions, change variables, and locate the minima, maxima, and zeroes of functions. Two programmable buttons are also present on this keyboard island. Two standard-format data display operators, for the typewriter and the scope respectively, also appear on the common operator keyboard. Certain delimiting and housekeeping operations are represented on the keyboard by the BACKSPACE, RELEASE, and START, RESET, period, comma, semicolon, and CARRIAGE RETURN buttons. The SUBSCRIPT operation is used to address the elements of arrays. The constants $\pi$, $\log_{10}$, and $\sqrt{2}$ are also addressable from this keyboard island, as well as two blank buttons which the user can assign to his own commonly used programs or variable. (Many other "programmable" keys are available elsewhere on the keyboard.)

The following examples provide a quick look at some of the present capabilities. Fig. 4 is a photograph of the scope face showing the printout which occurs when the user solves a differential equation using the SOLVE operator. The user's first statement causes the printout of any instructions that may be present in the next subroutine which he is about to call (in this case, the SOLVE subroutine).

The second statement demonstrates the present procedure for solving a differential equation. When the SOLVE 1 button is pressed (or the mnemonic SOLVE 1 is typed in from a teletype terminal), the computer selects the appropriate Runge-Kutta formula and begins the process of

---

Mr. Clem is a programmer analyst at Computer Sciences Corp. in Huntsville, Ala. He was previously employed at Northrop/Huntsville where he was in systems programming. He has a B.S. in mathematics from Birmingham-Southern College.
solution. (Note that the solve operator is a console programmed subroutine.)

The third instruction in Fig. 4 causes the scope display of the solution (Fig. 5). The solution-curve is automatically scaled with printed x and y scale factors, and with the origin optimally located to fully utilize the scope face. If we wish to retain a list of operations and to thereby construct a console program or operator, we proceed by entering:

RESET
(There operation resets the system so that it is ready for a new program list.)

ENTER PROGRAM
1. \[
\frac{2}{R^2 - \lambda^2} A Q
\]
2. CALL THIS PHI.

Note the implied multiplication between \( \lambda \) and \( Q \). This is possible only because the keyboard bypasses the mnemonic label interpreter required for typewriter input. Since the keyboard inserts unique code numbers directly into the computer, potential confusion is avoided between \( \lambda \times Q \) and the (possible) mnemonic label \( AQ \).

After the program has been stored under statement 2, the system automatically resets for the next program. Having generated a mathematical operator (which, incidentally, would compute the axial component of an electrostatic dipole field), let us now differentiate it, using the symbolic differentiation subroutine.

Fig. 4

ENTER PROGRAM
1. INSTRUCTIONS.
2. SOLVE1 DY/DX = Y Y - 3Y + 2XX.

THIS OPERATOR USES FOURTH ORDER RUNGE-KUTTA FORMULAE TO SOLVE DIFFERENTIAL EQUATIONS OF THE TYPE

\[
\frac{DY}{DX} = F(X, Y)
\]

PLEASE ENTER THE RANGE OF X, THE STEP SIZE AND INITIAL VALUE.

\[
X_{MIN} = 0,
X_{MAX} = 2,
H = .1,
Y(X_{MIN}) = 0.
\]

Fig. 5

ENTER PROGRAM
\[
\frac{d \phi}{d \tau} = \frac{-2}{2 \lambda} A Q (2x)
\]
\[
\frac{d}{d \tau} = \frac{-2}{(\lambda^2 + x^2)^{3/2}}
\]

This statement causes the computer to analytically differentiate the \( \phi \) expression and type out the partial derivative.

The computer automatically labels the derivative after differentiation. The resulting formula for the partial derivative is an executable program which is temporarily retained by the computer and can be permanently stored by the user, if he so desires.

As an example of the latest version of AMTRAN, consider the following:

ENTER PROGRAM
1. TYPE-ON-SCOPE "PLEASE ENTER \( \eta \) AND \( \phi(x) \) NOW."
2. FOR \( \eta \geq \phi(x) \geq \phi_{MIN} \)

\[
\eta = 1 - \sqrt{\pi} \exp \phi(x) \int_0^{\eta} \exp(-t^2) dt,
\]

OTHERWISE, \( \eta = \exp[-\phi(x)] \); WHERE \( 0 \leq \tau \leq 3, 100 INTERVALS
3. CALL THIS RHO.

After the typewriter has typed ENTER PROGRAM, the statement 1 causes the message PLEASE ENTER \( \eta \) AND \( \phi(x) \) NOW to appear on the cathode ray scope face.

The second statement causes the computer to divide the array \( \phi(x) \) into two parts: the portion which lies within the range \( 0 \leq \phi(x) \leq \phi_{MIN} \) and the portion which does not. The computer then carries out the indicated calculation on the two portions of the array \( \phi(x) \). The WHERE following \( \phi(x) \) causes the "dummy" (local) variable \( \tau \) to be generated before the first part of statement 2 is executed—i.e., it puts the "0 \leq \tau \leq 3, 100 INTERVALS" at the beginning of statement 2 rather than at the end. The third statement assigns the label \( \phi_{MIN} \) to the operator which we have just constructed.

This program illustrates several features of AMTRAN. First, in statement 2, since \( \phi \) is not previously defined within the subroutine, the computer assigns to \( \eta \) at execution time the value of the first operand which follows the \( \phi \) operator. These variables are dummy (local) variables and the data associated with them is automatically deleted at the end of a console program. Such variables are used for "working storage." On the other hand, \( \rho(x) \) will remain after the subroutine has executed. Since \( \eta \) appears only once in the subroutine, no working storage is provided for it by the computer. (This fact is determined by the computer during the initial entry of the code string.) The second variable, \( \phi(x) \), which appears in the subroutine is also undefined so the computer takes for its value the second operand (or sequence of operations) which follows the \( \rho \) operator. Since \( \phi(x) \) appears more than once in the subroutine, the computer automatically provides working storage for \( \phi(x) \), automatically dimensioning this storage area at execution time. For example, if the second operand was equivalent to a single number, the result for \( \rho(x) \) would be a single number, whereas if the \( \phi(x) \) entry were a one-dimensional array, \( \rho(x) \) would also be a one-dimensional array. (Of course, the user need not concern himself with this detailed system logic.)

Second, when \( \tau \) is calculated, it is calculated only once and the resulting number is multiplied by all of the numbers in the array \( \phi(x) \).

Third, this operator contains the integral operator, which in turn, contains the forward difference operator. Thus, three levels of nested subroutines are embedded in the macroinstruction \( \rho \). The operator \( \rho \) may itself be embedded in other programs and may be used as freely as the exponential subroutine.

Note the method of generating the independent variable \( x \). Most commonly, for functions which can be defined
by means of formulae, the construction of the function begins with the generation of $x$. However, when a function is known only in terms of tabulated values, these may be entered with the instruction set. To later use the $\texttt{the}$ operator, we might say $\texttt{Density = Nuo (1.05, y)}$.

**other conversational mode systems**

The basic inspiration for AMTRAN was the Thompson-Ramo-Woolridge on-line computer system originated by G. J. Culler and B. D. Fried and later extended by Culler at the Univ. of California (Santa Barbara). The Culler-Fried system utilizes a 5-inch Tektronix storage scope, a typewriter keyboard, and another typewriter keyboard with specially-labeled operator keys. The system possesses the ability to handle complex numbers, two-dimensional arrays, vectors and matrices. It is designed to permit the console programming of operators or instructions and it also provides array arithmetic. It is very fast in execution. Although there are similarities between AMTRAN and the Culler-Fried systems, there are also sizeable differences.

Another early conversational mode system consists of the RAND Corporation's highly-polished joss system, which has formed the basis for the Burroughs Interp system and the SDS Cal language. Four more recent conversational mode languages are QUIKTRAN (IBM's conversational-mode FORTRAN system), and the MAP, RECKONER, and Cogo systems. The RECKONER and MAP systems are quite similar to AMTRAN in their provision of a streamlined, applied-mathematics language for scientists and engineers. The Cogo system is a problem-oriented language designed to accommodate civil engineering problems.

Two on-line batch-processing systems which use special high-speed compilers consist of the Klerer-May system and Dartmouth's basic language. The Klerer-May system is particularly strong in its emphasis upon natural mathematical formatting of its input and output. General Electric has implemented BASIC on a commercial basis.

AMTRAN differs from the preceding systems in various ways. It has been given certain features intended to facilitate future research in applied mathematics. It should be emphasized that AMTRAN is a full-scale ALGOL-type programming system and not a simplified language designed only for small computations or for a narrow range of problems.

Two restricted versions of AMTRAN are presently available which can be used on any IBM 1620 computer with floating point hardware and indirect addressing capabilities.

One version is intended for 1620's with 40,000 digits of core storage while the other is designed for 60,000 digit machines. No special equipment is needed except for the usual console typewriter and a card-reader punch. Copies of these 1620 programs are available from the authors upon request.

Although these restricted versions are designed for small core machines, they possess considerable power. Virtually all of the capabilities of the 1620 version of FORTRAN II are present, in addition to automatic array arithmetic multi-level programming of operators, rudimentary symbol manipulation capability, the ALGOL IF test, subscripted subscripts, and above all, the ability to deal with straightforward problems at approximately the level of classical mathematical analysis. Through an encoding arrangement, this system can store up to 50 console programs or subroutines and can accommodate matrices or two-dimensional arrays up to 25 x 25. (When small desk-top computers become economically feasible, a 4-8,000 word edition of AMTRAN could combine the mathematical power of a digital computer with the simplicity and convenience of a slide rule.)

A more elaborate system utilizing one of the special terminals described in this article has been implemented on IBM 1620 mod II computer with a disc file. Although the writers have had very favorable experiences with keyboards and visual displays, considerable effort has been expended in rendering AMTRAN compatible with typewriter and teletype input and output, since the latter are cheaper than full-scale AMTRAN terminals.

An extended version written in ALGOL 60 is currently under development in collaboration with the Burroughs Corporation. This time-sharing AMTRAN incremental compiler will act like a single program in the multi-processing B5000 or the faster (800-nanosecond cycle time) B6000 computers.

Finally, the Brown Engineering Co. is presently developing an AMTRAN incremental compiler for the IBM 1130 computer.

**conclusion**

An effort has been made in the development of AMTRAN to develop a broad-based programming system which spans the spectrum from a streamlined machine language for the professional programmer to the highest level mathematical operations (for the scientist or engineer).

In addition to the writing of an incremental compiler, future plans call for effort in the areas of symbol manipulation, automatic numerical analysis, and the introduction of new simplified basic programming operations. It is hoped that these improvements, particularly in the symbol manipulation area, will improve the programming checkout and debugging rates beyond their present values. Turnaround times are presently running 5% to 10% of the batch processing rates.

An interesting result of our demonstrations has been the response of scientists and engineers to the system. The reaction is invariably "Where can I get one of these?" There is no doubt that a market exists for a conversational-mode computer system which speaks the natural language of mathematics as nearly as possible, and which relieves the user of all those programming and analytical bookkeeping operations which can be prescribed in "cookbook" terms. Of course, incorporating the procedures of classical and numerical analysis into an on-line computer system is a formidable task. Nevertheless, we hope AMTRAN will provide a first step toward everyday use of an automatic mathematical system for on-line computation.

---

10 This differs from the Burroughs INTERP system.

October 1966
The magnitude and complexity of technical information flow in the United States is nowhere more evident than the level of federal government, with its numerous super-large libraries and information-handling networks. Because of this, the urge to propose a government-sponsored centralized technical information service is as recurrent as the stirrings of a troubled conscience. Various studies of this possibility have been undertaken, and as often as not the recommendation has been against establishing such a service. Considerable conservative sentiment exists, and few expect the establishment of any centralization of information handling similar in size and scope to that in the U.S.S.R.; nevertheless, it appears that centralization of some sort is unavoidable.

In regard to this question, as to many other abiding questions in the information field, much talk has occurred without clarifying how a decision is to be made. This is not the fault of the discussants, and of course the issue must be discussed. The fault is not even in the complexity of the national information flow picture. The fault is that there is not nearly enough “information about information.” The nation’s goods and services economy is far better understood than its information economy, and even the metabolism of the human body is better known and understood than the metabolism of information in modern civilization. Bits and pieces of the information transfer and utilization scene are often brought into sharp focus by conscientious studies, but under present conditions it is hard to describe adequately any large portion of the total picture.

When it comes to making decisions such as whether or not to have centralized information management, or decisions about the degree and kind of centralization (if that route is taken), we literally do not know enough to have confidence. There are occasional glimmerings of concern about the dearth of such knowledge. For example, in a report to the National Science Foundation entitled “Centralization and Documentation,” Giuliano of Arthur D. Little, Inc., points out: “Many of the proposals for major changes tending toward the development of large centralized systems do not appear to be based on sufficient quantitative data to justify investments of the magnitude contemplated.”

A thesis can be built that if something is to be centralized and if large investments are to be made therein, it might best be a massive and concerted program to gather, summarize, and distribute data on the dynamics of national use of technical information. This thesis argues that if beneficial control of information transfer is possible, then the first step in achieving control is the collection of information about information at a level of detail and volume of almanac proportions. This reservoir of information would be both the context for decision making and, with rapid updating, the feedback element that a good control system needs. A strong possibility is that if this massive information-gathering program were undertaken successfully, the need for “management”—control from the top—may not appear; distribution of summarized material to the numerous people (in and out of governmental activities) who now make decisions about information handling may permit local control that would be more satisfactory than centralized control.

**designing for the user**

There is a part of the total information flow picture that we might call “the technical document system,” in which authors put useful information and/or discussion in a form that can be directed flexibly to a large audience, scattered widely in time and space. In this communication system, in which information can be stored and tapped at will, the accent is on the convenience of the user. This is appropriate beyond measure; it is hard to imagine how a rapidly progressing technology would be possible unless users have freedom to program their own inputs. Most users may not approach their optimum in exercising this latitude; nevertheless, if the user doesn’t know when, why, and how he needs information, it is hard to contend that anyone else knows either.

Many information specialists seem to deny this by presenting themselves as critics or spokesmen in relation to the user. The user’s critics want to change him—an unrealistic objective, even when “change” means “educate.” The user’s spokesmen are even worse, adopting an idealized model of the user in an unconscious attempt to simplify the information problem. An oft-heard example of the latter process is the admonition: “What users want is information, not documents.” Really? I wonder who knows that much about what “the user” wants.

Of course, criticism can be constructive, and descriptions of the user can be accurate. The point being made here is that, under conditions of fragmentary information about users, value-laden or idealized pictures of the user compete with and even drown out those sketched perceptively from experience and available information. Moreover, the possibility of great diversity in user needs can be uncomfortable to system planners. But in the absence of sufficient information, system designers are free to adopt a conception of user needs that conforms to ideals of system efficiency or economy; it requires only a minor shifting of mental gears thereafter to expect the user himself to conform.

Many have seen that these ills are subject to a direct remedy: increase what is known about the user. But recent user studies—though many of them have been enlightening—are isolated fragments of a very large mosaic. We note that, senior people in the information field have been saying, lately, that technical information should be considered a “national resource.” From this it would require no great stretch of logic to conclude that user behavior data ought to be the fundamental stock of knowledge.

---

1 Available through the Clearinghouse for Federal Scientific and Technical Information, United States Department of Commerce.

---

Mr. Doyle is on the language processing and retrieval staff at System Development Corp. He was a member of the advisory committee for SDC’s report to COSATI (Committee on Scientific and Technical Information) of the Federal Council for Science and Technology: “Recommendations for National Document Handling Systems in Science and Technology.”
on which information system and policy decisions are based just as traffic and driver behavior data are relied upon in determining legislation relating to highways.

For readers who already agree with this view, it remains only to postulate that we need information far more complete and far more representative of the cross-section of technical information users than current studies give us.

Earlier the thesis was offered that the first step in achieving management and/or control of information on a national scale should be a massive information-gathering program, and the qualification was just added that emphasis be on user behavior data. To consider the user’s key position in the “technical document system,” one might think of communication between author and user as derivative from that between a speaker and a listener. The speaking-listening relationship can be thought of as the basic mode of human communication. If communication involves the written word only, the relationship changes to writing-reading, much closer to the relationship of author and user, but still not identical.

To provide a sound framework within which to examine the user, it would seem prudent to begin with an understanding of the role of the user within the information system. One view is that the user, like the reader in the writer-reader relationship, does nothing more complicated than read what the author has written. This, however, would overlook the fact that actual reading of documents is seldom studied in user studies; stress instead is placed on the interaction between the user and “the literature,” meaning the entire mass of documented material in the user’s field and the means of access to it. The “user” function thus appears to be defined in terms of his motivations and actions in selecting material, and rarely in terms of his use of it. Ultimately, it may be standard in a user study to give the reading process (or, more broadly, the using process) as much importance as the searching and selecting process, but the case now is that these studies seem impelled to treat the non-reading aspects of user behavior.

The non-reading aspects of user behavior get emphasis because of their greater immediate significance in information-system operation. But there is a more fundamental reason why they are significant. The author-reader relationship is a one-to-one interaction in the use of written correspondence, whereas the author-user relationship is—form the user’s viewpoint—a many-to-one interaction in searching and selection. The process of searching, say, an index to ten thousand documents is that of converting a relationship between the user and many thousands of potential authors to one between the user and perhaps one or several authors to whom the user wants to be exposed. The burden of this process is primarily on the shoulders of the user, and this is the price he pays for being free to program his own information input.

It is this selection function that distinguishes the author-user relationship in the communication model we have been considering. The Weinberg report2 sets forth this function as follows: " . . . The information chain operates like a switching system. The ultimate aim is to connect the user, quickly and efficiently, to the proper information and to only the proper information. But perfectly precise switching is neither possible nor desirable. One cannot define in advance exactly what information is proper; the switching system must always allow for some borrowing in neighboring areas. Moreover the capacity of the user to absorb information limits the system . . . ."

The author, of course, can and often does take part in the operation of “the switching system.” Through his mailing list and his selection of publication outlet he may partially determine his user population. But the final choice—to use or not to use—resides with the user, who is his own best authority on the information he needs, if not on how to get it.

It may now be more evident why monitoring of user behavior that is both perennial and widespread can eventually bring a kind of information control not previously known. This information gathering—which we can think of as a “perpetual user study”—could come to constitute a democratic control system with the user as the electorate. The user, however, would not vote in the usual sense, but more in the manner of the refugees from East Berlin who “voted with their feet.”

Eventually, another and possibly more important kind of controlling effect should arise: feedback. Changes in user behavior patterns, detectable wherever monitoring is fairly continual, can be analyzed as responses to introduction of new facilities or to changes in policy. In this age of fast-changing horizons of technology, so many new methods and machines are becoming available to use in information access that choosing among them—or even knowing about them—is an unmanageable task. Nationwide monitoring of user behavior, however, would lead to wide advertisement of technological mutations showing unusual utilization or popularity.

user complexity and fallibility

At least two important difficulties are seen in a user-governed control system: (1) the user's complex behavior in searching and selecting information, and the impossibility of making a complete record of all pertinent interactions of the user with access mechanisms; (2) the user's fallibility, especially his limited understanding of how best to approach the information store (or even how to use the information he acquires). Surely the first goal of the “user census” is to know the typical user and his range of variation in behavior. The requirement for a continual user study on the scale we're talking about is generally to observe as much as possible within some budgetary limitation. This probably entails representative in-depth studies of a very small number of users, in addition to some data on all users. Though the census may be shallow of the total user population, it will furnish a sounder basis than we now have for deciding where to focus in-depth studies. People using in-depth study results in determining policies affecting information assimilation would by this token be assured that the situations investigated were indeed representative.

In general, microscopic scrutiny can be brought to bear on any portion of the nation's information use pattern, with full understanding of what kind of user situation is being observed and how much of it is typical. As we know from the history of science, the first tasks in establishing a new realm of scientific inquiry is organization of what is known; when the large amount of user data are tabulated in summary form, a portrait of the user population will emerge that will become the foundation for a more securely analytical phase of the "zooology of the user."

The fallibility of the user, the other difficulty we are considering, is probably a matter of more practical concern than is user complexity. A great part of the problem is something we touched on earlier: attitudes toward the user. Some writers about use of information facilities believe that information system personnel know best about almost anything having to do with information access, and advocate requiring those who would aspire to be technical information users to be educated "from the ground up" in use of access facilities. One does not want to be in the position of being against education, of course. But

---

the benefits of education or re-education are limited, especially in an age of specialization. The user, after all, is not expected to know as much as the information specialist about information access—so by that criterion he will always be somewhat fallible.

The preoccupation with the inadequacies of the user, and the consequent criticism (some of it open and much of it thinly disguised), would not be an auspicious mood in which to begin scientific inquiry about information use. A more neutral way of seeing the user would be helpful. His situation must be seen in its over-all context, not just in relation to information access.

He is getting paid to do his job (as is the information specialist), and his most influential critic is his boss—who is also a user—and so on up the line. The user does more than merely retrieve information: he rules technology.

Even those who feel more kindly and respectful toward the user may still have unrealistic expectations of him. Some of the recommendations of the Weinberg report (op. cit.) seemed to paraphrase a larger sentiment of those times: "Ask not what the system can do for you; ask what you can do for the system!" It seems to me, though, that—except during times of widely understood emergency—telling people to accept more responsibility is the easiest but least effective approach to a social or organizational problem.

collecting information about the user

User behavior data can be and should be collected painlessly. Monitoring need not be watching or even interviewing. To choose an obvious case, everything a user does with an on-line computerized literature search facility can be recorded automatically without strain or even awareness on the part of the user. Experience with time-shared computers has turned up many frustrating difficulties, but sensitivity to having one’s acts recorded has not been one of them.

In a conventional technical library, monitoring would be less automatic, but can still be painless. Closed-circuit TV, transducers, photocells, magnetic actuators, and even lasers or low-strength X-ray devices can be used in common library situations. (If the reader feels incredulous about the more bizarre of these sensors, he might consider the wide variety of uses such devices have in industry.) One ought not to feel concerned that this array of user-watching equipment will create a “big brother” atmosphere; even in banks and supermarkets, where its purposes are less noble, it causes little stress.

The great bulk of data collection on information usage might consist of nothing more than pooling records of the type that some libraries keep anyway. As pointed out earlier, the data about users en masse may not need to be particularly detailed, and the expensive equipment can be reserved for in-depth studies. Precedents in other areas of government-sponsored information gathering give grounds for optimism, and the final compilation of user data would probably be as faceless and unjudging as the U.S. Census.

I list below a number of “burning questions,” which people have wondered about and argued about without, really, great progress having been made toward answering them:

1. What percentage of references placed before a user leads to his ordering or procuring a document and/or further information? What is this percentage with respect to KWC indexes, citation indexes, standard bibliographies, monographs, abstract journals, citations in journals and reports, and on-line computerized searches? This is an example of a particularly difficult study—one whose results could be misinterpreted even under the best of conditions. Without background data on a specified (and hopefully standard) population of users, however, it would be reckless to claim that a given study is generalizable beyond the group involved in that study. It is granted that most user studies are not intended to be representative of the “user universe,” and are frankly geared to a special field or special user class. Unfortunately, since this sort of thing is all that is available today, people are bound to generalize from it. What else can they do?

2. How do reference publications based on computer output fare in comparison to manually produced reference publications? What is the effect of post-editing? The question of computer vs. manual output is going to become more “burning” as time goes on, and the answers more confusing as the variety of computer outputs increases. Dependable answers are quite important in this area because they will help us reach a more effective man-machine balance.

3. What forms of literature search figure most prominently in user behavior? Search for unique items of information not requiring context? Exhaustive searches for all pertinent material on a topic? Searches for anything on a given topic? Searches for the document in a given field? Browsing in which no definite information need is in mind? Browsing for problem-solving purposes where one fulfilled searching step leads to the next step?

4. Is there any relationship between a user’s productivity and his literature access habits? Notice that this is one kind of study where results could be very misleading under now-existing conditions of not having adequate data and not being able to judge representativeness.

5. To what extent do typical users prefer “social” information access forays (professional meetings, telephone calls, visits, correspondence) over the essentially non-social chores of library searches or use of subscriptions to journals and reference publications? The ramifications of the user’s humanity and gregariousness in access to information are little understood at present, but may be among the most important factors we need to understand. The questions are aired repeatedly among information specialists and interested bystanders, often quite emotionally. Yet the answers to the questions are tentative and do not inspire confidence; we don’t have the apparatus to observe and describe users representatively and conclusively. As a result, the voices of those who might see reality in spite of lack of appropriate data are lost in the competitive shouting of user critics, user spokesmen, dogmatists, vested interests, promoters, and well-meaning but ignorant authorities in neighboring fields. Those isolated workers who have tried to be scientific are to be complimented, but their efforts are too puny in relation to what is required.

Conclusion

One hears increasingly that technical information is a “national resource.” We must come to know more about the use of this resource. If knowledge of information use is to be truly representative, we must begin by defining a national user population. If knowledge of the user is to be kept current as information access techniques and systems change, we must monitor the user population perpetually. Then, in the context of the trends brought to light, we may evolve a decision-making apparatus that will eventually be as self-regulatory as our economic system itself. As in the case of the economy, only where it is not truly self-regulatory need we apply centralized controls.
PRODUCTIVE GRAPHIC DATA PROCESSING

by WILLIAM J. QUIRK

At Boeing-Huntsville, we were faced with a unique computing problem that was placing an inordinate drain on time, engineers and facilities. We thought the solution time could be vastly speeded up by the use of a graphics system; thus in 1965 we installed an IBM graphic system linked to 7044 and 7094 computers. The new approach has been applied to two of our chief missions. One is the reduction of raw flight data that we receive from telemetry stations after a missile shot. The second is the simulation of data in advance of a launch.

In the first instance, the moment-by-moment flight of a bird is transmitted from launch until impact by telemetry back to ground stations. The result is a digitized tape containing thousands of information bits for each of 20 to 50 flight parameters. This tape must be reduced to tabular form, analyzed and then converted into curves that will describe pictorially the actual flight path of the missile. But the number of telemetry receiving stations involved on each flight, the effects of static, and inherent errors of transmission and reception add a confusing number of extraneous bits that must be eliminated by judicious editing and replaced by hours of iterative deduction on the computer. Thus our engineers are confronted with a mass of data, some wholly irrelevant, some erroneous, and several information gaps with a wide variety of variables that must be explored, tested and discarded or accepted purely by engineering intuition and trial and error.

Traditionally, each flight curve was constructed from computer outputs, then translated back into digital inputs and fed back to the computer to see if the curve was the correct one. This constant conversion and need for run and rerun, plus off-line recording to obtain graphic output, added to computer turnaround time and meant that each flight reduction problem took up to three weeks. But with the use of a graphics system, we now do the same operation in minutes.

changes during processing

The difference lies in the new capabilities of graphics; changes and decisions can be made at any time during the run. This is the real time-saving factor for us.

In essence, the graphic mode enables us to display the digital flight data as a curve. If the curve needs alteration or adjustment at any point along the run, we can make these changes by throwing out incorrect information and adding new variables that help form the correct curve.

We had, of course, been aware of the potential in graphics for some time, but when we first thought of applying it to some of our solution needs, we anticipated a great number of programming difficulties. But happily, this wasn't the case. Our analysis programs were already written and we simply added graphic interfaces to them by supplying macros for display, plot, record, plus all the standard macros IBM had provided.

In the graphics system we got from IBM, there are some 30 basic macros to generate orders to channels for computer, function keys, light pen, alphanumeric keyboard and display tube. Typical macros would order the display tube to draw a vector or a point, draw characters, set counters, turn the tracking cross on and off and reposition it. In addition, there are other macros that form the calling sequences for subroutines. These enable the programer to simply initiate the order for a specific function—such as draw a circle—and the subroutine, already built into the macro, would generate every order to draw each vector that would go to make up the circle. The programer simply provides the center of the circle and the radius as an addition to the macro.

There are also subroutines to draw grids on the display tube and all the programer must add is the amount of screen he wishes to be taken up by the grid. This appears as an option for the engineer to select based upon the specific problem being run.

To these, we added our own macros to alert the programer to the fact that an attention had occurred, or to wait for a forthcoming attention.

In essence, we were simply adding on to our existing programs some wishful thinking in the form of displays we would want if they were available. And we found that we could make them available.

Thus, we were able to shrink the lengthy computer complexities of flight data reduction to a matter of minutes instead of weeks. This solution begins by reading both the tape and the program disc into the computer. A request is then made for the tape to be mounted on the tape drive and the program loaded into core.

Initialization occurs as the Alpine system shifts to a conversational mode by asking the engineer at the display console which parameter he wants to look at. The engineer replies by sensing with his light pen one of the 20 or more parameters, e.g., thrust and time, he wishes.

The routine then goes to the tape and records it on microfilm. Once again the dialogue between engineer and computer resumes as the program says, on the cathode ray tube, that the entire graph is on microfilm and then asks what segment the engineer wishes displayed.

The engineer again uses the light pen to select the desired segment and the program then creates the necessary orders to draw that segment on the CRT. At this point, the engineer can edit the segment, with both light pen and function keys—eliminating extraneous bits, filling in gaps and removing obvious errors. From this point he proceeds to call for each of the other segments of editing. Thus far, all functions have been performed by the IBM 7044. But now, curve fitting of information on the tape is necessary and this requires an analysis program rather than the display control program used to this point.

A function key alerts the proper macro that requests the analysis program stored in the 7094. At the same time, a background program, already running on the 7094

Manager of the Boeing-Huntsville Simulation Center, Mr. Quirk was formerly director of research for Comcor Inc., a subsidiary of Astrodatal. While in the Air Force, he was an assistant professor in electrical engineering at the AF Academy. He holds a B.S. and M.S. from the Naval Academy and an M.A. in electrical engineering from the Univ. of Washington, Seattles.
for a totally different problem, is checkpointed and the graphic analysis program is loaded in its stead.

When the analysis program has completed its curve fitting function it notifies the display control program and the engineer to this effect and stores the information on its disk file. A call for the curve drawn by analysis brings it forth on the CRT. Now, the engineer's judgment and intuition come into play. He can accept the curve, if it looks right, or, if not happy with it, he can change it. To do this, he may weight some of the coefficients by adding or subtracting variables—again an iterative problem solved by engineering judgment. The changes are analyzed and a new curve drawn and displayed. If the engineer is now satisfied he can call for the curve, and the digital data from which it was built, to be recorded on microfilm, or printed out by the 1403. Then he moves on to the next variable, until all flight parameters are reduced. Total elapsed time—one engineer approximately 40 minutes, as opposed to the three or four engineers taking two to three weeks for the same problem using our old system of a computer without a graphic capability.

From flight data reduction, it was a simple step for our engineers to program the system for flight simulation. In this instance flight curves must be constructed in advance to take advantage of launch windows that in some instances are only minutes wide, to tell the range safety officer at every second in time where the debris from a possible destruct will land, and to provide tracking stations with advance data so that the target may be acquired and tracked through every moment of flight. These trajectories also involve thousands of information bits for each parameter of the flight path and required the same amount of engineering time and computer use and turnaround as flight data reduction. This too has been speeded up to the point where minutes instead of weeks are needed for the solution.

Present and future effects

What graphics has made possible is to free the engineer from drudgery, from those hibernation periods that data processing forced on him. Now it is possible to utilize people as well as machines efficiently. Eventually, the scope of the graphics revolution may go even beyond our wildest imaginings. Twenty years ago, when we first started using computing on a large scale, we were solving problems we already knew how to solve but didn't have time to do by hand calculation. The space program, for example, was not possible until these machines could be brought into the picture. But now we have reached the point where conventional ways of using the machine have reached a plateau. Graphics will remove that restraint so that we can concentrate on engineering thought and its documentation.

I can illustrate this with some examples of pure engineering thought now being applied at Boeing-Huntsville. In addition to flight simulation and flight data reduction, we are using the graphics mode in a crash for logistics planning of Saturn V launchings. With the program we can translate digital inputs into blocks on the CRT, assign flow lines to them and make changes at any point along the way. The topology for any flow chart can even be created without digital inputs and the computer will then provide the input table. Production lines, logistic designs and all other topology problems we have found, can be solved far more quickly by graphics, since on-line errors can be corrected immediately. Again, the big time saving is in reducing computer turnaround and engineering brain hibernation.

There is little doubt, based on our experience, that the iterative areas pay off quickest, but we are not limited to these. Often, we don't even know what type of analysis we want to perform on a given problem until we see it in graphic form. In that sense what we have the computer doing is showing the way toward the programming needed.

Problems of configuration are particularly applicable to the graphics mode. By freeing the engineer from the sheer mechanics of computing and allowing him to question, in his own language, the possibilities of design, his creative horizons are greatly expanded.

We have learned that even the draftsman and the artist may benefit from the graphics computer. The creation of an isometric drawing, for example, used to take us three to four hours and after it was finished it was not always right. But it is now possible to work out on the CRT all the perspectives possible in a matter of minutes and enable our artist to choose the one that works best. Then, his three or four hour rendering will be correct the first time.

One day, we may see the largest use of graphics in the still relatively unexplored area of management sciences. We find that graphics can provide us with more up-to-date information for management planning. Decisions such as "Should we bid on a new contract?" and "How much should we bid?" can be made far more accurately and swiftly than with the present generation of computers, due to the instant read-out possible with graphics.

Until now we have been developing methods and techniques. But we have learned enough to start applying them across the board, in every area, wherever we are doing computing. Graphics has spurred us on to attempt the solution of future problems that today have no solutions, because the problems have not yet been fully perceived. One area is the conversion of the CRT into a true stereo scope. Using four prisms we salvaged from World War II tank periscopes, George Monnig, one of our physicists, is designing a three-dimensional system that will project images on the CRT in stereoscopic perspective. At the moment, we have a program for the creation of a safe with a door that swings wide to reveal the yawning depths of its interior. Soon, such a stereo system with the capability of solving depth-of-field problems will be needed for the rendezvous and docking solutions required by the Apollo and its associated Lunar Excursion Module. Without such a stereo capability, no true simulation of a lunar mission is possible.

What we have here is the new generation of computers, that can right now be effectively harnessed to productive use on a variety of problems. The only true new generation is in the graphics mode—everything else has been just more of the same. Graphics, however, is the first step toward really efficient man-machine communication.
When an individual applies for credit—for a bank loan, department store charge account, oil company credit card or the like—he realizes that usually some sort of credit investigation will take place. For obvious reasons, both the individual applicant and the credit grantor are desirous that this credit investigation take place quickly and efficiently.

This article will describe how a credit investigation can be accomplished quickly and efficiently by means of a random access computer.

The investigation which follows an application for credit usually takes one of three forms: a direct check, credit scoring or use of an outside agency.

If the credit grantor uses the direct check method, he telephones the place of employment and credit references listed on the application to verify the information the applicant has revealed. Disadvantage of this method is that the credit grantor usually is limited in obtaining information which the applicant desires to divulge, and few applicants will list as a reference someone who can report a bad credit history. Direct checking also is expensive and time consuming.

Credit scoring is a method whereby certain point values are given for positive factors such as the applicant owning his home or holding the same job for several years and subtracted for negative factors such as derogatory credit experience or low income. In most instances, the applicant's "score" must reach a specified level if his application is to be given further favorable consideration.

A third method of obtaining information needed to evaluate a credit application—the one most used—is to forward the application to a credit bureau which checks out references and supplies any additional data that might be in the files on the applicant. This method, too, can be costly and time consuming. Additionally, because Americans are tending more and more to range over entire market areas for their shopping, there are limitations created by time and economics on the amount of information a credit grantor can obtain from what normally is thought of as a credit bureau. Such bureaus generally operate within definite geographical limits, maintaining credit records only on transactions occurring in their own areas. Information is interchanged among bureaus, but this often takes weeks and costs are high.

Primarily, the credit grantor needs three types of information to properly evaluate the credit application before him. These include any derogatory experience—slow pay, repossession, etc.—that previous credit grantors have had with the applicant; amount of credit the applicant currently has outstanding to determine whether additional credit might over-extend his ability to repay; and signifi-
CREDIT CHECKING . . .

cant historical data showing how extension of credit has been treated in the past.

**variety of services**

Different approaches toward furnishing credit information have been developed, some utilizing electronic data processing equipment and some limited in the type of service they offer.

One such service limits its operations to the check-cashing field. Derogatory information, including that pertaining to persons who have records of cashing bad checks, is stored in computers and retrieved quickly when interrogated on behalf of subscribing merchants. Primary identifier used in this system is a driver’s license.

Another computerized system gathers only derogatory information and was specifically designed to serve mail order companies which sell books or phonograph records. Files are oriented by address only, a limiting identifier because of the ease with which addresses can be changed.

Other firms have announced plans for use of electronic data processing equipment for check verification or other forms of limited credit checking but as of this writing have not begun actual operation.

Normal credit bureaus, as discussed above, furnish derogatory, current and historical data to credit grantors.

Mechanical filing, however, slows issuance of reports, and each bureau generally has in its files only that portion of an individual’s credit record involving transactions which occurred in the bureau’s service area. This area normally is limited to a single city or community within a trading area. For example, in the Greater Los Angeles trading market which comprises portions of four counties, there are more than 30 credit bureaus, any of which might have bits and pieces of a credit applicant’s entire credit record or file. It is distinctly advantageous to offer regional service so a person’s complete credit record will be in one central file.

The approach taken by Credit Data Corp. to serve banks, finance companies, retailers and other businesses which make consumer loans or sell on credit has been to “pool” the derogatory, current and historical credit experience data from the files of individual subscribers throughout an entire marketing region. This is stored in a random access computer system for quick retrieval when needed.

This system, first of its type in the nation, went on the air in September ‘65 to serve the 3,000 square mile Greater Los Angeles trading area which covers portions of four counties with a population of nearly 10 million persons.

Since then, the service region has been expanded to cover the bulk of the southern California population. Meantime, CDC’s semi-automated regional credit reporting system in San Francisco is being converted so that the entire state of California will be covered by early next year. Similar conversion of files is taking place in the Detroit CDC office, which by mid-1967 will become the hub of a vast midwest service region covering the “strip city” beginning to emerge from Buffalo, N.Y., to and beyond Chicago.

More than a year of working experience has proven the practicability of such systems to meet the needs of credit grantors.

Major elements of the Credit Data Corp. system are a telephone communications network with an automatic call distributor, a high-speed document conveyor and an IBM 1410 storage and retrieval system.

Credit information about individuals from throughout the megalopolis that comprises most of southern California is stored in the central file computer. A subscriber needing any individual credit record can obtain it within 30 seconds via telephone. For those subscribers not requiring the speed of telephone service, a night operation generates written file reports for delivery the following morning.

**the subscribing public**

Subscribers include all major banks and oil companies in the service area, as well as many retailers, finance companies, mortgage lenders and other businesses offering credit.

A telephone request for information is initiated when the subscriber dials a local number assigned to his area. The call is automatically routed by foreign exchange lines to the automatic call distributor at the CDC center. The call distributor selects an available operator and completes the connection, or stores the call until an operator is available. Output from the call distributor also provides a continuous visual display so supervisors know at all times the volume of telephone traffic and can make necessary adjustments in manpower to handle incoming calls.

The CDC operator who receives the subscriber request is seated at a standard keypunch machine alongside the document conveyor. The operator punches into the inquiry card the identification data and transaction data provided by the subscriber, then sends the card to the computer room via the conveyor.

Once inside the computer room, the inquiry is read into the computer, which scans the credit file and prints all pertinent information on a form. This is returned to
WHY IN THE WORLD DID EAI ADD THE 8400 TO THE LIST?

IF YOU KNOW SCIENTIFIC SIMULATION, YOU'LL UNDERSTAND OUR ANSWER. THE NECESSARY COMBINATION OF SPEED, CAPACITY AND MODERATE COST... OF ON-LINE CONTROL AND INTERACTIVE SOFTWARE...SIMPLY DO NOT EXIST ANYWHERE ELSE IN THE MARKET TODAY.
We didn't want a computer that could do everything. We wanted a system a scientist could do everything with.

Simulation, experimental design studies, engineering model building—these are computer-aided creative processes. They place great demands on the designer and the computer that assists him. The EAI 8400 and its simulation software is the first computer a designer can really consider a partner. He can talk to it, ask questions about his simulation model, demand the highest performance. He can require that all his own mistakes be found and forgiven, with error-free behavior on the part of the computer.

The creative design engineer—the man who has devised a mathematical model of a new design and wants to experiment with it—needs to be close to the machine at run-time. He needs to modify the program and data during the run. He can't afford to be hampered by operating details such as octal conversions and symbol searches. He needs the simplicity—and the sophistication—of the 8400.

The prime focus for the 8400 system is man: the design engineer, the experimentalist, the simulation engineer. The system was designed to respond to his needs in every way. This concept of usability calls for an economy of means and effort to yield a high throughput.

It starts with the problem of how to give a powerful, expensive complex machine to one person—aid him as he searches for an undefined number of answers through a trial-and-error process and still provide computer services for others. Moreover—provide this usability and an economical cost/performance ratio.

Scientific laboratory computation is not all creative and experimental. There will always be a significant amount of straight processing—assemblies, FORTRAN compilations, data sorting, report generation. The 8400 was designed to do these jobs while fully meeting the requirements of the simulation engineer.

The 8400 multiprogrammed system provides real interactive control and conversation for the designer. It lets him have as much think time as he wants. Batch processing goes on as background work, soaking up all the machine time he doesn't use. In fact, he is unaware that it is taking place.

Why is the EAI 8400 the best digi-
tal computer for simulation? Look at features like these:

**High Operational Speed**

The EAI 8400 has the speed performance of some giant machines that cost 4 to 5 times as much. As for machines in its own price class, the 8400 is 1½ times as fast!

First there is raw speed—minimum execution times for each machine function. Memory access: 1.75 μsec. Typical floating point multiplication of two 32-bit data words: 7.35 μsec. That's fast.

Then there is the speed-up due to shorter sequences for doing a given job. This comes from the very large set of instructions and options. One group of floating-point instructions automatically performs mode conversions between fixed and floating-point numbers with no additional time penalty. Sixty-three decision commands reduce tests to one or at most two steps. There's direct addressing of every bit in core. Indexing with the accumulator, as well as 6 other high-speed registers. And most valuable of all, a 56-bit push-down store (the SAVE register) which will accept the contents of all the arithmetic registers just prior to any arithmetic instruction at a cost measured in nanoseconds! All these are important hardware features that mean speed.

But for real-time simulation something more is needed. The entire software system must be designed for very short computer response time. The 8400 FORTRAN generates code that speeds the execution of entire programs. The object code is optimized for minimum execution time—just as well as a top programmer could do it for a large, complex program. For tough problems, such as a hybrid computer program where tight coding is needed, assembly code may be freely intermixed with FORTRAN statements.

The 8400 Monitor system has a master scheduler and priority interrupt handler which direct the multiprogram schedule in the computer. But for quickest response, the monitor permits the user to assign a priority above the multiprogram priority list.

Finally, to help the programmer design for real-time constraints, the compiler and assembler both contain pseudo-operations for estimating and adjusting the execution time of segments of code by as little as several microseconds.

**On-Line Access To The Model**

The EAI 8400 brings the design engineer close to his program—that is, to his model—not just close to the computer itself. He need not be concerned with machine operating details, yet he still has direct access in symbolic fashion to many details of his program. To do this, the 8400 has the hardware features for interactive control: mass memory devices, remote typewriter stations and CRT display systems with the latest options of light pens, vector mode, and special operating features.

Above all, the entire software system is geared to the interactive mode of operation. This includes the IOCS, the multiprogramming schedules of the monitor, the language processors, and the special conversational-mode systems HYTRAN™ and SPECTRE. The HYTRAN Operations Interpreter is a JOSS-based mathematical processor with numerous extensions to provide control of the linkage and analog computer in a hybrid system. The SPECTRE on-line assembly system, based on DDT, is a full symbolic assembler. In fact, it is a disassembler—which means it will create a symbolic listing from a program in core. SPECTRE permits you to modify a program in core, assemble and insert new code segments, run a trace, and execute a program section to a breakpoint.

**Economic Computer Utilization Through Multiprogramming**

It is obviously inefficient to tie up such a powerful system for fast, short runs. Yet it is necessary for the user to sit and think between runs. How is this conflict overcome?

Only by multiprogramming. Only with a monitor designed for this kind of interaction. Only with a system that can assign the full resources of the computer to a single user for a short period, and can respond at any time to real-time interrupts and still do batch processing on a queue of jobs. Only with the 8400.

This multi-user mode takes several forms. In a hybrid system the 8400 is usually assigned one top priority job (the hybrid programs) to which it applies full power whenever and for however long it is needed. Other interactive processes have next priority. And the job queue is the "background" that uses the remainder of the system time.

Thus, the 8400 gives you high run-time speeds ... effective, rapid, on-line interaction of the investigator with his model ... and economic utilization of the system with no charge for "think time." This, we believe, is exactly what the man interested in simulation and scientific computation is looking for in a digital computer system.
Our goal is more than just to manufacture computers... It's problem-solving through simulation.

The EAI 8400 Digital Computing System is an expression of this aim.

Electronic Associates is in the computer business because we believe in simulation.

You've known us for a long time as the leader in analog simulation. We are now the only company that's strong in all three: analog, hybrid and digital computer systems.

We have grown in the three disciplines as we sought to improve the art of simulation. The culmination in digital systems is the 8400. And this system is designed for use in a powerful new hybrid, the EAI 8900.

We have lived and breathed simulation for 14 years, working with thousands of design people through all the trials, errors, headaches and successes of innumerable simulations. This experience is embodied in both the hardware and software of the 8400.

The rapid acceptance of this medium-scale system marks it as the most popular digital computer ever designed for simulation, and several are already in full operation here and abroad.

We and the 8400 speak a problem-oriented language. If you're not sure of how to handle your particular scientific simulation requirements, come in and talk to us at one of our five computation centers. We'd like to help you discover the power of computer-aided design.

... Write For Brochure

What you've read is only part of the story. For the rest, let us send you the detailed technical description of the EAI 8400 design. We've given deep thought to the rationale of every detail. You'll see "reason why" for everything we've put into the EAI 8400. You'll understand why it's being called the "hottest" digital computer on the market today—and "the computer that has everything." Send to Dept. 302 for your copy today.

Name __________________________ Title __________________________
Organization __________________________
Address __________________________ Zip __________
City __________________________ State __________________________
the operator, who completes the process by reading the data over the telephone to the subscriber. On an individual inquiry, it takes only 90 seconds for the entire process from the time the subscriber dials until he has the requested record. When multiple inquiries are made, the time for him to receive each record is reduced to about one minute.

CDC's random storage media consists of two IBM 2302 model 2 disc files. Present storage capacity of the system is 468 million characters, which provides room for the credit histories of approximately 15 million persons. By early next year, histories of nearly nine million persons will be in storage and instantly available. The credit records are compacted in a unique and proprietary fashion.

When the inquiry card created by the operator is fed into the card reader, the processor scans the identification data and attempts to match up information stored on one or more disc file tracks with the identification. The contents of any match with the file data are printed out and returned to the operator for reading to the subscriber.

Identification data furnished by the subscriber includes name of the credit applicant, spouse's name, address, previous address, employment and, when available, social security number. The computer verifies those elements of the identification with which it has obtained a match in the file, then prints out the file data, which consists of a list of transactions on file for the subject. For each transaction there is shown an industry designation, subscriber branch code, file data, type of transaction, amount in dollars, terms in months or years, a rating and a date last rated.

For purposes of personal identification a worse system than name and address would be difficult to devise. Names are replete with redundancy, multiple spellings and endless nickname variations. Addresses, particularly in California, are not constant since one out of every three residents of the state moves each year. Names and addresses, however, are the only identifiers that occur universally in the records of credit grantors. Therefore, of necessity, they are the primary search argument of CDC's retrieval program.

Routines in the program check for alternate spellings and alternate given names, and search all addresses given at time of inquiry. Employment and social security numbers are used as secondary identifiers.

Through the use of such routines, a very acceptable mismatch rate, in the order of one part in 10,000, is obtained.

the central file

Data stored in CDC's central file is obtained from the files of subscribers throughout the service region and consists of positive and negative credit experience they have had with individual customers. In addition, pertinent data affecting credit standing is taken from public records.

CDC bears all file building expense. Consumer credit experience records stored on index or ledger cards are microfilmed, necessary information is keypunched from microfilm readers and the information is entered into the random access files. If the subscriber's own files are stored on magnetic tape, special programs are written to extract the needed data and read it into the central file.

Before the southern California system went on the air 13 months ago, CDC teams gathered millions of consumer credit experience records from the files of more than 3,000 subscribing companies and branches. Since the system has become operational, additional millions of subscriber records have been gathered and stored in the central file.

Once a subscriber starts using the service, he is required to report ongoing credit experience regularly. Likewise, new public record information is entered into the file daily. Inquiries are noted in the file at the time a subscriber requests information about a credit applicant. This inquiry notation is replaced with the appropriate data when the subscriber notifies CDC that the application has been approved or rejected.

Subscribers who have their own credit files computerized, at least some in each industry grouping, furnish CDC with magnetic tapes on a daily or weekly basis. These are fed into the CDC computer to update the central credit file with the subscribers' new accounts and any delinquencies that have occurred since the last reporting. Some subscribers send in reports on a daily basis according to their accounting cycle. Subscribers without computers report new accounts and delinquencies on special forms furnished by CDC or on their own forms. Pertinent public record information is entered into the central file on the second business day after it has been filed in the courts.

Included in the public record information gathered for the file are such items as notices of bankruptcies, chattel mortgages, mechanic's liens, federal and state tax liens and defaults on first trust deeds.

In this manner, the central file is continually kept up to date.

At the time the CDC system started a year ago the service area included the Greater Los Angeles trading market, which covers the population majorities of four southern California counties—Los Angeles, Orange, Riverside and San Bernardino.

Since then, service has started to the Greater San Diego area and to Santa Barbara and Ventura counties, so that the service region now covers the bulk of the southern California population. Subscribers in distant areas dial local telephone numbers to request information, with their calls automatically routed via long distance lines to the automatic call distributor in the Los Angeles computer center.

a statewide system

For the past three years, CDC has been operating its semi-mechanized credit system for the San Francisco Bay Area and the data in this file is presently being converted for inclusion in the computer file in Los Angeles. At the completion of this conversion, early in 1967, a communications processor in San Francisco will link that office with the file in Los Angeles. Extension of service to cities of California's Central Valley—linking them via long distance telephone lines to the computer subcenter in San Francisco—will complete the system and permit credit grantors in any part of California to obtain credit information from one statewide random access central file.

At the present state of the art, it is feasible to serve cities as far as 400 miles from a computer center or subcenter. Thus, a relatively small number of interconnected regional systems similar to that operating and being expanded in California can provide rapid access to credit information from any point in the United States.

Credit grantors and the credit-using public, alike, are benefitting from the new breed of regional computerized credit systems.

Credit grantors are able to quickly and inexpensively obtain the information they need to evaluate applications—information from throughout a vast area that formerly was not accessible or prohibitively expensive to obtain.

Because of the speed and accuracy with which this data reaches the credit grantor, legitimate users of credit card get almost immediate approval of needed loans or purchases, rather than having to wait for days or weeks frequently was the case before the advent of more electronic data processing in credit reporting.
Micromation Technology

a practical solution to information management

Stromberg-Carlson introduces an important advance—by cutting turn-around time and lowering the cost of turning computer data into readable language!

Would you like to turn a reel of magnetic tape into its equivalent in readable language—at computer speeds up to 90,000 cps—and for a fraction of what you now pay? That's Micromation, a new approach to the two big problems in information management—high cost and slow turn-around. Now, for the first time, your computer is released from the 600-1200 line rate of peripheral mechanical printers—free to go at its own pace!

Look for the announcement of a new family of Stromberg-Carlson Compatible Equipment at the Fall Joint Computer Conference, November 8-10. Here's a system that turns computer output into readable text at electronic speeds and makes it readily available to anyone who needs current information. No costly communications installations needed, either. Investigate Micromation—see if it doesn't let you break through to substantial savings.

Get all the facts at the Fall Joint Computer Conference in November—or write now to Dept. D-100 at the address below for details

Stromberg-Carlson

A SUBSIDIARY OF GENERAL DYNAMICS CORPORATION

Data Products Division, P.O. Box 2449, San Diego, California 92112

CIRCLE 19 ON READER CARD
Preparation of today's technical publication demands that the documentation keep abreast of product development and engineering efforts. When technical achievements are announced, the documentation must be available, too. With the advent of System/360, technical publications groups at IBM were confronted with the problem of providing complete, accurate and comprehensible documentation, and providing this at the time of system announcement. Ultimately, this problem was reduced by a computer-assisted system known as TEXT90. TEXT90 speeds the basic documentation effort by allowing publications groups to incorporate changes with ease. Thus the finished product is timely as well as technically accurate.

Historically, editors and writers have had to compile a master manuscript which is retyped several times until final approval of the document; it is then typed in final form and submitted to the printer. Each major change of substance requires alteration of all copy following it. Even if a single paragraph were to be added to a manual, an entire page, not only the added paragraph, would have to be retyped, proofread, and corrected again. Or, for example, if the name of a product were changed at the last minute, much of the manual would have to be redone and rechecked.

Because incorporating change into printed matter has been a continuing problem in almost all publishing operations, widespread attention is being given to systems that incorporate changes automatically, thus reducing repetitive clerical tasks, such as proofreading. TEXT90 is one such system.

In essence, TEXT90 creates a master record of a manuscript that can be processed by a computer. This master record can then be altered rapidly, no matter how much the change may alter the subsequent version. Moreover, machine processing permits us to produce updated manuscripts for writers' or editors' use at computer printer speeds.

TEXT90 also includes subprograms which enable us to produce page proofs suitable for photo offset reproduction. Other TEXT90 features are hyphenation and justification routines, routines that organize copy into single and double-column page layouts, and routines that select and display subject headings. Space requested for illustrations is reserved by TEXT90 throughout subsequent alterations to the editorial matter surrounding the space.

A special type font with both upper and lower case letters, as well as 68 special characters, was created and assembled into a chain for the 1403 printer so that final copy would resemble typed copy. However, unlike standard publishing type, the TEXT90 characters are each of equal width, a compromise that is not difficult to accept in publishing of manuals. If the compromise were unacceptable, the computer printout could be used until the manuscript had final approval. Then the master record could be converted into input to an automatic composition machine.

The TEXT90 program has helped us produce over 60 manuals running up to 500 pages in length. It can be obtained from IBM* for use by other organizations with similar problems and similar equipment. Interest, however, should not stop here, for we do not regard TEXT90 as an ultimate solution, but rather as a successful demonstration of how data processing can aid editorial effort.

We designed TEXT90 for implementation on the 7090, and display subject headings. Space requested for illustrations is reserved by TEXT90 throughout subsequent alterations to the editorial matter surrounding the space.

A special type font with both upper and lower case letters, as well as 68 special characters, was created and assembled into a chain for the 1403 printer so that final copy would resemble typed copy. However, unlike standard publishing type, the TEXT90 characters are each of equal width, a compromise that is not difficult to accept in publishing of manuals. If the compromise were unacceptable, the computer printout could be used until the manuscript had final approval. Then the master record could be converted into input to an automatic composition machine.

The TEXT90 program has helped us produce over 60 manuals running up to 500 pages in length. It can be obtained from IBM* for use by other organizations with similar problems and similar equipment. Interest, however, should not stop here, for we do not regard TEXT90 as an ultimate solution, but rather as a successful demonstration of how data processing can aid editorial effort.

We designed TEXT90 for implementation on the 7090.
See here Mr. Businessman...

There are some things you should know

... about the major advantages Sanders 720 Communicator System offers over conventional displays.

For instance, the 720 is the only fully modular desk-top display system: you buy just the capabilities you need. 256, 512, or 1024 character systems, with or without full editing, single or double keyboards per display console... all are typical options available in the Communicator.

The full-editing Communicator lets you insert or delete letters, words or sentences in the text already displayed on the screen. You can also hold portions of displayed data, e.g. prevent accidental erasure of computer-generated forms by separating them from the fill-ins.

Then there is the low cost control unit which handles from three (1024 character) to twelve (256 character) displays. Furthermore, with its microcircuit logic, it is small enough to fit in a standard rack, a desk or in a closet — with no special cooling required.

The 720 has an unbelievably quiet, solid state keyboard that uses no switches, contacts or linkages.

Because the 720 does not count spaces as characters, it will display up to 50 per cent more data per message than systems of equivalent character memory capacity. And even with 256 character systems, you can use the entire vertical 7½” x 9” message area.

Naturally, you can interface with modern computers via numerous data transmission methods.

And as for the price — it's lower than many systems with far fewer capabilities.

All the details are in our brochure. Write for a copy, or better still, write and tell us about your specific needs. Sanders Associates, Inc., Data Systems Marketing, Nashua, New Hampshire 03060.

*T.M., Sanders Associates, Inc.

SANDERS ASSOCIATES, INC.
Creating New Directions in Electronics

720 | SANDERS
The larger machine performs text manipulation while the 1401 processes all new entries to the records and supervises the printing at about 230 lines a minute.

Input to TEXT90 is punched cards. The card punch operator's job is much the same as that of a typist's, the only difference being that the deck of cards is not the finished product, but rather the input to a computing device. Special codes are required to control text format. These special codes can be learned within two to three days by an editorial typist who, with a few weeks of experience, can punch manuscripts almost as quickly as they can be typed.

**Free form punches**

The TEXT90 language uses a free-form concept. Unlike most punching operations, where certain punches must be placed in certain card columns, the codes and text of the TEXT90 language can be punched anywhere within the 80 columns. Words and codes can even be split between the end of one card and the beginning of the next. As little as one word or code can appear on a single card.

For a 60-page, double-spaced manuscript to be produced in double-column format, approximately nine hours' punching is required (including special code entry): eight hours for initial copy entry and one for subsequent copy change and/or corrections following document printout. Total machine time to process the 60-page manuscript is about 30 minutes on the 1401—10 minutes for prescan (input error detection) and 20 minutes printing—and nine minutes on the 7090. Editorial time to mark manuscripts prior to punching is approximately one hour for the initial manuscript and eight hours for proofreading and copy reading later editions. Such documentation speeds buy time that can be secured in no other way. For IBM, it has saved an average of one month in the writing and publishing of each manual.

Initially, the TEXT90 system creates two magnetic tapes. One, called a print tape, contains the text of the document in the format specified by the control codes. This tape is listed on a 1403 printer equipped with the special upper and lower case print chain. If upper and lower case facilities are not necessary, the document can be printed with any standard upper-case chain; upper case is used for all letters, and blanks are left for special characters not available.

The other tape produced by TEXT90 is the master tape. In addition to text, it contains control codes that specify the document's format. The master tape is used when the document is changed (updated), using punched cards containing special codes to indicate copy deletions, additions, and revisions and to move the text and codes stored on this tape. This update routine produces a new master and a new print tape.

Changes can be made in one line of the document without affecting the contents of the next. The program automatically repositions the text within paragraphs and pages to compensate for additions or deletions. Then when changes are made, only the changed lines need be proofread. Because of this capability, TEXT90 output can be updated, checked, possibly updated again, run in final offset reproduction form and taken to a printer in the same day.

The 7090 was selected because it was the most conveniently available large computer. Core storage requirements are 32K, which must be available at all times because line construction is done character by character and virtually all the routines are resident as the line is developed. Also, as a page is developed, the entire page is kept in storage.

The portion of TEXT90 performed on the 7090 consists of three sections. Functionally, they are:

1. File maintenance
2. Build-a-line
3. Build-a-page

Fig. 1 shows the general flow of these three elements. During the original processing of a document, the new input is all that is required; because there is no old master, the file maintenance section is bypassed. During an
now you can......

Buy a Burroughs higher speed Memory System for your...... next generation computer

Yes. This is New! Burroughs, one of the foremost manufacturers of computers, is now making Memory Systems commercially available. They are high-speed units......some are higher speed than most blueprints now specify. See them at the Fall Joint Computer Conference, November 8-10. Full details at the show!

Burroughs Booths 835-837.

Burroughs Corporation / ELECTRONIC COMPONENTS DIVISION
PLAINFIELD, NEW JERSEY 07061
update run, the file maintenance section makes the changes, insertions, and deletions indicated by certain codes on the old master. This is a typical file maintenance routine. As updated copy is passed by the maintenance routines, the next section exercises the copy-character routine to build a line.

build-a-line

This section analyzes each character so that as soon as the end of a word is reached (recognized by a blank space) and the number of characters designated for the appropriate alter codes.

The program for the 7090 consists of three parts linked together for operation under the nsvs monitor. All elements of this system, except the hyphenation routine, were created especially for TEXT90. The hyphenation routine was originally written for the 1620 typesetting program and was subsequently rewritten for the 7090.

Justification is accomplished by inserting extra blanks in each text line until the line is filled out to the set length. We alternate this process on succeeding lines to reduce the possibility of "rivers" of white space within blocks of text. TEXT90 hyphenates a word at the end of a line when the line cannot be adequately justified through the insertion of blank spaces between words. Hyphenation, like justification, can be turned off and on by insertion of appropriate alter codes.

In TEXT90, an algorithm and an exception dictionary are used to hyphenate words. The exception dictionary is a listing of words frequently found to be incorrectly hyphenated by the algorithm. If the word to be hyphenated is not in the table listing, then the program resorts to logical analysis of the word by a set of rules for syllabification.

When lines are passed to the line buffer, the program makes an entry in a cross-reference table and checks to see if enough lines have been accumulated to create a page. So that the page layout routine need not re-analyze individual lines during the format sequence, the cross-reference table contains information about the line such as indentation required, line length, or special handling requirements such as placement of footnote lines.

Many page layouts are possible. One layout, similar to galley proofs and containing line numbers for easy reference, is used during the early manipulations of the copy. Later, as headings and illustrations are added along with footnotes, the page layout routine generates a format to meet the page requirements of the finished manual (see Fig. 2), retaining line references so that changes can be made until the final printing run.

build-a-page

The page layout routine constructs the page by combining elements from three work buffers. These are for double-column figures, for footnotes, and for normal lines. As a routine begins, each entry of the cross reference table is analyzed to find any lines that require special processing.

Fig. 2 Build-a-Page Section of TEXT90

...Such lines include: a new page request, the first line of a double-column figure, a footnote, a skipped line, the first line of an illustration or table. The address of the cross reference entries for all other lines is stored in a work buffer. At the same time, a check is made to see if the column is full. When the column is completed, widows are eliminated and when necessary, the column is expanded to bring it to the desired depth. This is done by repeating some of the existing skips.

At this point, in single-column pages, the format is completed. For double-column pages, completion of the first column sets a switch and the routine is repeated for the second column. When the layout of the page is complete, the entire page is written out on both the new master record tape and on the tape which is passed to the 1401 for printing.

Special lines handled by TEXT90 routines include a hierarchy of subject headings to lead off and identify segments of the publication, running titles, folio lines at the bottom of the page, and page numbers. Codes punched along with the titles indicate both case of the characters and placement of the titles. Page numbering and placement are automatic. An additional 1400-word routine for the 7090 permits the user to extract and list by line and page number any previously specified words and phrases contained in the copy. This is done by a scan which compares given words with those in the text. Although this requires an additional pass during a post processor phase, it pro-

Before joining IBM's System Development Div., where he now manages a programming publications group, Mr. Lowenstein was a business writer with Prentice-Hall. He has a BA in economics from Rutgers Univ., and an MS from Columbia Univ.'s Graduate School of Business.

October 1966

45
We can give you 300 good reasons why you should use outside software services. Here are the first eleven.

These men specialize in the design and implementation of information systems, with primary emphasis on computer-communications, file management, on-line and display-oriented systems. And they manage our other 289 good reasons.

Informatics Inc.
5430 Van Nuys Boulevard
Sherman Oaks, California 91401
ceeds at tape speed because it is the only processing being done.

Core storage allocation for the entire 7090 portion of TEXT90 is illustrated in the memory map, Fig. 3. The 1401

Fig. 3 7090 Memory Map for TEXT90

phase of the TEXT90 includes a prescan procedure that checks the card input and converts it to card image on tape and a printer program. Each of these programs requires 4K.

Because we do not regard TEXT90 in its present form as the ultimate solution, additional investigation is being done to further improve its assistance to IBM publishing requirements. An Administrative Terminal System, previously announced by IBM for use by customers, is being used as alternate input to TEXT90 on an experimental basis in Poughkeepsie. Terminals are located within the writing sections so that initial input and updating use ATS to create documents on disc file. This disc file can then be converted to TEXT90 input format.

The cost of operating with the TEXT90 system is higher than for conventional methods. In addition to the continuing programming support for the system, we make full-time use of the 7090 and 1401 computers. The fact is, however, that the cost is more than justified by the ability to deliver publications quickly and accurately, thereby supporting IBM's marketing objectives. Furthermore, we are gaining valuable experience that will help us develop better systems for the future.
Best remedy for digital systems headaches is one of the new $10,000 class digital computers like the LSI System 8000. Designed to replace hardwire systems. Gives the flexibility of a stored program real-time computer at no increase in cost. A blessing when the ground rules change in midstream.
You can even afford a multi-processor configuration for a complex application.
If you think computer, the LSI System 8000 solves your funding problem. If you don't, its flexibility may cure your design problem.
Call us. We can help, or we'll supply the aspirin.
A PUT-LIST FOR ENHANCED COMMUNICATION

by SAM A. and ANNE H. ROSENFELD

Science is breeding a new child—the analysis of technical language. Consider the psycholinguistic origins and implications, for example, of the "put" construction whereby three new nouns may be formed by combining the particles "in," "out," and "through" with the verb "put." The resultant nouns "input," "output," and "throughput" (or its variant "thruput") have received rapid and widespread acceptance by the technical community. Such thorough incorporation of a new construction, and not merely of a new term, indicates to us the existence of a technico-linguistic gap requiring closure by additional terms of similar construction.

In this paper, therefore, we propose 13 new "put-terms," whose subsequent appearance, if any, in both technical journals and in conference presentations we will study and report at a later date.

The first group of put-terms follows the precise construction of the original three terms (i.e., particle + put), and, like them, pertains to data processing systems. Let us consider a significant element of a dp system—its "memory." Instead of borrowing from the humanities this weak term, redolent of Aristotle and Proust, let us choose, rather, from the language of everyman. What could be more natural than to call that store of information containing what has been put away the AWAY-PUT? Similarly, the term "delay circuit," so outmodedly verbose, could be far more crisply and naturally replaced by OFF-PUT, an unforgettable noun to anyone who has ever put off until tomorrow what was unpalatable today. Following the same simple linguistic transformations, the integration of information is obviously TOGETHER-PUT, while intelligence processing might best be described as ONTO-PUT.

The effectiveness of the total process of information dissemination and communication, ACROSS-PUT, depends heavily, in dp systems, upon the manner of presentation to the user. Ultimately, the human makes the decisions, usually based upon the FORTH-PUT (a far more discreet term than the exhibitionistic "display"). Occasionally the problems of scheduling result in UPON-PUT, in which one user takes over another's time. On those rare days when analysts are called upon to give presentations of their work, they have been known to so dazzle their audience with their intellectual elegance and personal charm as to result in a thorough OVER-PUT.

The group of put-terms mentioned above is sufficiently close in form to the original three terms to be assured of rapid assimilation into the technical vocabulary. The next group, while possibly slower to gain acceptance due to its looser put-construction, nonetheless has much to recommend it. First, the all-important field of microminiaturization obviously needs a more miniature and far less syllabic term as its descriptor; we propose LILLI-PUT, a name simply and swiftly said. In both LILLI-PUT and more conventionally sized circuits, one commonly finds many feedback loops providing for stability by error detection and correction. Programming loops are also commonly found which might well share the same term as feedback loops: STAY-PUT.

As we move further from the orthodox put-list, several terms arise for consideration, among them SHOT-PUT (track-ball data), and that Teutonic borrowing KA-PUT, meaning specifically a short circuit, but, by extension, catastrophic failure of any system.

In conclusion, in view of the importance of improved communications among communications personnel, we encourage other authors to use this DOWN-PUT as a guide to improve the technical lexicon.

Mr. Rosenfeld, on leave of absence from the Mitre Corp., where he has been a systems analyst since 1962, is currently in the Psychology Dept. of Harvard Univ. Anne Rosenfeld is a science writer-editor at the Neurosciences Research Program of MIT.
Adage makes the best computer on the market for signal processing

...it's called Ambilog 200

Ambilog 200 is a computer which combines the best of both analog and digital techniques. Unlike conventional machines which were intended for manipulating numeric data, Ambilog 200 was designed right from the start for signal processing. Signal processing, which encompasses data acquisition, monitoring, editing, analysis, recording, and display, generally requires efficient handling and high-speed processing of analog as well as digital data. Ambilog 200 with its flexible analog/digital interface and powerful hybrid structure is ideal for such applications.

DIGITIZING AND RECORDING

Multiple inputs, from up to several hundred sources, are routed through multiplexer switches under stored program control. At no penalty in sampling rates over conventional systems, Ambilog 200 converts incoming data to engineering units for recording or monitoring. An analog-to-digital converter performs a complete 14-bit conversion in 4 microseconds for digital storage, recording or outputting.

REAL TIME WAVEFORM MEASUREMENT

Peak values, axis crossings, ratios of successive differences, and other characteristics of analog signals are measured in real time. Incoming signals are monitored for events of interest, using complex programmed detection criteria. In a typical biomedical application where "floods of data" are generated, the result is a 100-to-1 reduction in the bulk of magnetic tape output records.

RANDOM SIGNAL ANALYSIS

Parallel hybrid multiplication and summing, 2 microsecond 30-bit digital storage, and a flexible instruction format providing efficient list processing combine to make Ambilog 200 an extremely powerful tool for statistical signal analysis techniques. These include Fourier transformation, auto and cross correlation, power spectrum density analysis, and generation of histograms of amplitude spectra.

ON-LINE DISPLAY

CRT displays of incoming raw data, or of results derived by reduction and analysis, are generated at frame rates of about 30 per second using line-drawing elements. This "quick look" facility helps the user select those processing techniques which best apply to the problem on hand. Display systems include light pen selection of control parameters and processing subroutines to insure close interaction between the analyst and his computing equipment.

SOFTWARE

Programming aids for use with Ambilog 200 were designed as well to meet the specialized needs of signal processing tasks. An extensive program library includes an Adage assembly system, Fortran, programs for source language editing and on-line debugging and control, and a wide range of applications programs and subroutines. Comprehensive system documentation, and programming and maintenance training and services, are also available.

Ambilog 200 signal processing systems are currently being used for seismic research, dynamic structural testing, sonar signal analysis, wind tunnel testing, speech research, and biomedical monitoring. For technical reports describing in detail these installations and other signal processing applications, contact M. I. Stein, Product Manager, Adage, Inc., 1079 Commonwealth Avenue, Boston, Mass. 02215, (617) 783-1100.
More than one million miles of precision magnetic computer tape are being consumed each year by more than 20,000 computers now in operation in the U.S. In another five years tape-devouring computer installations are expected to increase to more than 70,000—even allowing for a 30% retirement of outdated equipment.

This year it is estimated that more than $110 million will be spent for precision magnetic tape in an effort to keep up with a mounting wave of information—doubling every seven to ten years.

Precision magnetic tape has provided and will continue for some time to provide the best combination of economy, accuracy and speed for the processing and storage of information. About half of the U.S. computers now in service, and an increasing percentage of the new machines being installed, are equipped with magnetic tape drives. Most of these tape-oriented computers today receive information from punched cards in sequential order. Since most business data processing is also sequential, tape consumption is expected to remain closely linked to the number and size of computer installations.

Storage cost of information on precision magnetic tape has been estimated at one-tenth of a cent per bit. Inherent economic advantages of tape also include the ability to erase and reuse it many times. Tape also offers a very high storage density. Current 7-channel, ¼-inch-wide, precision tapes have typical packing densities of 800 bits per inch. On a 2400-foot reel this provides a capacity for approximately 160 million bits. Packing densities of 4,000 and then 8,000 bits per inch are being predicted within four to seven years.

Wide frequency and dynamic range are coupled with magnetic tape’s low inherent distortion characteristics. Signal storage in magnetic form lends itself to automatic data reduction, and makes possible immediate playback of the information. To top it all, precision magnetic tape is easy to transport and to store.

Typical edp systems today perform more than 150,000 operations per second employing eight small tape drives with a punched card input and a printer. This compares with an all-punch-card system of 10 years ago that performed a thousand operations per second. By 1972, a typical system is expected to have about 12 tape drives on-line capable of handling 15,000,000 characters at a speed of 4,000,000 operations per second, resulting in a corresponding increase in tape use.

Nearly all of the precision magnetic recording tape made today uses a base, or substrate, of polyester film. For convenience, precision tape is usually defined to include audio tape. With about 20 U.S. manufacturers currently making magnetic tape, only eight (until recently) produced a precision tape to the exacting requirements of the computer market. In all it is estimated by industry sources that well over 10 million pounds of polyester film will be converted to precision magnetic recording tape during this year.

Sales of precision tape, estimated at over $110 million in 1965, are expected, by computer and tape industry experts, to exceed $250 million by 1970. With only minor exceptions this precision tape will be made of polyester film. Other tape bases are generally ignored by the precision tape market because of the availability of tough and durable polyester film.

Steel wire, oddly enough, was the original magnetic recording media used in voice recorders as early as 1898 in Denmark. Steel tape continues in use for some special applications which demand extremely high heat resistance and dimensional stability. Next in line historically is the coated-paper tape patented in 1928 that initiated the development of the modern tape recording. Around 1944 paper was in general supplanted by cellulose acetate film as a magnetic tape base. Both polyvinyl chloride and cellulose acetate films, however, lacked the necessary strength and dimensional stability required for reliable computer tape, although both are still employed satisfactorily in most audio tape applications.

Polyethylene terephthalate polyester film has dominated the field as the precision magnetic tape base material for at least ten years. Because of its basic strength and economy it is confidently expected to grow with the edp industry. Other plastic film materials continue to be evaluated for computer use as they are made commercially available. One such, the new polyimide film, has been employed in specialty uses requiring resistance to high temperatures. The very high cost of the film, at least for the

Mr. Ricci is West Coast sales supervisor for film and sheet products, Celanese Plastics Co. Joining Celanese as a project engineer in the plastics research and development laboratory, he later became technical marketing representative at Newark, N.J., headquarters. He has a BS in chemistry from Seton Hall Univ. and has been employed by Westinghouse Electric Corp. and Standard Packaging Corp.
present, prevents its widespread use as a precision magnetic tape base.

**precision magnetic tape—what is it?**

The modern precision computer tape is typically a half-inch wide strip of coated polyester film 2400 feet long that is wound on a 10%-inch O.D. reel. It can store 800 bits of magnetic information per inch on each of seven or more channels as the tape moves across a read/write head at 112.5 inches per second.

Viewed closely and in profile, a standard computer tape is seen to consist of a polyester film base 1.42 mil thick (0.000142 inches) and a magnetic oxide coating on one side that is about 400 micromicrons thick (0.000400 inches).

The magnetic coating is composed of a dispersion of ferromagnetic oxide (usually gamma ferric oxide—$\text{Fe}_3\text{O}_5$) with thermosetting binders, lubricants, electrically conductive additives, dispersing agents and solvents. It is coated onto master rolls of polyester film to one side of which has been applied a primer coat approximately one micron thick (0.000039 inches) to assure a strong bond between base and coating. The coated film passes through a strong magnetic field to orient the magnetic particles before it is dried and slit to standard computer tape widths.

The magnetic coating is not permitted to vary in thickness by more than about 15 micromicrons (0.000015 inches) and the coated tape must hold to a tolerance of less than 25 micromicrons (0.000025 inches) over its entire length. In addition, each finished reel of computer tape is tested 100% for electronic defects. This means the whole tape is written at the proper packing density (e.g. 556 or 800 bits per inch) and then played back. A single defect in the tape that causes a permanent drop in strength of the signal below 50% of its original level when it is played back (called a dropout) is considered cause for automatic rejection of that tape for computer use.

As the tape passes over the head, any tape defect may lift the tape from the head—causing a drastic signal drop. It takes only a gap of 140 micro-inches (0.000140 inches) between tape and the read/write head, for example, to cause a dropout or loss of signal at 800 bpi. It follows that—discounting the boundary air layer between head and tape—a tape surface defect of 140 micro-inches height would result in tape lift causing a dropout. Suppose we magnify the 1/2-inch wide 2400-ft. roll of tape 1000 times—in length and width—until it is a 42-foot-wide highway some 455 miles long. Then the surface defect that caused a tape dropout at 800 bpi would have been enlarged to the size of a pebble of approximately one tenth of an inch in diameter in the road surface.

Care and maintenance of computer tape is the one item for which the computer user has full responsibility. Normally the maintenance and repair of computers and peripheral equipment is performed by the manufacturer's customer service engineers. It has been estimated that a tape defect resulting in a serious information loss may cost as much as $500, or more, in computer time to correct. It is obvious that with such ultrasensitive equipment extreme care must be taken in order to reduce costly dropouts in the tape.

However, tape is also one of the few key parts of a modern computer involved in a strictly mechanical system. And mechanical operation immediately brings with it the associated difficulties of wear, tear, friction, alignment, environment and so forth. As the carrier for the magnetic tape coating, the tape base bears the full brunt of all this mechanical wear, tear and stress. And, as we have seen, even microscopic deviations in these critical mechanical dimensional factors can cause a dropout or malfunction.

The physical characteristics of the tape base thus play as important a role in the tape's performance as magnetic characteristics of the oxide coating. In normal computer operation the typical half-mile-long reel of tape moves back and forth across the read/write head, around driving and braking capstans, through pulleys and guide flanges, and then onto take-up reels. This occurs at speeds ranging from about 6 to 20 miles per hour (100 to 350 inches per second). To find a particular bit of data or instruction on the tape, it frequently comes to a full stop and starts off in the reverse direction. The start-stop time of a conventional tape system currently is of the order of 5 milliseconds, or less.

With the weight of the reel behind it, these sudden stops and reversals produce excessively high stresses in the tape. The ultimate tensile strength of the tape thus obviously has to exceed the greatest stress that the drive mechanism can deal out. But, just as important, the tape should not stretch or elongate beyond the point that would cause signal distortion. The tensile yield strength of a material is defined as the first stress level on a stress-strain curve at which there occurs a marked increase in strain without an increase in stress. In essence, tensile yield strength measures the stress required to make a material excited to stretch and begin to stretch permanently. Since permanent stretch in the tape can distort or destroy the signal fidelity and the tape alignment, the tape's tensile yield strength is a major factor. Another way of evaluating tape stretch as it relates to performance is to measure the amount of stress required to produce a 5% elongation in the film—which is known as the F-5 value. This method is used since it has been determined that computer tape can withstand 5% elastic stretch without adversely affecting signal fidelity. A typical value for this stress measurement on a one-mil polyester film is about 16,000 pounds per square inch. Low residual elongation of the tape during heavy operating or storage stresses also helps to prevent signal loss during playback.

Additionally, a high resistance to tear initiation is displayed by polyester film in comparison with other film base materials. This tear resistance ensures against tape breaks under constant handling.

Dimensional stability is one of the essential physical characteristics of any tape base. This means that there should be no significant change in size or shape of the tape either temporarily or permanently under temperature and humidity variations. Swelling or shrinking of the tape base can cause lateral shifting of the channels away from the read/write head, possibly resulting in crosstalk, and garbled or weak signals on some channels. Transverse expansion of the tape beyond width tolerances forces it to ride up on tape guides. This ruffles the edges, which, in turn, yields poor head contact. Shrinkage or expansion can also produce "cupping" of the tape so that it makes only partial contact with the read/write head, again causing crosstalk, dropouts and garbled signals. A tape that shrinks below the width tolerance, on the other hand, tends to weave back and forth laterally across the read/write head and thus reduce signal strength.

The way the base film is fabricated also affects its performance in precision tape use. Major trouble spots are surface dirt, contaminants, and gels which are caused by improperly dispersed polymer that forms nodules on the surface of the film. Polyester and other plastic films tend to accumulate a static charge during processing which promptly attracts all airborne dirt, dust, smoke, lint and fine contaminants within reach to the film surface. Electrically conductive additives are therefore incorporated in the magnetic oxide coating to dissipate or eliminate static charge on the finished magnetic tape supplied to

---

52
Visit us in memory lane, booth 733, Brooks Hall, Civic Center, San Francisco.

October 1966

We’ll be building on our reputation in San Francisco

On Nov. 8, 9 and 10 at the Fall Joint Computer Conference, we’ll triple the memory of a Bryant Series 4000 Disc File. Right before your eyes. It’ll progress from an eight-disc single-positioner unit to 24 discs and dual positioners. Capacity—better than a billion and a half bits. We’ll do it without a clean room. Without wasting time. Without a fuss. Want to watch? Visit the Bryant Exhibit. In addition, our famous Positioning Head Drum System (PhD) will also be in operation. They’re the best memories you’ll have of San Francisco.

BRYANT COMPUTER PRODUCTS

EX-CELL-O CORPORATION

October 1966
MAGNETIC TAPE . . . 

the computer user.

Carefully controlled film extrusion and orientation is employed to maintain optimum gauge, or thickness, uniformity in the manufacture of polyester film. This can be particularly critical in the transverse film direction. Poor gauge uniformity in the base film produces coating irregularities, such as a wedge-shaped section, which yields uneven signal fidelity across the tape.

Improper handling of the base film in storage and fabrication can also produce wrinkles, cross-buckles, stretch-lines and beaded edges which interfere with the critical performance of computer tape.

Each of these factors, then—tensile strength, dimensional stability, and uniformity—plays a vital role in the performance of the tape and the ultimate electronic system. Maximum values in each of these factors is mandatory for precision magnetic tape applications. In actual use, the uniform maintenance of a high level of performance from reel to reel is equally important to the operation of the system.

how do magnetic tape bases compare?

Polyester film clearly dominates the field today in the precision magnetic tape market. Its pre-eminence in this area is derived from its superiority in property characteristics in comparison with other film base materials. Cellulose acetate and rigid (non-plasticized) polyvinyl chloride plastic film materials offer the only real economic competition to polyester, at present. However, neither material comes near to challenging polyester in the precision magnetic tape market.

Cellulose acetate film, for example, is a popular base for audio tape. But for the more demanding use in precision magnetic tape, it lacks the high values of tensile strength, dimensional stability and tear initiation resistance that are now required. Polyester film is between two to three times stronger (in tensile strength) than cellulose acetate film—it is thirteen times more stable dimensionally, three times more resistant to tear initiation, and about ten times more resistant to cupping and curling.

When cellulose acetate tape breaks, however, it breaks cleanly with a minimum of stretch out, or elongation. This has the advantage for audio tape of minimizing sound distortion when the tape is spliced back together.

A film made of rigid polyvinyl chloride plastic is used to an appreciable extent in Europe as a base for audio recording tape. Its tensile strength is slightly lower than that of cellulose acetate, and still falls far short of the exceptional strength of polyester film. Rigid polyvinyl chloride film is clean breaking, but does not age as well as acetate.

As far as price goes, though, rigid polyvinyl chloride and cellulose acetate win hands down. On an area yield basis (that is, in cost per square inch), gauge for gauge, polyester film costs about twice as much as either of the other two films. Physical properties, of course, make the significant difference, carrying polyester into another class entirely. Because of these superior properties, polyester film is employed exclusively in the manufacture of precision magnetic tape for computers, video and instrumentation, despite its premium price.

Of course, better area yields can be obtained with polyester if a thinner polyester film is used that matches heavier gauge competitive films in strength. The thinner gauge film also saves weight and storage space; consequently, polyester film is seen as a major competitor in the audio tape market, too.

Although in a class by itself for use as precision tape, polyester film can be graded into different types. Three kinds of polyester film for magnetic tape emerge on a closer look. Fabrication technique and physical properties are the basis for the distinctions. The three types of polyester film are sometimes referred to as “tensilized,” “balanced,” and “balanced/tensilized.”

Tensilized polyester film is oriented or stretched in both directions but preferentially with the length—known as machine direction (MD)—of the film as it is manufactured. The result is a higher tensile strength in the machine direction.

Stretching orients the long-chain molecules in the direction of stretch from an original random distribution and results in higher strength.

A typical tensilized polyester film has a tensile strength of 40,000 psi in the machine direction, but only 25,000 psi across the width or transverse direction.

Balanced polyester film, as its name implies, has nearly equal strength in each direction. This biaxially stretched film provides roughly comparable tensile strength—approximately 25,000 psi—in both directions.

Balanced/tensilized polyester film strikes a middle ground in tensile strength and at the same time maintains its balance. A balanced strength of about 30,000 psi—a value between the upper and lower figures for tensilized film—is achieved in both machine and transverse directions for this new polyester film.

Tensile break strength and tensile yield strength for all three types of polyester film are compared in Table I in both machine and transverse directions. Tensile test data

<table>
<thead>
<tr>
<th>BASE FILM</th>
<th>TENSILE BREAK STRENGTH</th>
<th>TENSILE YIELD STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MD*</td>
<td>Width**</td>
</tr>
<tr>
<td>Balanced/Tensilized Polyester</td>
<td>30,000</td>
<td>30,000</td>
</tr>
<tr>
<td>Balanced Polyester</td>
<td>25,000</td>
<td>25,000</td>
</tr>
<tr>
<td>Tensilized Polyester</td>
<td>40,000</td>
<td>25,000</td>
</tr>
<tr>
<td>Cellulose Acetate</td>
<td>10,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Rigid Polyvinyl Chloride</td>
<td>8,000</td>
<td>8,000</td>
</tr>
</tbody>
</table>

**Commonly referred to as “Machine Direction” (MD) in the tape industry.

**Commonly referred to as “Transverse Direction” (TD) in the tape industry.

are also supplied for one-mil films of cellulose acetate and rigid polyvinyl chloride for further comparison. As can be readily seen, any one of the polyester films has the decisive edge in strength that means greater reliability under the shock impact of computer operation.

Anisotropy, or the imbalance of properties in different directions, produces further significant differences in these polyester films. Thus the tensilized film also displays unbalanced dimensional stability in machine and transverse directions.* As a result, at various temperature and humidity conditions the tensilized film expands or contracts more in one direction than in the other. The unbalanced tensilized film, or the tape made from it, has a tendency to cup or distort as the temperature and humidity change.

A comparison of the dimensional characteristics of the three types of polyester film, including coefficients of linear thermal and hygroscopic expansion, moisture absorption,

*In a magnetic tape evaluation conducted by the U. S. Army Electronics Research and Development Laboratory, results conclusively demonstrated that tensilized polyester film was considerably lacking in dimensional stability when compared to other magnetic tape base films.
Fact:

Drum Memories Make Time-Sharing Economically Feasible

Key requirements for time-sharing are fast access... capacity... reliability... flexibility... economy. Applied to time-sharing systems, drum memories meet these requirements better than any other mass storage device.

Take our Type 1116 Drum Memory System, for example. To TELCOMP, a time-sharing computer service for engineers and scientists developed by Bolt Beranek and Newman, Inc. (Cambridge, Massachusetts), the Type 1116 contributes average access of 8.3 msec... 10,000,000-bit capacity... memory bit cost of 0.35¢... internal parity generation and checking... 17µsec word rate... and read/write capability of 1 to 16 64-word blocks with two IOT commands.

What about reliability? BBN tells us one of their VRC memory drums recently completed 40,000 hours of continuous, trouble-free operation averaging no more than 1 parity error per week.

Small wonder so many memory problems get dumped in our lap. May we tackle yours?

If you're a computer-oriented circuit designer, systems designer or support technician, chances are there's an exciting assignment waiting for you at VRC. An assignment with an excellent present and sky's-the-limit future.

Contact Richard A. Stover, vice president.

Computers are known by their MEMORIES

...so is Vermont Research Corporation
ONLY 3C OFFERS...

TOTAL DIGITAL CAPABILITY

TOTAL BECAUSE . . . you get the most complete spectrum of digital hardware, associated software and customer support available today!
Products at the base of this capability include: digital logic modules . . . core memories . . . memory test equipment . . . special systems . . . and DDP computers that are the favorites in applications like flight simulation, message switching, freight yard control, laboratory work and computation analysis.
And in our own pioneering techniques laboratory we design and develop integrated circuits which are then mass-produced for use in most of our products. Extensive R&D like this helps to assure continued advanced hardware at low cost.
TOTAL BECAUSE . . . 3C (formerly Computer Control Company, Inc.) is now an operating division of Honeywell’s new Computer Group.
To extend our digital capability even further, the computer facilities of the Industrial Division in Fort Washington, Pa. recently became part of our division in Framingham, Mass. This addition to 3C is well known for its H20 control system — ideal in the manufacture of chemicals, steel, food, textiles, and electric utility dispatching.
Result! A concentrated total digital capability under one roof that specializes in on-line real-time plus control applications.
TOTAL BECAUSE . . . also a member of the new Computer Group is the EDP Division — a leader when it comes to commercial/business data processing.
It’s easy to see why Honeywell’s new Computer Group can satisfy almost any digital application. Why not take a look at 3C total capability now — write for our new brochure, “3C TODAY”.
Honeywell, Computer Control Division,

Honeywell
Would you believe a CalComp plotter and any computer can draw pictures like these in seconds?

a perspective sketch of your new plant

statistical trend charts

molecular structure diagrams

apparel patterns, graded for sizes

and even the Mona Lisa

it can

Call or write Dept. D10, California Computer Products, Inc., 305 Muller, Anaheim, California 92803. Phone (714) 774-9141.

CALCOMP
Standard of the Plotting Industry
(Talented Engineers and Programmers required—right now.)
CIRCLE 28 ON READER CARD
MAGNETIC TAPE

and thermal and hygroscopic shrinkage is shown in Table 2.

Resistance to tearing, and particularly the initiation of a tear, is a property of significant practical importance in the use of magnetic tapes. The anisotropy of the tensilized film adversely affects its tear initiation resistance as compared to the balanced films. The balanced/tensilized type attains typical tear initiation strengths of 2.5 pounds—as compared to a typical 1.0 pound value for tensilized film. Data on tear initiation resistance was generated by employing the Graves test method (ASTM D 1004-61).

<table>
<thead>
<tr>
<th>Property</th>
<th>Coefficient of Thermal Expansion</th>
<th>30 min. at 105°C</th>
<th>30 min. at 150°C</th>
<th>Coefficient of Hygroscopic Expansion</th>
<th>Hygroscopic Shrinkage</th>
<th>Moisture Absorption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units</td>
<td>Thermal Expansion</td>
<td>%</td>
<td>%</td>
<td>% in/in/90%RH</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Film</td>
<td>Length* Width**</td>
<td>Length* Width**</td>
<td>Length* Width**</td>
<td>Length* Width**</td>
<td>Length* Width**</td>
<td>Length* Width**</td>
</tr>
<tr>
<td>Base Film</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balanced/Tensilized Polyester</td>
<td>1.1 x 10^-5</td>
<td>1.1 x 10^-5</td>
<td>0.6</td>
<td>0.5</td>
<td>1.2</td>
<td>1.5</td>
</tr>
<tr>
<td>Balanced Polyester</td>
<td>1.5 x 10^-5</td>
<td>1.5 x 10^-5</td>
<td>0.7</td>
<td>0.6</td>
<td>2.0</td>
<td>2.2</td>
</tr>
<tr>
<td>Tensilized Polyester</td>
<td>3.3 x 10^-5</td>
<td>3.0 x 10^-5</td>
<td>2.0</td>
<td>1.4</td>
<td>9.0</td>
<td>8.5</td>
</tr>
</tbody>
</table>

*Commonly referred to as "Machine Direction" (MD) in the tape industry
**Commonly referred to as "Transverse Direction" (TD) in the tape industry

on nominal one mil samples.

As has been indicated, significant differences in the quality of polyester films stem from the conditions under which the film is fabricated.

Another major advantage of the balanced/tensilized polyester film is that the gauge uniformity is held to a tolerance of ± 5% of the mean gauge. No other polyester film currently is manufactured to conform to this stringent tolerance. Magnetic tape manufacturers, it will be recalled, hold their coatings to extremely close tolerances, and it thus becomes apparent that a consistently uniform tape is dependent to a large extent on the uniformity of the base film.

Attention to the holding of close tolerances is maintained throughout film and tape production. For example, something as simple as the control of the width of the tape can have a decided effect on its performance in a high-speed computing system. A tape that is less than the specified width by as little as 0.002 of an inch is free to begin to wander up and down between the tape guides. As a result the narrow tape crosses the read/write head at different angles at different times. This slight change in the angular tape-to-head relationship can cause an error or dropout when the reading head is not positioned exactly over the data track. The prevention of the difficulty is in the carefully controlled slitting of the coated master rolls of film into narrow tapes.

Dirt, or extraneous particles of matter, is one of the major causes of failure, or dropout, in precision magnetic tapes. Impurities in the tape itself, such as gels, airborne dust, and self dirt (e.g. shedding of the oxide coating) cause dropouts. To avoid contamination of the tape with these error-producing particles, extreme care is taken in both the manufacture of the film base and the magnetic tape.

Elaborate safeguards, similar to those used in hospital

and film often does not show up until the defective film is on the user’s production line.

Similar precautions are taken at each level of manufacture of precision magnetic tape. When it is turned over to the user, computer tape is normally 100% error free. To preserve this ultra-purity in actual use, most computer rooms are kept almost antiseptically clean as compared to the standards applied to conventional office maintenance.

the big dropout problem

Now, why all this elaborate cleanliness ritual for the sake of a few specks of dust? Is the tape and the data processing system so sensitive that it can be upset by a wayward airborne particle? Unfortunately, with modern digital computing systems it takes only one mote of dust, as small as 140 millionths of an inch in height, to cause a temporary or permanent tape malfunction. This error can be compounded many times when tape is wound on reels and the pressure of layer upon layer produces indentations in the surface of succeeding layers of tape.

Digital data in binary code is generally recorded above the magnetic saturation level in the form of sharp, discrete pulses that occupy only a microscopic space on the tape surface. At current packing densities of 800 bits per inch, a dropout, or 50% signal reduction, will result from a piece of embedded dirt projecting only 140 millionths of an inch above the surface of the tape. The introduction of one such error can be cumulative throughout the whole computer program, and render it useless.

Modern instrumentation tape recording is also highly sensitive to tape dropouts. Instrumentation tape like audio tape, employs analog recording methods in which a continuously varied signal is recorded below the magnetic saturation level. Here a dropout interrupts a small portion of a wave pattern without affecting the data that comes after it on the tape. However, a speck of dust will as
MAGNETIC TAPE . . .

easily produce an increase in modulation noise and a decrease in short wavelength response in addition to causing dropouts. As a case in point, a bump of less than 10 millionths of an inch can cause a 50% signal reduction at a recorded wavelength of 100 millionths of an inch. Again, this introduces significant error into the data reduction and processing system.

Returning to computer tape, higher bit-packing densities only increase the need for more and more stringent quality control and maintenance practices. The tenfold increase in packing density envisaged by 1972 to accommodate the growing mound of data in less space, tends to accentuate this formidable dropout problem.

An attempt at classification of dropouts has brought to light three distinct types:

1. **Permanent dropouts** result from an imperfection of the tape base or the magnetic coating during its manufacture. This built-in dropout is not removed by cycling and registers as a dropout in the initial 100% tape testing.

2. **Temporary dropouts** result from the bits of dust and airborne particles lightly stuck to the tape surface that fall off during normal machine cycling.

3. **Embedded dropouts**, like raisins in a cookie, are formed when temporary dropouts are made permanent by sticking them firmly into the tape coating.

The embedded dropout is by far the biggest problem source in computer tape care. And "self dirt" is the major source of embedded dropouts. Self dirt is commonly produced by oxide shedding in which chips of magnetic oxide break away from the coating surface. The oxide chips then accumulate on tape heads and guides where they are eventually dislodged and redeposited onto the tape surface. A contaminated film base, to which the coating can not be firmly bound, can be another source of oxide shedding and redeposition.

Slitting debris is another form of self dirt. It is produced by microscopic chips and burrs left on the edges of the tape by improper slitting of the tape. The chips or burrs are frequently dislodged by normal computer operation. The buildup of electrostatic charge on the tape tends to attract all small charged particles to it. Most plastic films subjected to friction will accumulate enough charge to create a problem. A thin film of oil or grease deposited on the tape by direct handling or improper care has much the same "flypaper" effect.

But, whatever the cause, temporary and embedded dropouts are essentially cumulative and self-propagating. In the normal wear process, foreign particles and self-dirt both serve to grind out more abrasive particles. After the first embedded dropout is formed, more and more tend to form in rapid succession.

Tape performance is more clearly tied to this embedded material than to the wearing away of the oxide coating itself. Self dirt and embedded dropouts have a number of origins. The list includes degree of roughness of the tape surface and its coefficient of friction, degree of smoothness of the tape edge, adhesive strength of the magnetic coating and the softening temperature of the binding resin as well as the speed, temperature, humidity, and tension at which the tape operates.

Physical distortion of the tape by folding, stretching, crimping, etc., is the second most common origin of dropouts or tape malfunction. The main source of trouble is in improper winding of tape reels. High speed tape drives produce side-to-side flutter as a result of air inclusion while the tape is being rewound onto the reel. After storage in this offset position the tape unwinds from the reel at a skewed angle on its next pass across the read/write head.

Tape folds result largely from a lack of constant winding tension on the tape reels. A momentary change in tension during wind-up causes the tape to slip during accelerated windup and fold on itself. This yields a horizontal crease as a permanent source of error. Longitudinal creases can be caused by guides or rollers that are badly out of line in the tape handling system.

Accidental damage is usually caused by human error in handling and storage of computer tape. Such simple things as dropping a tape reel and threading tape improperly in the machine can cause folds or creases in the tape. Holding the tape through the reel flange at a skewed angle on its next pass across the read/write head.

<table>
<thead>
<tr>
<th>Table 3-Major Causes of Computer Tape Dropouts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>This Dropout Cause</strong> . . . is indicated by this . . . Tape Condition</td>
</tr>
<tr>
<td>1. Oxide coating wear, flake-off, etc.</td>
</tr>
<tr>
<td>2. Defective read/write heads, or tape guides</td>
</tr>
<tr>
<td>3. Delaminating magnetic oxide coating</td>
</tr>
<tr>
<td>4. Foreign particles, dust, dirt, etc.</td>
</tr>
<tr>
<td>5. End-of-reel tabs</td>
</tr>
<tr>
<td>6. Fast rewind</td>
</tr>
<tr>
<td>7. Faulty machine operation</td>
</tr>
<tr>
<td>8. Improper storage or transportation conditions</td>
</tr>
<tr>
<td>9. Loose reel winding, improper tape wind-up tension</td>
</tr>
<tr>
<td>10. Faulty slitting</td>
</tr>
<tr>
<td>11. Failure to normalize to computer ambient environment</td>
</tr>
<tr>
<td>12. Misaligned drive mechanism</td>
</tr>
</tbody>
</table>

Table 4—Precautions for Handling and Storage of Precision Magnetic Tape

1. Store tape reels in dustproof sealed bags; stack on edge in original carton and maintain at regulated temperature and humidity conditions suggested by manufacturer.

2. Handle with care by picking up reel at hub, not flange, keeping fingers off working surface of tape, fastening tape end so that it is not exposed; load take-up reel as manufacturer suggests, without folding tape leader or leaving it outside reel.

3. Establish rigid maintenance check adopting manufacturer's recommendations for periodic checking of tapes and tape reels for contamination; cleaning of read/write head, braking and driving clamps and pulleys; and adjusting of rewind mechanisms according to manufacturer's specifications.

4. Rewind tapes in long-term storage at least once a year to relieve built-up internal stresses.

5. Maintain thermal equilibrium of tape and computer environment by placing stored tape in operating ambient condition for at least six hours before use.
Geo Space's revolutionary DP-203 Digital CRT Plotter uses a CRT's electron beam for plotting. Does away with messy ink receptacles and skipping ballpoint pens. An electron beam positions up to 96 million plotted data points over an entire 2400 sq. in. surface to within ±1/2 bit. That's ±.0025 of an inch in the 200 dpbi plotting mode. Match that accuracy with a pen plotter!

Do you require multiple copies of any plot you produce? The positive film images of the Geo Space DP-203 CRT Plotter can be used to produce multiple Ozalid or Xerox copies at a cost of only pennies apiece.

On-line plotting is now a practical, economic reality. Gone are the separate core buffers and controllers of yesteryear.

Using Geo Space furnished ALPACA® linkage software, you can produce detailed contour or cartographic maps, electronic schematics, PERT charts, tabular charts, annotated drawings and the like. One-pass annotation to describe and label your primary images.

Another important benefit—up to 32 levels of intensity shading can be program selected to enhance the tonal contrast of your completed imagery. Background area shading also.

Want more information on the most advanced plotting peripheral available today for digital computers? Write or call Computer Marketing: Geo Space Corporation, Computer Division, A Subsidiary of Westec Corporation, 3009 South Post Oak Road, Houston, Texas 77027. Telephone: 713/622-4570.
Some important things you should know about Potter’s low-cost chain printer

By now, nearly everybody has either seen or heard about the Potter HSP-3502 printer with its unique chain design.

Since its introduction, this printer has offered the combined benefits of high reliability and the lowest price in the field.

Now, you can buy the Potter chain printer plus complete control electronics, including buffer, for only slightly more than the original price of the printer alone.

Other Potter chain printer benefits:
- Marked reduction in number of parts compared with conventional printers.
- Quiet operation.
- Precise vertical registration.
- Up to 192 characters in 80 to 132 columns.
- Sharp character definition — up to six copies.
- Integrated circuit electronics.

The Potter Chain Printer is completely different from any other. It uses a continuously rotating belt with individually attached, easily removable type slugs.
For full details on the Potter Chain Printer—write, wire or phone today.

POTTER INSTRUMENT COMPANY, INC.

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

See the complete line of Potter peripherals at FJCC—San Francisco, Booths 801, 803, 805.

October 1966
Which approach to Digital Plotting fulfills your needs?

If you prefer an incremental plotter:

Model 6650 Omnigraphic® Incremental Plotter is a bi-directional recorder that operates directly from digital computers, incremental encoders, pulsers, pulse generators or any incremental signal.

- Z-Fold Paper (tears out to standard 8½” x 11”)
- 18,000 Increments/min Speed
- 0.01” or 0.005” Resolution
- Infinite Scale Expansion
- $2850

If you prefer plotting directly from parallel digital data:

Model 6710 Omnigraphic® Digital Plotter is a high speed point plotter which operates directly from binary or BCD data.

- Z-fold Paper (tears out to standard 8½” x 11”)
- 2400 inch/min Slewing Speed
- Capable of Both Digital or Analog Operations
- 2 μsec. Access—Single Point Memory
- $3725
A truly effective computer-directed data processing system is one that can be programmed rapidly and efficiently by the intended user. However, most data processing systems, and the languages developed for use with them, implicitly require that the user be trained as a computer programmer. Contrary to the system programmers' general conception, the user may not readily adopt programmers' conventions for his task. A problem-oriented data processing system is not automatically a user-oriented system, and may present a severe obstacle to the non-programming-oriented user. In the case of automatic test equipment, the user is a test engineer who thoroughly understands testing techniques and the functional operation of his equipment. To prepare programs which direct the operation of his tests on the automatic test equipment, the test engineer needs a programming system which he can understand and use easily.

**The ATE System**

An automatic test equipment (ATE) system consists of a configuration of programmable devices which apply stimuli to, and obtain measurements from, electronic units under test (UUT's). The testing process is designed to determine the operational condition of the UUT. The programming task consists of translating the procedures for testing a UUT into a program which conducts the equipment test.

The ideal test equipment programmer should be capable of understanding complex logical sequences of both hardware and programming processes. He should be able not only to devise the test specifications and assist in the debugging of the unit being tested, but, because the testing procedures are controlled by the test program, also must be capable of writing and checking out the computer program.

In practice, few people have the necessary combination of programming and engineering training and experience. In many applications, the broad differences in technologies between test engineering and computer programming make it more efficient to train test engineers in the rudiments of programming techniques than to teach programmers the intricacies of equipment checkout. The problem, then, is one of developing a programming system which can be readily used by a non-programming-oriented test engineer to prepare and check out his test program. Such a programming system not only expedites the process of obtaining operational test programs, but reduces the overall cost of test programming. A user-oriented programming system consisting of a compiler and simulator was developed for the Depot-Installed Maintenance Automatic Test Equipment (DIMATE) system.  

DIMATE, a computer-controlled test system, was designed and built for the U. S. Army Electronics Command, Fort Monmouth, New Jersey, to test and check out a wide variety of electronic and electrical communications equipment in real-time.

The DIMATE System consists of a complex of stimuli and measuring devices. Adapter cables connect the test points on the UUT to connector panels on DIMATE. Stimuli are routed to these connector panels and the responses of the UUT presented at these connector panels are measured.

The DIMATE System consists of the following six subsystems:

1. **Computer/Controller Subsystem**
   - The computer/controller subsystem contains a general-purpose digital computer and a system controller. The digital computer makes logical decisions and performs computations. The controller controls the operation of the switching subsystem and the input and output devices.

2. **Stimulus Subsystem**
   - The stimulus subsystem generates the basic voltage previously with RCA Aerospace Systems Div., Mr. Scheff was the project engineer for the development of a compiler and simulator program for an Automatic Test Equipment System (DIMATE). He is currently responsible for the programming aids being developed for an aerospace computer at Raytheon Co., Missile Systems Div. He received a BA in math from Oberlin College and an MA in mathematical statistics from Columbia Univ.
A thousand words

To get the whole picture about how our media conversion systems can save you computer time (which means money) you'll have to read most of the following thousand-or-so words. It'll be worth your while.

Our premise: The work of translating punched-card or punched-tape data into the kind of electronic information your computer can understand is too often done on a peripheral computer which really ought to be doing better things. And in some instances, the main frame itself is being used for this time-consuming chore.

Our solution: Do your media conversion off-line. Our paper tape-to-magnetic tape and punched card-to-tape systems were designed specifically for this one job. By putting your data on magnetic tape and feeding it to your computer in this pre-formatted fashion, you increase your data input rate so dramatically that you may effect main frame time savings as high as 50%.

The systems: We make three basic media conversion systems; one (P/T) handles paper tape-to-magnetic tape; the second (C/T) converts data from punched cards at speeds of 800 or 1500 cards per minute; the third MCS "COMBO" combines the abilities of both the C/T and P/T, alternately handling punched paper tapes and punched cards.

How they operate: Our media conversion systems are adaptable to any form of punched tape or card input. The P/T system accepts 5-, 6-, 7-, or 8-level paper tape in virtually any code. The paper tape reader handles 1000 characters per second, yet it stops between characters to let the magnetic tape unit record an accumulated data block.

The C/T systems read 51- or 80-column punched cards in column binary or Hollerith code. Cards are read column-by-column by a photodiode read scheme.

The outputs from the P/T or C/T units are identical: data blocks written on magnetic tape according to the desired length and packing density, in either 7- or 9-channel magnetic tape format. And every single data block is completely free of conversion errors.

A series of built-in checks during conversion assure you that no main frame computer time will be wasted on erroneous input information. The following sequential operation charts demonstrate how each step of the conversion is carefully checked:
BYPASSING PROFESSIONAL PROGRAMMERS

by BENSON H. SCHEFF

A truly effective computer-directed data processing system is one that can be programmed rapidly and efficiently by the intended user. However, most data processing systems, and the languages developed for use with them, implicitly require that the user be trained as a computer programmer. Contrary to the system programmers' general conception, the user may not readily adopt programmers' conventions for his task. A problem-oriented data processing system is not automatically a user-oriented system, and may present a severe obstacle to the non-programming-oriented user. In the case of automatic test equipment, the user is a test engineer who thoroughly understands testing techniques and the functional operation of his equipment. To prepare programs which direct the operation of his tests on the automatic test equipment, the test engineer needs a programming system which he can understand and use easily.

the ate system

An automatic test equipment (ATE) system consists of a configuration of programmable devices which apply stimuli to, and obtain measurements from, electronic units under test (UUT's). The testing process is designed to determine the operational condition of the UUT. The programming task consists of translating the procedures for testing a UUT into a program which conducts the equipment test.

The ideal test equipment programmer should be capable of understanding complex logical sequences of both hardware and programming processes. He should be able not only to devise the test specifications and assist in the debugging of the unit being tested, but, because the testing procedures are controlled by the test program, also must be capable of writing and checking out the computer program.

In practice, few people have the necessary combination of programming and engineering training and experience. In many applications, the broad differences in technologies between test engineering and computer programming make it more efficient to train test engineers in the rudiments of programming techniques than to teach programmers the intricacies of equipment checkout. The problem, then, is one of developing a programming system which can be readily used by a non-programming-oriented test engineer to prepare and check out his test program. Such a programming system not only expedites the process of obtaining operational test programs, but reduces the overall cost of test programming. A user-oriented programming system consisting of a compiler and simulator was developed for the Depot-Installed Maintenance Automatic Test Equipment (DIMATE) system.

DIMATE, a computer-controlled test system, was designed and built for the U. S. Army Electronics Command, Fort Monmouth, New Jersey, to test and check out a wide variety of electronic and electrical communications equipment in real-time.

The DIMATE System consists of a complex of stimuli and measuring devices. Adapter cables connect the test points on the UUT to connector panels on DIMATE. Stimuli are routed to these connector panels and the responses of the UUT presented at these connector panels are measured.

The DIMATE System consists of the following six subsystems:

1. Computer/Controller Subsystem
   The computer/controller subsystem contains a general-purpose digital computer and a system controller. The digital computer makes logical decisions and performs computations. The controller controls the operation of the switching subsystem and the input and output devices.

2. Stimulus Subsystem
   The stimulus subsystem generates the basic voltage

Previously with RCA Aerospace Systems Div., Mr. Scheff was the project engineer for the development of a compiler and simulator program for an Automatic Test Equipment System (DIMATE). He is currently responsible for the programming aids being developed for an aerospace computer at Raytheon Co., Missile Systems Div. He received a BA in math from Oberlin College and an MA in mathematical statistics from Columbia Univ.

Contact DA-36-049-SC-90583
A thousand words

To get the whole picture about how our media conversion systems can save you computer time (which means money) you'll have to read most of the following thousand-or-so words. It'll be worth your while.

Our premise: The work of translating punched-card or punched-tape data into the kind of electronic information your computer can understand is too often done on a peripheral computer which really ought to be doing better things. And in some instances, the main frame itself is being used for this time-consuming chore.

Our solution: Do your media conversion off-line.

The systems: We make three basic media conversion systems; one (P/T) handles paper tape-to-magnetic tape; the second (C/T) converts data from punched cards at speeds of 800 or 1500 cards per minute; the third MCS “COMBO” combines the abilities of both the C/T and P/T, alternately handling punched paper tapes and punched cards.

How they operate: Our media conversion systems are adaptable to any form of punched tape or card input. The P/T system accepts 5-, 6-, 7-, or 8-level paper tape in virtually any code. The paper tape reader handles 1000 characters per second, yet it stops between characters to let the magnetic tape unit record an accumulated data block.

The C/T systems read 51- or 80-column punched cards in column binary or Hollerith code. Cards are read column-by-column by a photodiode read scheme.

The outputs from the P/T or C/T units are identical: data blocks written on magnetic tape according to the desired length and packing density, in either 7- or 9-channel magnetic tape format. And every single data block is completely free of conversion errors.

A series of built-in checks during conversion assure you that no main frame computer time will be wasted on erroneous input information.

The following sequential operation charts demonstrate how each step of the conversion is carefully checked:

Increase your main frame data input rate by a factor of 120!

Your punched card or paper tape direct input rate to the central processor is, at best, 1,000 cps; typical magnetic tape input rate is 90,000 to 120,000 cps. You can see that it makes sense to put your raw data onto magnetic tape with an off-line media conversion system.
If you are doing data conversion on your computer, compare the savings possible by doing it on an Ampex media conversion system.

The time and money savings you can expect from an Ampex media conversion system are difficult to project on an across-the-board basis because of many variables, but if you study the charts above you can get fairly good "ball park" ideas.

Chart I illustrates paper tape-to-magnetic tape conversion costs for three different computer systems. It is based on weekly processing volume in hours, and costs of this processing are shown in relation to the per-month cost of the system. We have also charted the approximate monthly rental cost of our P/T 1000 system. You can see that the break-even points are where the lines intersect.

Chart II compares the main frame time required to input raw data from paper tape with the time required to input the same volume of data from magnetic tape. It is easy to translate time saved into dollars. The time and dollar savings illustrated in these charts for the P/T system are similar for the C/T system.

We will be glad to study your current procedure and demonstrate what our media conversion system could mean to you in savings of time and money. Just drop us a note.

Lease or purchase: Low cost lease plans and a very attractive lease-purchase option plan fit the financial circumstances of many users. They permit you to begin using this money-saving system without tying up capital.

If you want to purchase your system, the prices are as follows: the P/T system, $26,800; C/T systems range from $28,900 to $39,500, depending on the card speed you want; MCS "COMBO" system sells from $50,600 to $58,000, again depending on card speed desired.

We realize that data conversion, as we are performing it with the Ampex P/T and C/T systems, is a fairly recent development and that there are many more details you will want to know before you can put them to work for you. We will be glad to send you (or bring you, if you wish) complete descriptive literature on our systems. Please fill out the coupon below and mail it to Ampex Corporation, 401 Broadway, Redwood City, California 94063.

Gentlemen: I am interested in details about data conversion to magnetic tape from punched tape punched cards both media.

Please send appropriate information. □ Have salesman contact me. □ My telephone number is:_____________________

NAME______________________________________________
COMPANY____________________________________________
ADDRESS____________________________________________
CITY_________________________________________________
STATE_________ZIP____________________

AMPEX

October 1966
First cost of digital computer tape? Forget it!

The real cost is the price-per-pass.

And on that basis, U.S. Tape with exclusive Duramil 7 may well be the lowest priced tape on the market today!

Duramil 7 makes possible the manufacture of computer tape with superior abrasion resistance and oxide adhesion . . . excellent scratch resistance. Coupled with 8 + 8 Total Surface Testing* — a forward step in truly error-free tape certification — U.S. Tape with Duramil 7 records and maintains your data pass after pass after pass. More passes, you’ll find, than any other tape you can buy.

Give us a call to arrange your own evaluation program.

* Write for free booklet: “The facts about testing magnetic tape for digital computers.”
levels, sinewaves, and pulses for use in stimulating a UUT. The basic stimuli can be mixed to generate complex waveforms.

3. Measurement Subsystem
   The measurement subsystem measures the response from the UUT, compares the response against programmed limits and converts the measurement to digital data. The basic parameters that may be measured are voltage, frequency, time interval, power, resistance, and impedance.

4. Switching Subsystem
   The switching subsystem selects and routes stimuli, responses and measurements, to the programmed assemblies within the stimulus and measurement subsystems. The switching functions include:
   1. Stimuli selection.
   2. Routing the selected stimuli to synthesize complex stimuli.
   3. Routing the synthesized stimuli to the UUT.
   4. Selecting measurement functions and ranges.
   5. Selecting UUT responses.
   6. Routing measurement data.

5. Control and Display Subsystem
   The control and display subsystem provides the primary interface between the operator and the remainder of the system. This subsystem permits the operator to exercise overall control. The control and display subsystem also displays test results and measurement data to the operator.

6. Power Supply Subsystem
   The power supply subsystem distributes primary power and converts primary power to the required dc voltage levels for the operating assemblies.

The DIMATE programming system permits engineering users with various technical skill levels to generate accurate test programs and debug them quickly. The compiler allows the test engineer to write the program directly in a language that he understands, automatically converting his specification to the operational system's digital code. The simulator permits the engineer to verify (i.e., debug) his test program prior to validation (operational checkout) on the test system with a UUT. The first DIMATE system is in operation at Tobyhanna Army Depot, Tobyhanna, Pa.

The purpose of this article is to demonstrate a user-oriented programming system using the automatic test equipment system, DIMATE. From a programming viewpoint, more sophisticated compilers and simulators have been written; however, the effectiveness of these DIMATE programming aids lies in their simplicity, permitting them to be used successfully without an extensive learning process on the part of the user.

The process by which DIMATE programs are generated, verified, and validated is shown in Fig. 1. The source language deck describing the equipment test procedures is keypunched directly from coding sheets prepared by the test engineer. The test program is translated to the operational machine code by the compiler which operates on the RCA-301 computer. The object deck produced by the compiler on the RCA-301 can either be exercised on the simulator program or used on the DIMATE system.

The DIMATE user can be any one of three types of individuals:
   1. Military test engineers at the depot responsible for developing test procedures for the equipment being serviced
   2. Test design engineers who participated in the development of the automatic test equipment
   3. Test technicians.

These personnel not only differ in their relative technical skill for testing electronic equipment, but, because computer training was not prerequisite, may differ greatly in their programming abilities.

For these reasons, the language used to specify the equipment test programs is of critical importance. The compiler source language must permit the engineer to program his test specification directly. Unfamiliar notation, terminology, or syntax will cause the test engineer difficulties in relating the compiler's source language to his test specification. As a consequence, either an explicit or implicit translation process from the user's ideas to the test program vocabulary must ensue. If programmers must be employed to code the engineer's test specifications, communication difficulties are likely to arise between the engineer and the programmer.

Therefore, the compiler's source language must accommodate the various skill levels, engineering and programming, of the DIMATE user so that both the highly skilled engineer and the relatively unskilled test technician can write test programs. If this is accomplished, the number of potential users of the compiler is increased, and the amount of training required to use the compiler by even the skilled test engineer is reduced.

**compiler source language and format**

These goals were achieved for DIMATE by developing a compiler input language consisting of engineering expressions arranged in a tabular format. Because the tabular structure provides a framework into which test parameters can be inserted, procedures are stated simply. Programming conventions are implicit in the structure of the table and the test engineer programs his requirements in a format and vocabulary which appears natural to him. The compiler vocabulary and format provide a basic language structure oriented towards the user's background and his associated task requirements without forcing him to rely upon unfamiliar terms. By not requiring specialized programming notation, engineer-to-engineer communication is facilitated and the test program in compiler source language becomes final user documentation.

The compiler language functions can be considered to be divided into three groups: a basic group of test functions for the relatively untrained user and two groups of functions which require, respectively, greater programming skill or engineering knowledge to use properly. These latter groups of compiler functions act as an "overlay" and are not required to perform the basic equipment tests.

The relatively unskilled user is expected to use only the
BY-PASSING . . .

Basic test processes to write his test program. He needs to:
1. Connect and disconnect stimulus and measuring devices
2. Establish proper time delays
3. Generate stimulus signals and perform measurements
4. Evaluate measured values against specified limits

Fig. 2 Basic program format on sample coding sheet

5. Branch based upon the results of a measured comparison
6. Print the measurement results.

The compiler statements for these functions form the primary language used to specify DIMATE test operations. This primary language is comprehensive and permits all output stimulus signals and input measurements to be selected. Each statement defines the selected stimulus to be applied to the UUT, the selected measurement to be performed, and the DIMATE connection points.

The more skilled user who is interested in programming his test more efficiently can use internal program branching and subroutine linkages. Internal test program control is achieved by the programmer through conditional jumps based upon the state of internal program indicators. The compiler language permits both open and closed subroutines. Any section of the program can be defined by the programmer as an open subroutine while predefined computational subroutines allow arithmetic functions of either a single measurement or several measurements to be evaluated.

The highly skilled user can intentionally violate the DIMATE system rules by making direct reference to each of the stimulus and measurement subsystems. This feature is considered beyond the capability of the normal user, because coding in machine language of the DIMATE computer requires skill in applying both engineering and programming techniques.

The complete compiler language consists of 24 function words. Associated with these function words is information which further defines the function such as units of magnitude, statements to be printed, and connection point identification. The function words and their meanings are listed in Table I. The test specifications are keypunched on cards to form the compiler's source deck. For operational convenience, each function is completely described on one 80-column card. The standard tabular form for the card is exhibited in Fig. 2. The test number field permits the test designer to identify the compiler statement by a test number reference or a symbolic tag while the function field contains the compiler function. The remain-

AN IMPORTANT ANNOUNCEMENT ABOUT DISPLAYS . . . A REPRISE

If you saw our advertisements in past issues, you may recall that we have described CRT displays for specific computers. IDI has probably sold displays for more different computers than any other manufacturer . . . including displays for the 160A, 250, 360, 425, 440, 490, 520, 1107, 1108, 7094, DDP24, DDP116, DDP 224, PDP5, PDP8, and Spectra 70.

And we take interface responsibility.

These are "building block" systems. Various CRT packages, function generators, and input devices can be economically combined to meet your exact requirements.

If you are concerned with computer-aided design, management information, simulation—in short, with information display—write for data sheet 127-666. (We will send a few others also).

At the Fall Joint Computer Conference, be sure to see our Computer Controlled Display operating in booth 1001-1003.
AMPHITRITE

For major Navy commands in the Atlantic and Pacific ocean areas, over the past 6 years, Planning Research Corporation has had the responsibility for analysis, design and programming of powerful automated information systems. Approximately 60 Planning Research staff members are now assigned to this ADP work in Hawaii, Norfolk, and Washington, D.C.

Planning Research systems synthesis is complete. It begins with analysis of the total system, and design engineering. It ends with final checkout on any computer system. Applied, it saves time or money, or both. For particulars, write to Dr. Alexander Wylly, Vice President for Computer Sciences.

PLANNING RESEARCH CORPORATION
Home office: 1100 Glendon Avenue, Los Angeles, California 90024
SYSTEM/360 passed Mobil’s computer economy run...

Twelve IBM SYSTEM/360’s are saving money for Mobil Oil Corporation…and helping them improve customer service, too. Their third SYSTEM/360 is a good example. It is a Model 30 that went in last March at the regional credit card center in Kansas City. In just two weeks it was out-performing a more expensive IBM 1460.

What the 1460 did in 20 hours, the SYSTEM/360 was doing in 17—using the same programs. With the time saved, Mobil can do more jobs. Like the two daily reports for the traffic department. They help get more productive mileage from 3,400 tank cars—and help save $100,000 a year in the process.

What about Mobil’s other SYSTEM/360’s? Well, the Model 40 at corporate headquarters uses existing programs to do payrolls and sales reports and to speed data into and out of three other computers.

It processes a variety of new programs as well. In its spare time, it’s being used to test programs for a much larger SYSTEM/360.

So far Mobil has SYSTEM/360’s in Tokyo, Dallas, Los Angeles, Melbourne and eight other locations. By the end of 1967, many more will be installed.

A couple of thousand companies in every type of business have, like Mobil, discovered that SYSTEM/360 works hard, long and fast. It’s like we’ve been saying all along: SYSTEM/360 is the computer with a future.

IBM®

at 15,000 bills per hour.
You probably are if you limit your data transmission rate to 200 cards or lines per minute, the average data transmission at 2400 bits per second. But you can take the gag off by boosting your data transmission throughput more than 80% with the Rixon Sebit 48-M Data Set which transmits at 4800 bps. You still use telephone voice circuits. You cut in half the time required to do such jobs as payroll transmission. You can add new functions to your system with the extra off-time gained from the higher transmission rate. You often save labor costs and line charges, too. The Sebit 48-M interfaces with all systems and complies with FCC regulations. So ask your computer manufacturer or telephone company how Rixon equipment is adding new speed to on-line computer systems. It can do the same to yours! Write or call us and we'll send you facts and figures on how you can move data faster.

INSPECT THE SEBIT 48-M AT THE FALL JOINT COMPUTER CONFERENCE

RIXON ELECTRONICS, INC.
2120 Industrial Parkway/Silver Spring, Maryland 20904

CIRCLE 35 ON READER CARD
ing fields contain modifiers, arguments, or DIMATE connection point numbers according to the requirements of each individual function. Modifiers are the units of measurement and magnitude which further define the task of a particular function while the arguments are the values which are used.

The test designer can write his test specification using only the basic test functions (Group 1 in Table 1). Because those functions which activate the stimulus and measurement devices form the basic framework for any

test, the associated compiler language statements provide important use of the basic language structure. The operations performed by these functions are briefly described in the following paragraphs.

**function operations**

The CONNECT function selects all DIMATE assemblies required to generate a particular stimulus and scales them to the specified values after which the stimulus is connected to the designated UUT connection points. The DISCONNECT function performs the associated disconnect operations. For the MEASURE function, the compiler selects the measuring device defined by the statement's arguments, automatically programs a standard delay, and gives the measure command. If tolerance limits are stated, the compiler selects the object program to perform the necessary comparisons after the measurement. This standard delay allows both the stimuli selected since the last measurement, and the devices selected for this measurement, to settle. To accommodate special UUT requirements, the engineer

**Table 1: DIMATE Compiler Functions**

<table>
<thead>
<tr>
<th>Group</th>
<th>Function</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CONNECT</td>
<td>Applies stimulus to UUT</td>
</tr>
<tr>
<td>1</td>
<td>DISCONNECT</td>
<td>Disconnects a stimulus from UUT</td>
</tr>
<tr>
<td>1</td>
<td>MEASURE</td>
<td>Measures a response from UUT</td>
</tr>
<tr>
<td>1</td>
<td>*MEASURE</td>
<td>Sets up to measure a response from UUT</td>
</tr>
<tr>
<td>1</td>
<td>MONITOR</td>
<td>Continuously measures a response from UUT</td>
</tr>
<tr>
<td>1</td>
<td>WAIT</td>
<td>Specifies a time interrupt period</td>
</tr>
<tr>
<td>1</td>
<td>DELAY</td>
<td>Causes a delay prior to measuring</td>
</tr>
<tr>
<td>1</td>
<td>TRIGGER</td>
<td>Starts external time delay period and a measure</td>
</tr>
<tr>
<td>1</td>
<td>PRINT</td>
<td>Prints a message</td>
</tr>
<tr>
<td>1</td>
<td>MESSAGE</td>
<td>Defines a message</td>
</tr>
<tr>
<td>1</td>
<td>PAUSE</td>
<td>Stops for manual intervention</td>
</tr>
<tr>
<td>1</td>
<td>GO TO</td>
<td>Conditionally or unconditionally changes the program sequence</td>
</tr>
<tr>
<td></td>
<td>HALT</td>
<td>System reset</td>
</tr>
<tr>
<td>2</td>
<td>SET</td>
<td>Sets a program indicator</td>
</tr>
<tr>
<td>2</td>
<td>RESET</td>
<td>Resets a program indicator</td>
</tr>
<tr>
<td>2</td>
<td>CHECK</td>
<td>Checks a program indicator</td>
</tr>
<tr>
<td>2</td>
<td>CALISUB</td>
<td>Calls a predefined subroutine</td>
</tr>
<tr>
<td>2</td>
<td>SAYEMV</td>
<td>Saves the last measured value</td>
</tr>
<tr>
<td>2</td>
<td>NAME</td>
<td>Creates a named location</td>
</tr>
<tr>
<td>2</td>
<td>ENTER</td>
<td>Enters a subroutine</td>
</tr>
<tr>
<td>2</td>
<td>LEAVE</td>
<td>Leaves a subroutine</td>
</tr>
<tr>
<td>3</td>
<td>ASSEMBLE</td>
<td>Permits DIMATE instructions to be used directly</td>
</tr>
<tr>
<td>3</td>
<td>COMPILE</td>
<td>Permits use of compiler functions</td>
</tr>
<tr>
<td>3</td>
<td>END</td>
<td>Terminates the compilation</td>
</tr>
</tbody>
</table>

In addition to the object test program in DIMATE machine code, the compiler will produce a From-To wiring list based on the connection point information. This list contains the information necessary to produce the test cables between DIMATE and the UUT.

By-Passing

October 1966
U.S. Case patent numbers are 3074546, 3138250, D196987. Foreign patents secured in principal countries. Other patents applied for.
5 cases fit where 4 did before.

If you store 204,387 reels of tape, this new case saves you one mile of shelf.

That’s not just arithmetic, either. For a big tape user, we could be talking about saving a new building, or at least a new wing. Certainly we’re talking about an awful lot of shelf. The best tape storage case in the industry is now thinner. Five-sixteenths of an inch thinner. And this is a complete case. It has a bottom and a top. It keeps out dust, moisture, other contaminants. Not only from the tape, but from the reel flanges. The case supports the reel where it should be supported ... at the aluminum hub, not the plastic rim. Then, there are the things we didn’t change. The unique locking device is still there, still patented, still fully enclosed within itself to keep wear particles away from the tape. When you turn the handle, you can still hear the click that locks it and read the word “lock” when you do. (Oh, we did change the handle a bit. Larger. Easier to grip.) For people who are choosy, there’s no protection that equals this case — now thinner than ever before. Tell your tape supplier to deliver on a Data Packaging reel — the one with the ring of color around the hub — locked in the new, slim storage case. Tell him you need the space.
is able to program his own delay. Overriding the standard delay is needed to ensure that a minimum time delay has elapsed or to measure, say, an instantaneous peak. By using the measure function, he can connect the measuring device bypassing the standard delay. The wait and delay functions allow a time delay to be specified directly.

For these functions, test statements in compiler format look identical to an English statement with connective words removed and some unnecessary descriptive words eliminated. Statement 1 of Fig. 2 connects a 100-volt dc stimulus source to dimate test points J80-19 and J80-12. Statement 2 of Fig. 2 measures 30.0 ohms with a tolerance of 12% between points dimate J1-20 and P1-20.

On the coding sheets, the test engineer only lists pertinent data, according to the following syntax rules.

1. The primary signal characteristic follows the function designation; the name of the signal is placed in the units field while the value of the signal is placed in the magnitude field.

<table>
<thead>
<tr>
<th>Table 2: Stimulus Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stimulus</strong></td>
</tr>
<tr>
<td>1. Internal Power Supply</td>
</tr>
<tr>
<td>2. Relay Supply</td>
</tr>
<tr>
<td>3. Primary Power (AC)</td>
</tr>
<tr>
<td>4. Filament Supply (AC)</td>
</tr>
<tr>
<td>5. Standard Frequency</td>
</tr>
<tr>
<td>6. Switches (AF/DC)</td>
</tr>
<tr>
<td>7. Signal Ground</td>
</tr>
<tr>
<td>8. Chassis Ground</td>
</tr>
<tr>
<td>9. DC Voltage</td>
</tr>
<tr>
<td>10. Power Load</td>
</tr>
<tr>
<td>11. Sine Wave Signal (CW)</td>
</tr>
<tr>
<td>12. Modulation</td>
</tr>
<tr>
<td>13. Audio Power</td>
</tr>
<tr>
<td>14. Pulse Train</td>
</tr>
<tr>
<td>15. Local Oscillator</td>
</tr>
</tbody>
</table>

Table 3: Measurement Statements

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ac Voltage</td>
<td>VAC, TVAC</td>
</tr>
<tr>
<td>A. RMS</td>
<td>VRF</td>
</tr>
<tr>
<td>B. RF</td>
<td>VPP</td>
</tr>
<tr>
<td>C. Peak-to-Peak</td>
<td>VDC, TVDC</td>
</tr>
<tr>
<td>2. Dc Voltage</td>
<td>OHMS, KOHMS, MOHMS</td>
</tr>
<tr>
<td>3. Dc Resistance</td>
<td>ZOHM, KZOHM</td>
</tr>
<tr>
<td>4. Impedance</td>
<td>W, MW</td>
</tr>
<tr>
<td>5. Average Power</td>
<td>VDC, TVDC</td>
</tr>
<tr>
<td>6. Frequency</td>
<td>KCP, TKCP, MCF</td>
</tr>
<tr>
<td>A. Frequency</td>
<td>KCP, TKCP, MCPS</td>
</tr>
<tr>
<td>B. Frequency Ratio</td>
<td>TO:1, TTO:1</td>
</tr>
<tr>
<td>7. Time</td>
<td>MSEC, TMSEC</td>
</tr>
<tr>
<td>A. Time Interval</td>
<td>CNCTS, TCNCTS</td>
</tr>
<tr>
<td>B. Interval Ratio</td>
<td></td>
</tr>
<tr>
<td>8. Frequency Modulation</td>
<td>FM</td>
</tr>
<tr>
<td>A. Frequency Modulation</td>
<td>KDEV</td>
</tr>
<tr>
<td>B. Frequency Deviation</td>
<td></td>
</tr>
<tr>
<td>9. Amplitude Modulation</td>
<td>KAMF</td>
</tr>
<tr>
<td>A. Frequency Modulation</td>
<td></td>
</tr>
<tr>
<td>B. Percent Amplitude Modulation</td>
<td>AMM</td>
</tr>
<tr>
<td>C. FM Modulation</td>
<td>FMA</td>
</tr>
<tr>
<td>10. Single Sideband</td>
<td>SBF</td>
</tr>
<tr>
<td>A. Frequency Modulation</td>
<td>SBR</td>
</tr>
<tr>
<td>B. Sideband Ratio</td>
<td>OPEN</td>
</tr>
<tr>
<td>11. Open</td>
<td>SHORT</td>
</tr>
<tr>
<td>12. Short</td>
<td></td>
</tr>
</tbody>
</table>

*Measure function. Different rules do not have to be followed by the user to perform the same basic test operations.

The ease with which a test engineer can associate the source language statements with test functions can be illustrated using, as an example, the slightly more complicated compiler statements needed to connect primary power. In dimate, primary power can be generated at 28 volts dc, 12 volts ac, and 240 volts ac, with either of the ac sources being generated at 60 cycles or 400 cycles. The 120 volts ac at 400 cycles may be either one-phase or three-phase; the one-phase source may have two test points specified. Although the signal is not specified solely by the units and magnitude parameters, the compiler source language statements can be formed directly from the English
stimulus description, as is shown in Fig. 3. Fig. 3 lists the six possible primary power statements.

Fig. 4 illustrates a representative test program. The meaning of each source language statement in that program is explained in Table 4. The sequence numbers in the right-hand column are determined by the compiler. Besides detecting clerical coding errors, the compiler compares the information presented in this source program against the specified characteristics of the DiMate system. Because the compiler cannot outguess the intentions of the test designer, errors are classified as either positive (always wrong) or possible (may be an error in some situations). The indicators in the left-hand margin of the source language printout distinguish between positive (*) and possible (##) errors detected by the compiler.

**Table 4: Explanation of statements in UUT 9075 program (Fig. 4)**

<table>
<thead>
<tr>
<th>Sequence Number</th>
<th>Statement</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>T001</td>
<td>Connect 63 volt 60 c.p.s. stimulus (AC filament power) across UUT terminals J10-1 and J10-2. Causes specified message to be printed.</td>
</tr>
<tr>
<td>2</td>
<td>Connect 120 volt 400 c.p.s. stimulus (3-phase, WYE connected AC power) to terminals J10-3, J10-4, J10-5, and J10-6. Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Measure DC volts, upper limit 275 volts, lower limit 225 volts between terminals J10-7 and J10-8. Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Transfer program control to locations as follows: next statement (if HIGH condition), P001 (if LOW condition), or 002 (if GO condition) as a result of measure statement 5. (A dash in any of these fields transfer program control to the next location). Set indicator &quot;A&quot; if HIGH or LOW. Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Transfer program control to locations: next statement (HIGH or LOW) or 003 (GO) depending on results of measure statement 5. Set indicator &quot;B&quot; if LOW. Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Transfer program control to locations: next statement (HIGH or LOW) or 003 (GO) depending on results of measure statement 5. Set indicator &quot;C&quot;. Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Transfer program control to locations: next statement (HIGH or LOW) or 003 (GO) depending on results of measure statement 5. Set indicator &quot;D&quot; if LOW. Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Transfer program control to locations: next statement (HIGH or LOW) or 003 (GO) depending on results of measure statement 5. Set indicator &quot;E&quot; if LOW. Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Transfer program control to locations: next statement (HIGH or LOW) or 003 (GO) depending on results of measure statement 5. Set indicator &quot;F&quot; if LOW. Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Execute last measure statement (set up in statement 13). Causes specified message to be printed.</td>
<td></td>
</tr>
</tbody>
</table>

**program debugging**

Debugging an equipment test program presents problems which are considerably more complex than those normally encountered by computer programmers. The interaction of program and hardware in automatic equipment testing does not allow debugging problems to be simply categorized. For example, suppose a test engineer received a NO-GO indication while checking a CO branch of a test program with a supposedly operational UUT connected to the automatic test equipment. (A CO path performs a qualification test required to certify that the UUT is performing within operational limits.) Obviously, an error exists somewhere. If the UUT developed a malfunction, the NO-GO indication would be valid. If not, then the cause of that response could be any one of the following:

1. The automatic test equipment system may not be operating correctly.
2. A device in the system may have different operating specifications than were expected by the test programmer (engineer).
3. The programmers who wrote the compiler program may have misinterpreted the automatic test system capabilities.
4. A compiler program may contain an error.
5. The test program may be incorrect. These possibilities must be systematically checked. However, some practical factors compound the complete debugging of the test program in its operational environment.

First, little time is available on the test equipment system. Generally, time cannot be made available to exhaustively check each branch in a typical UUT test program, especially if specific program errors must be isolated. The prime use of the automatic test system is expended in operational UUT testing and the lack of equipment availability time precludes thorough program debugging. Second, all stimulus signal sequences cannot be guarded. The test program has control of the stimulus and switching subsystems. Consequently, as the result of incorrect test program coding, legitimate stimuli coding could be generated in a sequence which causes a catastrophic failure of the UUT.

Third, it may be impossible to check every NO-GO path in a test program by generating specific errors. Furthermore, generating certain errors to force a NO-GO path may result in destroying the UUT. Even if an equipment malfunction is generated under known conditions, it may have too wide a range of effects to be controlled to the precise level required to predict the specific program branches which will as a consequence be executed.

A user-oriented programming system, to be completely effective, must give the test engineer as much assistance in debugging his test programs as it does in writing them. The natural choice would be a program which simulates the characteristics of the test equipment system. Having such a simulation program, the engineer could verify the correctness of the test program prior to executing it on an automatic test system, reducing significantly the amount of on-line program debugging needed. The entire debugging process would be much more effective, faster, and less costly.
process is expedited since the simulator can contain a multiplicity of debugging procedures not otherwise available.

Simulation programs, although widely used in other real-time systems, have not been generally accepted for use with automatic checkout systems. The reason for their disfavor appears to be that a sufficiently comprehensive simulation program is extremely difficult to develop and, because it requires a substantial amount of programming effort, is considerably expensive. These arguments are true, but when one carefully analyzes all factors, he will find that the cost of developing a thorough simulation program is more than offset by the initial and accrued savings and reduced risk.

First, the development cost of a simulation program represents only a small fraction of the total cost of the test equipment system. Second, debugging for the most part becomes an off-line operation with the result that the availability of the test system is increased and the unit cost of UUT testing is reduced. For test systems such as DIMATE, the savings accrued over a long period of time can be substantial. Third, off-line debugging not only maximizes the operational availability of the prime equipment, but permits program debugging to be accomplished in a comparatively "unhurried atmosphere." Fourth, repairing any inadvertently damaged UUT's adds to the repair shop workload and diverts costly spare parts.

**simulation program**

The simulation program developed for DIMATE provides a reference for the entire system; i.e., compiler, test program, and the DIMATE equipment. Debugging the object programs produced by the compiler establishes a measure of confidence in the compiler. Hence, verifying a test program on the simulator also certifies the compiler's processing. Because the simulation program represents the specified test system's characteristics, any problems which arise on a verified test program during validation can be easily isolated and reconciled.

In the DIMATE system, the simulation program is the primary verification tool for the test engineer. It (1) checks the legality of the compiler output, (2) checks the compatibility between stimulus and measurement programming and DIMATE functions, (3) performs programmed arithmetic functions, (4) allows the results of each test to be predetermined (either by a numeric value or by a HIGH, LOW, GO indicator), (5) performs various trace routines, (6) performs various types of memory dumps.

The level of simulation is sufficiently thorough to remove the need for validating, on the DIMATE system, any NO-GO path which has been previously verified. To ensure consistency between the simulator and the test system, only the basic NO-GO path of the test program needs to be validated.

**benefits**

The intrinsic value of a programming system is realized when it is designed to fulfill the needs of the user. The ever-increasing application of computer-directed systems, both in defense and industry, where the user is not trained as a skilled programmer emphasizes the value of programming aids. The field of automatic test equipment is only one example.

Programming aids which are based on techniques and vocabulary which the user can relate to his background mark a significant step toward practical user-oriented programming systems. A simple processing system which is specifically tailored to a user's background can be more
effective than a very elegant and powerful processing system. In the case of DIMATE, the compiler with its user-oriented source language and tabular format has made it possible for non-programming-oriented test engineers to write their test programs without undergoing an intensive education process. The long range benefits become apparent when one considers for a moment the normal turnover of personnel during a five-year period. Without these aids, the task of teaching programmers the intricacies of testing a wide variety of equipment on a complex test system would be large. With the aids and minimal indoctrination, an electronic test engineer can almost immediately write test programs.

Assuming proper training an engineer can write a UUT program in compiler language in about 40% of the time in which a computer programmer (and engineer) would require using only assembly language. Assembly language permitted a reduction in coding time of 90% when compared with direct machine language coding.

For the DIMATE I system, each UUT required on the average 650 tests. However, the number of tests could vary from 1000 tests needed to comprehensively self-check a complex unit, to 65 tests needed for a simple device. Junior electronics personnel with a high school background were, after a few days indoctrination and training, able to code approximately 20 tests an hour in compiler language. Significantly, longer training would have been required to enable them to reach the corresponding figures of 12 tests an hour using only assembly language or 1.2 tests an hour using only machine language.

The compiler language provides indirect benefits which are most helpful in the test program debugging process.
(1) The user-oriented source language permits engineers who did not participate in writing the test program to be of immediate assistance during program checkout. (2) The tabular format for the source language simplifies the compiler design; consequently, little time is needed to analyze the compiler's processing when compiler errors are suspected.

For complex equipment systems where available time is premium and a large number of programs must be prepared and updated on a continuing basis, the simulator becomes an integral part of a user-oriented programming system. The advantages to be derived in time savings and risk of damage more than offset the cost of developing a comprehensive simulation program.

**summary**

The DIMATE programming system is a user-oriented system because it:
1. Reduces the time and cost of test programming
2. Minimizes the specialized training needed to prepare test programs
3. Improves overall information flow
4. Eliminates retraining required by the user for new ATE systems

These goals were accomplished by:
1. Decreasing the engineering skill level required to write test programs
2. Removing computer programmers from the UUT programming loop
3. Reducing engineering training time
4. Decreasing the time required to prepare and check out UUT programs
5. Facilitating emendations to existing UUT test programs
6. Permitting engineer-to-engineer communication on the engineering level
7. Using the UUT test program coding input
   a. as the test program specification
   b. as final test design documentation
URBAN PLANNERS AND INFORMATION

The announcement for the fourth annual conference on Urban Planning Information Systems and Programs, held late in August at the Univ. of California, Berkeley, declared that it would "bring together planning professionals and computer specialists for a critical appraisal of existing automated information systems and an exploration of new techniques and emerging technological developments." This statement was broad enough to constitute a wide spectrum of appeal, yet formal enough to suggest academic trappings and the scholarly atmosphere. By and large, performance met the promise. It is surprising and comforting what can be tucked comfortably in the shadow of such words as "planning," "computer specialists" and "automated information system."

It also became apparent as the meeting progressed that our urban planning friends are as much in need of a discipline as are we information/computer specialists. How else does one explain the co-existence on a single program of such presentations as the esoteric Role of Models in Setting Values (learnedly done by Claude Gruen), and the prosaism of A Federated Statewide Information System by Robert Donati? Donati, incidentally, strongly suggested that Lockheed is yet to be heard from in the local-government information processing field.

The agenda did reflect an attempt at unity. Yet how can one structure the amorphous activities of urban planning and computers? The attempt at Berkeley was made by arranging program topics on the basis of computer use: data systems, models, simulation, hardware, education, and geophysical location. Perhaps it served as well or better than any other. It did reflect the enormous range of phenomena which are being marshalled to do battle with the problems of urban information and its hand-maiden, computer specialization.

the opening triad

Chronologically, the meeting started Friday morning with a triad of panels on (1) data systems, (2) information systems and (3) intelligence systems. As an ordering device for panel formation, such categorizing has much to be said for it. As a valid analytic classification, it is open to question, as the successive panel presentations showed. Joel Kibbee's panel led off for the data systems session. Santa Clara County's Logic, Lockheed's Federated System, Los Angeles' APOF and New York's Systems Design for the planning function were in turn discussed or exposed by their representatives.

Several conclusions of significance emerged: the old "integrated data bank" has serious conceptual defects as well
as inherent maintenance problems; the assumption that increased rationality in the decisional process will evolve spontaneously from an increase in valid, quantified data is open to serious question; the average local-government official, political or administrative, must be made more knowledgeable about computerized data systems; a computerized data system package must be linked to a computerized analytical package and to organizational change; academic explorations of urban phenomenon using the concepts of the economist are intellectually titillating and pragmatically mercurial; and as a society we are moving rapidly towards the accumulation of socio-economic data with which to identify more precisely the environment in which local government operates.

Friday afternoon consumed the second of the triad, "Information Systems for State and Local Governments chaired by Leslie Carbert, chief, California State Office of Planning. Carbert introduced the subject by reflecting that future state and local governmental administration will move toward a greater concern for information and its aggregation to aid in the decision-making processes. To move in this direction, governmental information flows must be integrated into a single process which both determines informational needs and provides for their generation. The issues here are not academic, Carbert contends, but involve significant decisional processes which will profoundly influence the character and quality of our citizenry.

Donald Foley followed with a demonstration of how analysis of census data can reveal the character of metropolitan growth in California. Apparently an analytic software package (UC's Statpac) is as important as source data in generating such extrapolations.

Robert Kokat, IBM, explored the ability to reflect the economic characteristics of a multi-state region. The means for such a projection was a socio-economic model which reflected the relationship of varying expenditures and their effect on employment. The U.S. Office of Economic Opportunity picked up the bill and IBM housed the study. The model can apparently be used in any large metropolitan area concerned with alternate programs designed to optimize the economic benefits of alternative expenditures. The salient point is that computers, models, and economic theory can be brought to bear on regional problems, which are economic in symptom and social in origin.

Richard Siegel of the California State Planning Office completed session with a discussion of his experiences in studying the informational needs of New York. His conclusions are that people who are designing information systems need to consort with the people who bear the responsibility for the activities—not a novel idea, but a refreshing one. The urban management system will yield to rationalization when the information specialist becomes an essential, governing, team member. Furthermore, the lack of an adequate management information system appears as a major obstacle to the more effective use of the theory of the firm in ordering governmental decisions through such devices as planning and programmatic budgeting.

enter time-sharing

Time-sharing and its kin, real-time processing, provided a most interesting Saturday morning. Of particular interest to the soothsayers of local government and the computer were the observations of Robert E. Fagen of Computer Communications Inc., Los Angeles. His view is that the rapid reductions in costs growing out of third-generation hardware and improved communications will make the power of the computer available to local governments of all sizes. His cost analysis provided impressive evidence for this view. The argument would have been more impressive, however, if comparative costs for small separate computers had been included. The same assumptions for cost reduction through technology for large computers need to be applied to the future cost patterns of smaller equipment.

Two other points which Fagen made: (1) the successful use of remote terminals and real-time data handling is primarily a software problem with a current no-man's land of responsibility between the manufacturer and the user for its development; and (2) because the most inflexible cost of remote input systems is communication distance, the future will see urban government computer users satellited around numerous central facilities rather than many such users tied into a sharply limited number of giant computer utility systems. Could be.

The Saturday luncheon provided an all too short diversion on information processing and political realities as seen by John T. Knox, a perceptive Assemblyman from California's 11th District. The dreams of computer scientists for monolithic systems serving unified geographic areas are incompatible with the realities of home rule, Knox believes. Rather, the future use of computers in local and state governments is to be found in the concept of federated information systems. Local governments will join such systems as benefits from such a union are demonstrated and as less efficient, special-purpose governmental agencies are eliminated. The state's job is one of outlining the major subsystems in the federation and providing policy and fiscal guidance for the creation of logical regional areas that are unified through compatible, operating information systems.

Regional agencies may come, but in Knox's view the solution of basic urban problems must start with better information that is computer-based and planning oriented. With such an approach, the definition and solution of urban problems on a regional basis are possible without violence to a political basic—viz., home rule. Urban computer and information issues thus become and are social issues, a fact we in urban information systems need to recall and recognize more often than just at annual conferences on the subject.

gaming & simulation

Saturday afternoon was Gaming and Simulation Day at the auditorium. Two professors (Richard Duke of Michigan State Univ. and Alan Feldt of Cornell) and a consultant (Robert Barringer of Arthur D. Little Inc.) provided an intellectually stimulating, if not pragmatic, session. Barringer aptly dubbed "simulation" as "like love—it can be discussed and participated in without a precise definition." His nine reasons for building a model justified the activity. Duke turned a bit abstract in discussing his METRO project, a metropolitan planning game played by three elements of a community: planning, city councilmen, and investors in a community. Feldt gussied up a training model by calling his exercise "heuristic gaming" and brought it into perspective by assigning it the acronym CLUG (community land use game).

Despite these interesting presentations, I left the session still wondering about the basic issue: are such exercises justified because they (a) serve as a training device, (b) constitute a prediction process, or (c) provide high entertainment for intellectuals who dignify game-playing by wearing academic cloths?

Saturday evening explored how computers could be used in "planning education" (apparently assuming the terms suffer no inconsistency). The discussion rose above the panel title, however, and faced some rather basic problems related to academic life and the computer. Andrei Rogers of UC's City and Regional Planning Dept.
suggested that computers should be presented to the student as (1) a processor of data, (2) a problem-solving facility, and (3) as an educational resource. The fundamental issue apparently is how—considering the press of contending academic interests for the student's limited time—computer exposure should be secured: through elective courses, integral parts of curriculum, or self-taught, student enrichment? Professor Duke suggested that a further factor was the need for a faculty retreat in computers, be the student's use of urban data on computer tape, exploration without leaving the laboratory. The real value experience the richness of computer-processed data ex­
terize our educational efforts to blend computer technology the growing need to generate and store urban data within
mental issue apparently is how-considering the
humor by suggesting seven
pating in the game itself.
Edgar Horwood (Urban Data Center, Washington U.) combined perceptive observation with a light touch of humor by suggesting seven "syndromes" which charac­
etize our educational efforts to blend computer technology into the education of future planners. These included the
grove syndrome (drop by and tell us about it), the gadget syndrome (we can't give you course credit for learning, but you should volunteer), the frill syndrome (an elective course available on an optional basis), and the get-off-my-back syndrome (take a short course from the computer manufacturer—it isn't an academic subject anyway).
Barclay Jones (Dept. of City and Regional Planning, Cornell U.) took a somewhat different, if not new, tact. He suggested that the computer should permeate the urban planning curriculum, rather than be a discreet portion of it. Whether computer education for the urban planner is an academic problem, a syndrome, or an inges­tion problem, Clark Rogers (Grad School of Public and International Affairs, Pittsburgh U.) supplied a measure of its market value in urban planning employment: students with planning degrees start at $6-5400 a year; students with a specialty in computer utilization to supplement their planning degrees start at $9-12,000! Perhaps our edu­
cational institutions cannot agree on what is to be taught about computers or how, but apparently there are very real rewards for students who acquire these skills.

land parcel information

The conference closed with a panel session on the Theory and Application of Geographical Information Retrieval, which readily translates to, "How do you code land parcel information so the computer can store and retrieve it?" The simplicity of the idea is matched, ap­
parently, with its difficulty in application. The problem is in part one of how to identify and locate the individual parcel. It could be solved by a Cartesian product system, but we neither deal nor think of land parcels that way. Legal descriptions would fill computer memory beyond a computer salesman's dream, and a system of street or situs addresses as the basis for indexing leaves something to be desired.

Into this complex of problems, there is tied the Bureau of Census accumulation of data by census tract and, in

3 Separate Ways That CYBETRONICS Increases Computer Efficiency and Reduces Error.

1 NOW, NATIONWIDE "LAUNDRY SERVICE" FOR MAGNETIC TAPE.

At Cybe-Tape™ service centers across the nation, customer tapes are inspected, cleaned of dropout-causing particles, recertified or con­verted to 9 channels and/or 1600bpi, rewound, packed and re­turned in 100% CERTIFIED CON­DITION. Cybe-Tape centers are operating in N.Y.; Boston; Los Angeles; Atlanta; Denver; Houston; Tulsa; Detroit; Teaneck, N.J. and Paris, France . . . more to come. WRITE FOR CYBETRONICS, inc.

2 MAGNETIC TAPE REHABILITATION & CONVERSION EQUIPMENT.

Investigate the operational and fi­nancial savings made possible by Cybe-Tape cleaners, certifiers and complete clean/certify systems. Sig­nificant savings from decreased computer downtime, fewer errors and longer tape life are guaranteed for the small library, larger user and tape manufacturer. Over 1000 units are now in service. WRITE FOR FREE "MAGNETIC TAPE CARE MANUAL".

3 UNIQUE, AUTOMATED COMPUTER MONITORING/ REPORTING SYSTEM.

(It is more than a clock, yet requires no preprogramming nor computer memory).

A wide variety of custom manage­ment reports can be on your desk daily, weekly . . . whenever re­quired to indicate machine & per­sonnel performance, job costs, set meaningful standards for opera­tions, help justify requisitions for men and machines. WRITE FOR MONITRON DATA:
Why Photocircuits' tape readers were selected for...

APOLLO
GEMINI
LEM
MINUTEMAN
TITAN II
SHILLELAGH
GSM 133
CENTAUR
DIMATE
LCSS
TEAMS

...because of the simplicity and reliability of the printed motor single capstan drive, with the electronic control of all tape movement. Troublesome, high-maintenance components such as pinch rollers, brakes and clutches have been completely eliminated.

The fully militarized 500RM was specifically designed as a military unit ... not a “beefed-up” version of a commercial tape reader. It has successfully passed mil specs, MIL-E-16400 Class 3, MIL-T-21200 Class 2 and MIL-T-945; tests for shock, vibration, RFI, altitude, salt, sand, dust and heat and cold.

The 500RM reads bidirectionally at up to 1000 char/sec., has eight inch reels with proportional reel servos, accepts 5, 6, 7 or 8 level tape and has a MTBF of 5000 hours.

For full specifications on the 500RM, or on Photocircuits' complete line of commercial tape readers, contact: Photocircuits Corporation, Tape Reader Division, Glen Cove, N.Y.
some instances, by block, which must be fitted into or related to the land parcel file. The critical issue appears to be one not so much relating computer processes to land parcel designation systems as it is a recognition that the individual land parcel designation will become the foundation for our future urban information systems. Moreover, such systems will deal increasingly with data reflecting the many socio-economic factors which spell out the path of our urban civilization and our efforts to channel it. The subject deserved the excellent treatment it received.

In a follow-up business meeting, attendees formalized the group which has sponsored and supported this and previous urban data conferences. The result was a new society, The Urban and Regional Systems Assn. Edgar Horwood was elected president, Andrei Rogers and Clark Rogers, vice presidents. Six regional representatives were also designated. Editor of the proposed newsletter is Herman Burkman. The constitutional guide for the association is patterned after the Regional Science Assn.

The very existence of such a permanent organization suggests the ground swell of interest and concern for the problems of local government information processing. It also raises a question of where one finds an equivalent group concerned with information processing for urban government short-range planning and day-to-day operations. Urban planning information systems are not synonymous with urban informational and decisional systems. One wishes that the association formed to consider the problems of planning information processing could have been explicitly enlarged to encompass the total range of urban information processing problems. Certainly, the urban phenomenon itself reflects no such artificial segregation of its information into "planning and other." Perhaps the new association’s broader title reflects a shift towards concern for all urban informational systems.

In summary, the conference was designed by city planners for city planners and their computerized fringe. There is rationale in such a limitation, but one cannot help wondering whether the urban planner can study himself without including the interests and perception of his contemporaries—police, fire, and recreation, to mention a few. Further, only one speaker took the management viewpoint of urban informational systems. Does urban planning exist as unity and in the abstract? Or does it find its wellsprings in the urban, human condition, which urban planning asays to do something about but which is best revealed through all local government activities?

Clearly, urban planning as a process and as a focus for academic effort finds the computer—with its approach, its technology, and its promise—very attractive and elusive. DF is taken seriously by those associated with planning, but not so seriously as to disrupt their dogma. Yet only as the paradigms of urban planning are changed through computer use will computers have become important in fact to planners. Several more annual institutes will have to pass before their agendas will reveal, by their very tissue, that this congenial marriage of discipline and technique has taken place.

WILLIAM H. MITCHEL
Manager, Project sogammys
School of Public Administration
Univ. of Southern California
How to remove SCR spikes without pain...

OR... Remove SCR spikes in the privacy of your own shop or laboratory with the exclusive WANLASS F-3010 DYNAMIC LINE FILTER!

Amaze your friends. Startle your boss. Be the first one in your block to remove SCR spikes and other line transients the painless way with the all-new Wanlass F-3010 Dynamic Line Filter. Operates on 60 or 400 cps with minimum filter efficiency of 98%. Handles maximum load current of 10 amps RMS and has a filter attenuation factor of 40 db per decade. Added waveform distortion is less than ½%. Over-voltage and overcurrent protection? You bet! The F-3010 is priced at $225. Why not talk to one of our friendly, soft-sell technical reps? He'll be glad to demonstrate the F-3010 to you and your boss. Grab a phone or pen now and call or write Wanlass Electric Co., 2175 S. Grand Ave., Santa Ana, Calif. (714) 546-8990.

Unretouched scope photo shows 70 volt SCR input spike (lower trace) and spike eliminated by the exclusive Wanlass Dynamic Line Filter (upper trace).

WANLASS DYNAMIC LINE FILTER SPECIFICATIONS

<table>
<thead>
<tr>
<th>Type of Filter</th>
<th>Active</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>117 VAC nominal</td>
</tr>
<tr>
<td>Max. Load Current</td>
<td>10 amps RMS</td>
</tr>
<tr>
<td>Attenuation</td>
<td>60 cps-0.2 db</td>
</tr>
<tr>
<td></td>
<td>10 K cps-40 db</td>
</tr>
<tr>
<td>Attenuation factor</td>
<td>40 db/decade</td>
</tr>
<tr>
<td>Corner frequency</td>
<td>1000 cps</td>
</tr>
<tr>
<td>Filter efficiency</td>
<td>98% minimum</td>
</tr>
<tr>
<td>Added Waveform Distortion</td>
<td>0.5% maximum</td>
</tr>
<tr>
<td>Size</td>
<td>9&quot; x 8½&quot; x 5&quot;</td>
</tr>
<tr>
<td>Weight</td>
<td>6#</td>
</tr>
<tr>
<td>Price</td>
<td>$225.00</td>
</tr>
</tbody>
</table>

*FOB Santa Ana, Calif. Prices & Specs subject to change. Patents pending.

WANLASS ELECTRIC CO.

VISIT WANLASS BOOTH 1729 AT ISA SHOW, NEW YORK COLISEUM

CIRCLE 44 ON READER CARD
3M brings you a new milestone in computer tape reliability and economy: “Scotch” Brand No. 777

1953 3M PRODUCES FIRST ERROR-FREE TAPE

In 1953, 3M helped develop the modern age of data processing by successfully producing the first error-free computer tape capable of 100 bits-per-inch density. Like all 3M computer tapes that have followed, it provided a clean, stable base and coating, with consistently dependable magnetic and physical qualities.

1957 3M DEVELOPS SANDWICH TAPE

The demand for more rapid access time, through faster transport speeds, required a tape that could withstand high speed tension and wear. To meet this need, 3M introduced sandwich tape. This featured a micro-thin plastic coating over the recording surface to prevent rub-off and protect transport heads against wear.

"SCOTCH" IS A REGISTERED TRADEMARK OF 3M CO.

1953
3M PRODUCES FIRST ERROR-FREE TAPE

In 1953, 3M helped develop the modern age of data processing by successfully producing the first error-free computer tape capable of 100 bits-per-inch density. Like all 3M computer tapes that have followed, it provided a clean, stable base and coating, with consistently dependable magnetic and physical qualities.

1957 3M DEVELOPS SANDWICH TAPE

The demand for more rapid access time, through faster transport speeds, required a tape that could withstand high speed tension and wear. To meet this need, 3M introduced sandwich tape. This featured a micro-thin plastic coating over the recording surface to prevent rub-off and protect transport heads against wear.

"SCOTCH" IS A REGISTERED TRADEMARK OF 3M CO.
1960 3M PERFECTS HEAVY-DUTY TAPE

In 1960, 3M perfected the first heavy-duty computer tape providing complete compatibility and extended error-free operation at 200, 556 and 800 bpi densities. Proven consistently stable under humidity and temperature extremes, this heavy-duty tape soon became accepted as the standard of the computer industry.

NOW 3M INTRODUCES "SCOTCH" BRAND NO. 777

To reduce costly tape errors to an absolute minimum, today an even more critical tape is needed. This new tape must deliver the highest level of performance over the longest possible time. It must prevent generation of drop-outs during repeated passes. It must withstand temperature and humidity extremes in shipping and storage indefinitely without generating errors. And it must be completely compatible at all densities, including 1600 bpi (3200 fci). Meeting all these needs, 3M now introduces the exclusive breakthrough in long-range reliability with true economy: "Scotch" Brand No. 777.

Whatever computer system you employ or plan to use, find out how 3M can cut your costs. Write: Market Services Department, Magnetic Products Division, 3M Company, St. Paul, Minn. 55119.

Who knows more about computer tape than the people who perfected it?
End high leasing costs forever with Midwestern's M4700 series digital tape transports. Designed as direct replacements for primary leased transports, the M4700 is ready immediately to become a part of your on-line operation. No conversion is necessary. The I-O connectors are exactly the same. So are the 3-phase power connectors. And the control electronics are completely compatible. Just slide it in place and plug it in. The M4700 is ready to start saving your company thousands of dollars per year.

You can own an M4700 outright for approximately the cost of 16 months' leasing. The M4700 is a refinement of Midwestern's M4000 that has earned acclaim for its compatibility and superior reliability throughout the O.E.M. market. Exclusive features include Midwestern's lightning-quick, but feather-light pneumatic tape drive and proven reliability at speeds to 150 ips.

For complete information on the M4700, (including names of companies who have made the change already) write or call Digital Tape Products Division, P. O. Box 1525, Tulsa, Oklahoma 74101. Our phone number is 918-627-1116.
THE CHAIRMAN’S WELCOME

by R. GEORGE GLASER

Attendees at the 1966 Fall Joint Computer Conference will be treated to an outstanding technical program, a keynote session of unusual quality and interest, a luncheon address by a prominent legislator, an exhibition of the latest developments in information-processing equipment, and the traditional array of JCC social events. To round out what promises to be a busy week, a full day of technical sessions will be held by AFIPS sponsoring societies.

Gerald Phillippe, chairman of the board, General Electric Co., will keynote the opening session on Tuesday, Nov. 8. Mr. Phillippe will discuss the “Impact of Computers on a Technical Society” from the standpoint of a businessman. The subject then will be discussed as viewed by an educator (Professor Patrick Suppes, Stanford Univ.), a banker/consultant (Harry M. Runyan), and a teaching psychiatrist (Dr. Ulric Neisser, Univ. of Pennsylvania). We expect this session to raise controversial issues, to provoke thoughtful discussion, and to make us, as professionals in the information processing industry, just a little uneasy.

The technical program is the heart of any conference; but in the technical program for the 1966 FJCC the topics and speakers are exceptionally noteworthy. Dr. William Davidow, technical program chairman, gives more details in pages that follow.

The conference luncheon, at noon on Wednesday, Nov. 9, will be highlighted by an address by Congressman Jack Brooks (Democrat—Texas). Congressman Brooks is the author of the Brooks Bill, an important (and controversial) piece of legislation dealing with the acquisition and use of computers in the federal government. Congressman Brooks has been mentioned frequently in the editorial and feature pages of DATAMATION. We believe his address will be interesting to all taxpayers, whether suppliers or users of data processing equipment.

Following the Congressman’s address, the Harry Goode Memorial Award will be presented by AFIPS to J. Presper Eckert and John W. Mauchly for their “pioneering contributions to automatic computing.” Known primarily for their participation in the design and construction of the ENIAC, the world’s first all-electronic computer, both men have a long history of professional contributions to the industry.

Over 100 exhibitors will occupy nearly 350 booths to make this the largest exhibition of information processing equipment ever held. A number of product introductions are anticipated; several exhibitors will feature hands-on use of time-sharing equipment. The lounges in the exhibit area will be turned over to the arts—with interesting results.

The opening session, theatres, and all technical sessions except those on analog computing will be held in the San Francisco Civic Auditorium. Exhibits will be in Brooks Hall, immediately adjacent to the auditorium. The luncheon, reception, all committee meetings and analog computing technical sessions will be held in the Jack Tar Hotel, conference headquarters.

Because Tuesday, Nov. 8, the opening day of the conference, is an election day, the traditional conference reception (cocktail party) will be held on Wednesday evening. Exhibits will remain open until 8 p.m. on Tuesday; on Wednesday, 10-6; and on Thursday, 10-5. We urge you to arrange for, and cast, your absentee ballot in your local area before leaving for San Francisco.

One major innovation in registration procedures is the introduction of one-day registration. Fees will be one-half of those for three-day registrants but will not include a copy of the conference proceedings. We hope that this innovation will encourage heavy local attendance.

The conference steering committee set out to arrange a great conference; we hope you will agree that we were successful.
Optical Character Recognition and Mark Reading represent a great advance in data processing, but the work the scanner does is no better than the forms fed into it.

We make precision forms so the scanning process will yield the speed, economy and accuracy expected of it.

This calls for the highest precision, for technical knowledge, production efficiency, a lot of research, and men trained in optical scanning techniques.

Our Research Engineering Departments have produced special manufacturing equipment and techniques for precision forms.

And working with the machine companies, Moore meets manufacturers' specifications on format and tolerances, involving also paper, carbons, margins, spacing, use of ink and colors and other factors.

Moore makes OCR and Mark Read documents for many uses—premium notices, utility bills, checks of all kinds, statements, invoices, library cards, coupons, membership cards, etc.

These are some of the things that give Moore forms Total Value. If you work with forms, we can show you how to make forms work for you.

MOORE BUSINESS FORMS INC

The right business form for every form of business

Niagara Falls, N.Y. • Park Ridge, Ill. • Denton, Texas • Emeryville, Calif. • Over 500 offices and factories in North America

CIRCLE 47 ON READER CARD

MARK READ FORMS are designed and manufactured by Moore with exact tolerances to make sure that they serve as accurate input documents.

MOORE'S MARK READ TESTER determines acceptability of documents for Mark Read applications, insuring form specifications that meet scanner requirements.

SELF-CHECK DIGITS are used to verify correctness of consecutive numbers. Many other features are available to save machine time and clerical labor.

Oct. 17-21—See Moore Products at the BEMA Show—McCormick Place, Chicago
CONFERENCE
PARTICULARS

Elegant and rigid, San Francisco is a city with an opulent traditionalist shell and bursting insides; a city where new ideas and technologies are not assimilated without a struggle. And nowhere are the contrasts more evident than in her transportation systems. The cable cars struggling up the hills are legendary; so are the boat tours of the bay from the Wharf. The street cars—so not famous, but rarely seen elsewhere—are side-swiped in the streets by ubiquitous taxis. A computer-controlled rapid transit district, now testing its first four miles, will be the most advanced in the world, and mocks the hulk of an unfinished freeway recently discarded by truth and beauty taxpayers.

The '66 Fall Joint Computer Conference will add its own vehicle to the fray—a shuttle bus will service the conference between the Civic Center (hq of the FJCC—just slightly younger than the '66 quake), and the Jack Tar Hotel. Sponsored by AFIPS members—Assn. for Computing Machinery, IEEE Computing Group, American Documentation Institute, Simulation Councils, Inc., and the Assn. for Machine Translation and Computational Linguistics—the conference is expected to draw all paid registrants from noon to 8 p.m. every day, so will the conference reception.

Over 100 companies will be exhibiting in Brooks Hall at the Civic Center, and the exhibits will be open to all paid registrants from noon to 8 p.m. on Tuesday; on Wednesday from 10-6; and on Thursday, 10-5.

Highlighting the conference, the technical program will include 72 papers (over 200 authors) in 23 sessions. Emphasis will be on the impact of computers in various fields (including music), and, of course, time-sharing.

The keynote speech at the opening session (9:30 a.m., Tuesday) will be given by Gerald Phlippe, chairman of the board of GE. His topic will be, "The Impact of Computers on a Technical Society." A "real" session, the keynote will also include "Prospects for Computers in Education," by Patrick Suppes; "Is There a Computer Revolution?" by Ulric Nesser; and "Which Way the Computer Revolution?" by Harry Runyan.

Three discussion sessions, on error analysis, multi-access management, and computer-oriented data analysis, will be among the regular sessions. For these sessions, preprints of the material to be discussed will be available two weeks before the conference. Copies include all three sessions, cost $1 each and may be obtained by sending name, address and check or money order to Dee Tozer Advertising, 517 E. Bayshore, Redwood City, Calif. Copies will also be available by filling out an "action card" to the found in the pre-conference program being mailed to members of the AFIPS organizations.

New this year to the conference will be a workshop on the complement of man/computer interactions, an evening program scheduled for Tuesday.

Advance registration for the conference will be Monday, Nov. 7, at the Jack Tar and Hilton Hotels. A pre-conference cocktail party will be Monday night at Jack Tar's Gas Buggy Room. The registration schedule will continue for all three days—a new feature—8:30-5 through Thursday.

The conference luncheon will be on Wednesday (and, because of election day, so will the conference reception). The luncheon address will be given by Congressman Jack Brooks of Texas, author of the Brooks Bill, passed last spring and dealing with federal government acquisition and use of dp equipment. Congressman Brooks will speak on the impact of computer technology in the federal government.

A special vocational program for students is also a new feature of this year's FJCC. Experts in the industry will speak to over 1200 students in the three days of the conference, emphasizing edp as a vocation. The presentations will be augmented by demonstrations on computers.

Movies on computer sciences will be shown in two rooms (Cinema #1 and #2) in the Civic Center, the schedules running simultaneously for the three days.

For the ladies, a special program is offering tours of Ghirardelli Square, Chinatown, a Japanese tea garden, and the Paul Masson Champagne Cellars in Saratoga.

If there's any time between scheduled and non-scheduled discussions, the city itself will provide many diversions: "Other Suns, Other Worlds" will be showing in Golden Gate Park's Morrison Planetarium; the California Palace of the Legion of Honor will be hosting "The Age of Rembrandt," containing 106 Dutch masterpieces. In the nightclubs: Arthur Lyman will be at Basin Street West, Vikki Carr will sing in The Fairmont's Venetian Room; and La Parisienne Revue will continue its long run at Bimbo's 365.

The closing night of the conference will also have a performance of "The Marriage of Figaro" at the San Francisco Opera, only one city block from the Civic Auditorium. And at the 85th annual San Francisco Art Institute (doors are open until 10 p.m.) there will be an exhibit by printmakers John Ihle and Gordon Cook.
### The Exhibitors

#### Booths

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Booth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acme, Inc.</td>
<td>122</td>
</tr>
<tr>
<td>Addison-Wesley Publishing Co., Inc.</td>
<td>228, 230, 327, 329</td>
</tr>
<tr>
<td>Advanced Scientific Instruments Div., EMR, Inc.</td>
<td>418</td>
</tr>
<tr>
<td>Allen-Babcock Computing, Inc.</td>
<td>1147</td>
</tr>
<tr>
<td>Amp, Inc.</td>
<td>112, 1114</td>
</tr>
<tr>
<td>Ampex Corporation</td>
<td>227, 229, 231, 233</td>
</tr>
<tr>
<td>Anelva Corporation</td>
<td>914, 915, 916</td>
</tr>
<tr>
<td>Applied Data Research, Inc.</td>
<td>519, 521</td>
</tr>
<tr>
<td>Applied Dynamics, Inc.</td>
<td>508, 510, 609</td>
</tr>
<tr>
<td>Auto-Trol Corporation</td>
<td>531, 533</td>
</tr>
<tr>
<td>Bell System, A.T.&amp;T.</td>
<td>909, 910, 911</td>
</tr>
<tr>
<td>Benson-Lehner Corporation</td>
<td>827, 829, 831</td>
</tr>
<tr>
<td>Bryant Computer Products Div., Ex-Cell-O Corp.</td>
<td>733, 735, 737</td>
</tr>
<tr>
<td>Burroughs Corporation, Electronic Components Div.</td>
<td>835, 837</td>
</tr>
<tr>
<td>Business Information Technology</td>
<td>1102, 1103</td>
</tr>
<tr>
<td>California Computer Products, Inc.</td>
<td>902, 903, 904, 905, 906</td>
</tr>
<tr>
<td>Calma Company</td>
<td>204</td>
</tr>
<tr>
<td>Camcor, Inc.</td>
<td>112, 113, 114, 115</td>
</tr>
<tr>
<td>Computer Accessories Corporation</td>
<td>800</td>
</tr>
<tr>
<td>Computer Design Publishing Corporation</td>
<td>912</td>
</tr>
<tr>
<td>Computer Products, Inc.</td>
<td>11108</td>
</tr>
<tr>
<td>Computer Sciences Corp.</td>
<td>1129, 1131</td>
</tr>
<tr>
<td>Computers and Automation</td>
<td>105</td>
</tr>
<tr>
<td>Conrac Division of Giannini Controls</td>
<td>1011, 1011A</td>
</tr>
<tr>
<td>Consolidated Electrodynamics Corporation</td>
<td>103, 104</td>
</tr>
<tr>
<td>Control Data Corporation</td>
<td>606, 608, 610; 705, 707, 709</td>
</tr>
<tr>
<td>Corning Glass Works</td>
<td>1010</td>
</tr>
<tr>
<td>Cybertronics, Inc.</td>
<td>207, 209</td>
</tr>
<tr>
<td>Data Disc Inc.</td>
<td>1110A</td>
</tr>
<tr>
<td>Data Equipment Company, A Div. of BBN Inc.</td>
<td>1034</td>
</tr>
<tr>
<td>Data Machines, Inc.</td>
<td>1020, 1022, 1024</td>
</tr>
<tr>
<td>Decision Control, Inc.</td>
<td>1137, 1137A</td>
</tr>
<tr>
<td>Data Pathing, Inc.</td>
<td>109, 110</td>
</tr>
<tr>
<td>Datamation</td>
<td>1026</td>
</tr>
<tr>
<td>Data Processing Digest, Inc.</td>
<td>828</td>
</tr>
<tr>
<td>Data Processing Magazine</td>
<td>814, 816, 818, 820</td>
</tr>
<tr>
<td>Data Products Corporation</td>
<td>1111, 1113</td>
</tr>
<tr>
<td>DI/AN Controls, Inc.</td>
<td>215, 217, 219, 221, 223</td>
</tr>
<tr>
<td>Digital Equipment Corporation</td>
<td>702, 704, 706</td>
</tr>
<tr>
<td>Digitel Corporation</td>
<td>101</td>
</tr>
<tr>
<td>Digitronics Corp.</td>
<td>116, 117, 118</td>
</tr>
<tr>
<td>Eastman Kodak Company, Business Systems Markets Div.</td>
<td>822</td>
</tr>
<tr>
<td>E.H. Research Laboratories, Inc.</td>
<td>1032</td>
</tr>
<tr>
<td>Elco Corporation</td>
<td>314, 316, 318, 413, 415, 417</td>
</tr>
<tr>
<td>Electronic Associates, Inc.</td>
<td>422, 424, 523</td>
</tr>
<tr>
<td>Electronic Memories, Inc.</td>
<td>213, 722, 724; 821, 823</td>
</tr>
<tr>
<td>Fairchild Semiconductor</td>
<td>527, 529</td>
</tr>
<tr>
<td>Ferroxcube Corporation</td>
<td>633, 635, 637</td>
</tr>
<tr>
<td>Friden, Inc.</td>
<td>102</td>
</tr>
<tr>
<td>General Computers, Inc.</td>
<td>202</td>
</tr>
<tr>
<td>General Dynamics Corp., Electronics Div.</td>
<td>1106, 1108</td>
</tr>
<tr>
<td>General Electric Information Systems Div.</td>
<td>320, 322, 324; 419, 421, 423</td>
</tr>
<tr>
<td>General Kinetics Incorporated</td>
<td>528, 530, 532, 534</td>
</tr>
<tr>
<td>General Precision/Librascopc Group</td>
<td>1012, 1014</td>
</tr>
<tr>
<td>Geo Space Corporation</td>
<td>331, 333, 335, 337</td>
</tr>
<tr>
<td>The Gerber Scientific Instrument Co.</td>
<td>206, 208, 210; 305, 307, 309</td>
</tr>
<tr>
<td>Hewlett-Packard Datamec Division</td>
<td>430, 432, 434, 436, 438</td>
</tr>
<tr>
<td>Hewlett-Packard Dymec Division</td>
<td>1019</td>
</tr>
<tr>
<td>Honeywell, Inc., Computer Control Div.</td>
<td>919</td>
</tr>
<tr>
<td>International Business Machines Corp., DP Div.</td>
<td>514, 516, 518; 520, 522, 524; 613, 615, 617; 619, 621, 623</td>
</tr>
<tr>
<td>ITT Data Services</td>
<td>922, 923, 924</td>
</tr>
<tr>
<td>ITT — Industrial Products Div.</td>
<td>824, 826</td>
</tr>
<tr>
<td>Kennedy Company</td>
<td>1013</td>
</tr>
<tr>
<td>Kleinschmidt, Div. of SCM Corp.</td>
<td>123, 124</td>
</tr>
<tr>
<td>Lear Siegler, Inc., Data &amp; Controls Div.</td>
<td>1104, 1105</td>
</tr>
<tr>
<td>Lockheed Electronics Company</td>
<td>502, 504, 506</td>
</tr>
<tr>
<td>Magna-Head, A Div. of General Instrument Corp.</td>
<td>802, 804</td>
</tr>
<tr>
<td>MAI Equipment Corporation</td>
<td>536, 538</td>
</tr>
<tr>
<td>McGraw-Hill Book Co.</td>
<td>1030</td>
</tr>
<tr>
<td>Memorex Corporation</td>
<td>1031, 1031A</td>
</tr>
<tr>
<td>Midwestern Instruments, Inc.</td>
<td>201, 203, 205</td>
</tr>
<tr>
<td>Milgo Electronic Corporation</td>
<td>706, 710; 807, 809</td>
</tr>
<tr>
<td>3M, Revere-Mincom Div.</td>
<td>1139</td>
</tr>
<tr>
<td>Monroe DATALOG Division of Litton Industries</td>
<td>601, 603, 605</td>
</tr>
<tr>
<td>The National Cash Register Co.</td>
<td>714, 716, 718, 720, 813, 815, 817, 819</td>
</tr>
<tr>
<td>Navigation Computer Corporation</td>
<td>512</td>
</tr>
<tr>
<td>North Atlantic Industries, Inc.</td>
<td>1028</td>
</tr>
<tr>
<td>Photocircuits Corporation</td>
<td>627, 629</td>
</tr>
<tr>
<td>Potter Instrument Company, Inc.</td>
<td>801, 803, 805</td>
</tr>
<tr>
<td>Precision Instrument Company</td>
<td>1033, 1035</td>
</tr>
<tr>
<td>Prentice Hall, Inc.</td>
<td>125</td>
</tr>
<tr>
<td>RCA, E.C.&amp;D. Div.</td>
<td>1019A, 1021</td>
</tr>
<tr>
<td>RCA, EDP Div.</td>
<td>214, 216, 218, 220, 222, 224; 313, 315, 317, 319, 321, 323</td>
</tr>
<tr>
<td>Raytheon Computer</td>
<td>414, 416, 513, 515</td>
</tr>
<tr>
<td>Rheem Electronics</td>
<td>602, 604</td>
</tr>
<tr>
<td>Rixon Electronics, Inc.</td>
<td>607</td>
</tr>
<tr>
<td>Rotron Manufacturing Co., Inc.</td>
<td>1005, 1007</td>
</tr>
<tr>
<td>Roytron Div., Royal Typewriter Co., Inc.</td>
<td>728, 730, 732</td>
</tr>
<tr>
<td>Sanders Associates, Inc.</td>
<td>1121, 1123, 1125, 1127</td>
</tr>
<tr>
<td>Scientific Control Corp., Inc.</td>
<td>1124, 1126</td>
</tr>
<tr>
<td>Scientific Data Systems, Inc.</td>
<td>402, 404, 406; 408, 410, 501; 503, 505, 507, 509</td>
</tr>
<tr>
<td>Simulators, Inc.</td>
<td>1101</td>
</tr>
<tr>
<td>Soroban Engineering, Inc.</td>
<td>636, 638</td>
</tr>
<tr>
<td>Spartan Books</td>
<td>631</td>
</tr>
<tr>
<td>Stromberg-Carlson Corp., Data Products Div.</td>
<td>1132, 1134, 1136</td>
</tr>
<tr>
<td>Systron-Dixon Corporation</td>
<td>235, 237</td>
</tr>
<tr>
<td>Tally Corporation</td>
<td>736, 738</td>
</tr>
<tr>
<td>Tasker Instruments Corporation</td>
<td>701, 703</td>
</tr>
<tr>
<td>Teletype Corporation</td>
<td>535, 537</td>
</tr>
<tr>
<td>Texas Instruments Inc., Semiconductor-Components Div.</td>
<td>918, 919</td>
</tr>
<tr>
<td>Texas Instruments Inc., Apparatus Div.</td>
<td>731</td>
</tr>
<tr>
<td>Thin Film, Inc.</td>
<td>111</td>
</tr>
<tr>
<td>Thompson Book Company</td>
<td>420</td>
</tr>
<tr>
<td>Teko N. Y. Inc.</td>
<td>810, 812</td>
</tr>
<tr>
<td>Transistor Electronics Corporation</td>
<td>236, 238</td>
</tr>
<tr>
<td>Tyshamre, Inc.</td>
<td>243</td>
</tr>
<tr>
<td>Ultronic Systems Corporation</td>
<td>628, 630, 632; 634, 727, 729</td>
</tr>
<tr>
<td>Upstate Corporation</td>
<td>232, 234</td>
</tr>
<tr>
<td>URS Corporation</td>
<td>833</td>
</tr>
<tr>
<td>U.S. Magnetic Tape Co.</td>
<td>920</td>
</tr>
<tr>
<td>Vermont Research Corporation</td>
<td>239, 241</td>
</tr>
<tr>
<td>Western Union Telegraph Co.</td>
<td>1015, 1017</td>
</tr>
<tr>
<td>John Wiley &amp; Sons, Inc.</td>
<td>1029</td>
</tr>
<tr>
<td>Wyle Laboratories</td>
<td>1025A, 1027</td>
</tr>
<tr>
<td>Zeltex, Inc.</td>
<td>1016, 1018</td>
</tr>
</tbody>
</table>
NOW YOU CAN HAVE A COMPLETELY UNINHIBITED KEYBOARD SYSTEM... CUSTOM DESIGNED for FUNCTION AND STYLE

Far cry from conventional keyboards! Here's a completely new, completely flexible data entry and control device which can be incorporated into any computer or industrial control system.

The new TEC-LITE Electronic Keyboard System can generate any code up to eight levels or more and, in addition, provide command controls and indicators on the keyboard console itself. Key and control arrangement is determined by your requirements.

Compact, simple... fast. The new TEC-LITE Electronic Keyboard System features pulse or momentary key switches virtually identical in feel and action to electric typewriter keys. Pulse switches make and break on the downstroke. Typing speed can be as fast as the operator's normal typing ability. No mechanical linkage to cause jam-ups or noise.

When custom designed, the new TEC-LITE Electronic Keyboard System is built for your particular system, both electrically and mechanically. Its keys can be styled to complement your console design. From stock you can select standard typewriter or 10-key keyboards compatible with popular computer languages. Keyboards can be mounted in desk tops, rack mounted or be portable.

Key to the TEC-LITE Electronic Keyboard System is this snap action SPDT pulse or momentary switch which virtually duplicates the feel and travel of electric typewriter key action. Two key styles are standard... special styles, including most button designs offered on electric typewriters, are available. The molded plastic body mounts on .750 x .780 centers, minimum. Standard terminals provide for solder-mounting on printed circuit boards or solder-plated, quick-connect types, with other terminals also available. Switch life is 1,000,000 operations, minimum. Operating force is 2.5 (±.5) ounces, with other pressures optional. Button travel is 5/32 and the switch will withstand a 50-pound downward force.

Write for complete information about the versatile TEC-LITE Electronic Keyboard System and individual Keyboard Switches.

Transistor Electronics Corporation
Box 6191 • Minneapolis, Minnesota 55424 • Phone (612) 941-1100

CIRCLE 48 ON READER CARD
PRODUCT PREVIEW

AUTO-TROL CORP.
Arvada, Colorado

The model 3700 Series Two and Three Coordinate Graphic Digitizer has output to a 500 cps mag tape recorder, and an 18-key keyboard for direct manual entry of variable data. X-Y or X-Y-Z coordinates are recorded onto 7-channel IBM-compatible tape in operator-wired recorder, and an IS-key keyboard for manual entry of variable data. The model has output to a directly manual entry of variable data. The system is suited for curve tracing including contour lines and strip charts.

CIRCLE 126 ON READER CARD

COMPUTER DIVISION
ELECTRO-MECHANICAL RESEARCH INC.
Minneapolis, Minnesota

The hardware debut of the previously-announced Advance 6130 computer is being held. An integrated-circuit machine, it has a cycle time of 0.9 usec and an add time of 1.8 usec. Word length is 16 bits plus parity and memory protect bits, and memory capacity is 4K to 32K words of core.

CIRCLE 127 ON READER CARD

CONRAC DIVISION
GIANNINI CONTROLS CORP.
Glendora, California

Being demonstrated is the model CDF alphanumeric display, an X-Y random scan CRT device for computer output. The unit accepts X and Y input signals (typically 0 to 6 volts) and, through its own deflection amplifiers and yokes, positions the electron beam on the CRT face. It also has a digital blanking amplifier for the Z axis, along with high and low voltage power supplies and regulation. Repeat time for a 90° deflection at approximately 15 KV is 80 usec.

CIRCLE 128 ON READER CARD

CYBERNETICS INC.
Waltham, Massachusetts

The Monitron is a computer configuration monitoring system that operates on-line. Consisting of input stations mounted on the processor and peripherals, it is said to generate system utilization reports. These reports enable a user to get daily studies of a processor’s run time, idle time, job set up and tear down, scheduled and unscheduled maintenance, and scheduled vs. actual workload correlations. The reason for system downtime—machine, component, software or operator—is also indicated.

CIRCLE 129 ON READER CARD

DECISION CONTROL INC.
Newport Beach, California

The Versastore core memory system operates at 2 usec with full or half cycle capabilities, with full read, modify and write capability. Available in 16K increments, it goes up to 64K with 36- or 72-bit words. The integrated-circuit system is available in 19- or 24-inch standard rack mounts.

CIRCLE 130 ON READER CARD

ELECTRONIC MEMORIES INC.
Hawthorne, California

A ruggedized unit, the Severe Environmental Memory System 5 (SEMs 5) has a maximum speed of 700 nanoseconds for an access and a cycle time of 2 usec. It consumes less than 60 watts at maximum speed, 10 watts on standby. Operating temperature range is -55° to +85°C. The system is available with capacities of 256 to 16K, from eight to 32 bits. It is a 3-wire coincident-current unit.

CIRCLE 131 ON READER CARD

FAIRCHILD MEMORY PRODUCTS
Mountain View, California

Two memory systems being shown are the Pacer and the Microcell. The latter is a scratchpad system with a capacity of 8,192 bits and a read-only cycle time of 50 nanoseconds. The Pacer, on the other hand, has a maximum core capacity of 2.4 million bits—up to 32K words of 12 to 72 bits each. It has a complete cycle time of 800 nsec and an access time from 250 to 400 nsec.

CIRCLE 132 ON READER CARD

FERROXCUBE CORP. OF AMERICA
Saugerties, New York

Being shown are the FX-22 coincident-current core memory system and an all-glass-bonded read/write head. The latter is a 7-track unit that is said to have a life expectancy five times that of all-metal or epoxy-bonded heads. The absence of organic material in the recording surface is said to be another advantage. The core memory system has a 4-usec cycle time and capacities to 512 (8-bit) words. The cores have voltage margins of ±10% and operating temperature range of 0° to 50°C.

CIRCLE 133 ON READER CARD

GENERAL COMPUTERS INC.
Los Angeles, California

The model 200 is a card-programmed diode function generator. Functions are composed of 11 contiguous line segments; units may be ganged to provide any greater number of line segments. Operating with a .1% programming accuracy, the unit provides for the programming of a start point, central slope, 10 pairs of breakpoint-slope values, central slope increase, function increase, and a start point decrease—all on one card. Standard input range is ±100 volts, output power is ±100 volts at up to 35 ma, and phase shift is less than 1° at 1000 cps.

CIRCLE 134 ON READER CARD

DATAMATION
and applications, the 360's image size plotted is vector generation, program control of intensity can be varied to produce up to 32 levels of gradation. Maximum size intensity and line structure, and characters in superscripts, subscripts, and characters in two sizes plus subscripts and superscripts, and vectors in two line structures (dash and solid). Available are three brightness ranges plus blinding. On the exhibit floor, it will be driven by a DDP-116, but interfaces for other computers are also available.

CIRCLE 136 ON READER CARD

MAGNE-HEAD DIVISION GENERAL INSTRUMENT CORP.
Hawthorne, California
A line of small-scale head-per-track disc memories is being shown. They reportedly were designed to facilitate maintenance, head placement, and bearing change in the field. Storage capacities are up to 10 million bits, and data rates to 1.5 MC. At that speed, average access times are as low as 8 nsec.

CIRCLE 137 ON READER CARD

MIDWESTERN INSTRUMENTS, INC.
Tulsa, Oklahoma
A new series of digital magnetic tape transports for on-line operation with medium and high performance computers will be announced. The Series/M4700 is an offshoot of the M4000 Tape Transport introduced in '65.

CIRCLE 138 ON READER CARD

NORTH ATLANTIC INDUSTRIES INC.
Plainview, New York
The model 537 is a digital-to-resolver or digital-to-synchro converter with circuits mounted on three cards. It accepts an 11-bit digital input and has a no-load output accuracy of 0.1°. Conversion time is less than 1 millisecond. With a resolver/synchro output of 11.8 volts, line-line, it has applications in industrial control and machine tool environments.

CIRCLE 139 ON READER CARD

POTTER INSTRUMENT CO. INC.
Plainview, New York
Paper tape gear from Facit AB of Stockholm, Sweden, will be shown under a new marketing agreement. Shown will be tape readers, spoolers, and punches. The PE 1000 reads and winds at 500 or 1000 cps, and accommodates 5, 6, 7 or 8-track tapes. The PE 1500 punch operates at 150 cps, also on 5- to 8-track tapes.

CIRCLE 155 ON READER CARD

RAYTHEON COMPUTER
Santa Ana, California
The model 300 memory systems, using the 2SD organization, have a cycle time of 900 nanoseconds using 30-mil cores. This is reportedly reducible to 0.6 usec with 20-mil cores. Standard modules are 8K with word lengths up to 112 bits, and 16K with lengths to 56 bits. With a read-restore or clear-write cycle completed in 0.9 usec, the access time is 0.3 usec. A third mode of operation is split cycle, in which read timing occurs normally, but writing is withheld until a write command is generated after the contents of the data register have been modified.

CIRCLE 156 ON READER CARD

SOROBAN ENGINEERING INC.
Miami Beach, Florida
Being shown is an Autodin Subscriber Terminal which consists of a central control unit, card reader, and card punch. The expandable system will also accommodate line printers, tape punches and readers, and mag tape modules.

CIRCLE 157 ON READER CARD

TALLY CORPORATION
Seattle, Washington
A punched card transmission terminal that operates at 80 columns/second over dial-up phone lines is being shown. It is for use with the System 311 data communications terminal. Off-line, it can be used for card to paper tape conversion. Error detection/correction during transmission is standard. Also new is the System 800 paper tape verifier and duplicator. It automatically verifies or duplicates tapes or verifies two tapes and punches a third. Operating at 120 cps, it runs with 1- to 8-channel tapes in any code structure. Options include parity check and blank and/or delete skip.

CIRCLE 158 ON READER CARD

TRANSISTOR ELECTRONICS CORP.
Minneapolis, Minnesota
An electronic keyboard system, for computer and industrial control applications, comes in various configurations, including one similar to a 10-key adding machine. With switches similar in feel and travel to electric typewriters, all switching action occurs on the downstroke. The unit will accommodate any code up to eight levels, including ascii, IBM octal, and 8-level teletype. Space is available for additional control switches, indicators, etc.

CIRCLE 159 ON READER CARD

WYLE LABORATORIES
El Segundo, California
Such programming techniques as branching, looping, and conditional transfer can be performed on the firm's scientific calculator. The model WSS-10 consists of the basic WS-02 electronic calculator, the punched card programmer, and these additions: patchboard programmer consisting of 16 32-step program modules, 10 24-digit storage registers (with provisions to add 16 more), and an auxiliary keyboard that permits manual addressing and access to different start locations for the patchboard programmer.

CIRCLE 160 ON READER CARD
TO PROVIDE a microcircuit systems approach adaptable to breadboarding, small quantity and production runs

- all-new, highly competitive prices
- built-in drivers, inverters and buffers eliminate most interconnecting wiring
- up to 18 microcircuits per card enable high density and lower costs
- boards designed to meet MIL- and NASA standards
- boards keyed to assure proper mounting
- dual in-line packages easily replaced for ease of maintenance
- off-the-shelf delivery

The Vitro microcircuit systems approach is directly adaptable to a broad range of requirements. Whether the application be for breadboarding, one-of-a-kind units or total production runs, Vitro Micromodules are designed to provide the systems engineer with a low-cost, flexible, building-block approach to designing an integrated-circuit system.

The logic implementation on all Vitro boards has been standardized for positive NAND logical functions at a voltage swing from 0 to +3 volts. The diode-transistor logic devices employed have individual circuit speeds up to 10 MHZ, and equipment speeds above 5 MHZ. These circuit boards can be provided as directly off-the-shelf logic, with standardized performance to simplify a logic design application, or can be custom-built according to customer specifications. High density packaging is utilized providing up to 18 removable microcircuits on a single card. Ease of maintenance is assured since all dual in-line circuit packages can be easily removed and replaced in the field. To further simplify maintenance, Vitro-supplied chassis configurations are constructed of standard components assembled on a building block principle.

For further information on the complete line of Vitro microcircuits, mounting hardware, card files, wiring accessories, and power supplies, contact the Micromodule Sales Department, VITRO ELECTRONICS, 919 Jesup-Blair Drive, Silver Spring, Maryland 20910, Phone No. (301) 585-1000.
THE TECHNICAL PROGRAM

by DR. WILLIAM H. DAVIDOW

The technical program of the '66 FJCC has been planned to present new and significant developments in the computer field, expose the attendee to basic material in areas of technology affecting his work, focus attention on some interesting applications of computers, and present a few of the issues facing the industry.

Three Discussion Sessions, similar to the ones presented at the '65 FJCC, are planned. Summaries of the sessions' participants work, insights, and opinions will be made available to conference attendees two weeks before the conference at a nominal cost. In at least two of the three cases, the discussion-type format has been used as a way to present material which is so new that papers are not available. Attendees are encouraged to request these summaries, prepare for the sessions, and participate actively.

A workshop is planned to enable participants who are interested in graphics to meet, exchange ideas, and discuss new concepts. This should provide an opportunity to obtain up-to-date information on developments, and should do much to alleviate the "publication delay."

The program committee strongly felt that all excellent manuscripts submitted to the conference should be published. To this end, a special session was created in which papers of high quality will be presented; these papers did not fit well into the topic-oriented sessions, but their inclusion will improve the quality of the conference and increase its breadth.

Four sessions deal principally with hardware technologies. The session chairmen have done an exceptional job of bringing new developments and ideas from the laboratory to the conference floor. Men with authority and insight will be speaking about developments that will shape future trends in the industry.

Several sessions deal with the application of computers in diverse fields such as music, publishing, government, and numerical analysis. Attendees should find these informative, stimulating and, at times, amusing.

The program committee organized a number of sessions dealing with different aspects of time-sharing. The committee has attempted to present an overview of this significant advance in which the problems that should be run in a time-sharing environment, the processor and software design, remote terminals, communication lines, and the man-machine interface could be discussed in a coherent fashion. The session, "Some Communication Aspects of Time-Sharing Systems," is one of the first public discussions of the communication problem facing time-sharing.

Three sessions have been planned on hybrid and analog computation. The members with interest in these fields have done an enthusiastic and excellent job of organizing the material.

While a considerable number of sessions contain material about programming and programming techniques, two of these—on "Natural Language Processing" and "Advances in Programming Languages"—will be of special interest to software specialists. These resulted from the judicious selection of a large number of papers.

It is the program committee's hope that the '66 FJCC will be a stimulating, memorable, and enjoyable experience. The energy and enthusiastic efforts of approximately 200 authors, session chairmen, panelists, and referees have gone into organizing the technical program. If their efforts can be used to estimate the quality of a conference, the technical program of the FJCC should be of interest to all.

Dr. Davidow
THE SESSIONS

Tuesday, 1:00 p.m.

Larkin

Computers and Publishing

Chairman:
William R. Nugent

Informatics Corporation

Maynard, Massachusetts

Early applications of computers in publishing were frequently characterized by eccentric typography, bizarre hyphenations, and outrageous page costs. This *wunderkind* of Gutenberg and Babbage, initially more profligate than prodigy, has matured, broadened, and prospered. "Computer typesetting" describes only a fraction of the diffuse applications; the role of the computer in publishing and its system configuration have changed; the end products of publishing are being modified to take advantage of new possibilities; and not least, a more economic rationale of application has produced profits.

This session will explore these changes. The tone of the session will be that of disclosure of new and significant methods and applications. In a sharply competitive field like publishing, there exists a Gresham's Law of disclosure, expressed as a strong tendency among the innovators to husband new techniques and keep their best papers in the vault. We are, therefore, fortunate to have in this session some of the most progressive innovators in the field who have agreed to describe their techniques in depth.

Newspapers have been leading users of computers in publishing, and a few of them have made telling advances in programs and systems. Such users have often spurned manufacturers' canned programs and standard configurations in favor of in-house programming and eclectic systems. While this approach has hazards, the session will point out two outstanding examples of success.

Brereton E. Nebel will describe a multiprogrammed tele-processing system in operation at the *Los Angeles Times*. Using twin 360/30s, the system services local and remote stations in a variety of time-shared tasks and can survive the demise of one central processor. Mr. Nebel is manager of Advanced Systems Programming at the *Times* and was previously active in systems programming at Lit­ton and IBM.

John H. Perry, Jr. invents his own machines and systems when the state of the art does not meet his needs or expectations, which, one gathers, is frequently: his inventions range from submarines to photocomposing machines. Perry Publications, Inc., publishes 27 Florida newspapers, as well as magazines, books, and commercial printing, and is considered to be the most fully automated graphic arts and publishing organization. Mr. Perry will describe his system and discuss the economics of print readers and computers.

One of the surprising effects of publishing on hardware has been the triumphant return of the special-purpose computer. Although special-purpose machines are often considered an anachronism in this age of the $10,000 general-purpose machine, a recent *Composition Information Services* survey showed special-purpose computers to hold somewhat less than half of the computer typesetting market. The statistics change daily, however, and as the price of the general-purpose machine is dropping, the required sophistication of programs, wired or written, is rising. That the special-purpose computers are competing so well is a tribute to the ingenuity of their logical designers. Constantine J. Makris, head of the Computer Development section of Mergenthaler Linotype, will describe how he has approached the problem of page composition logic in the design of a special-purpose computer.

Our sampling of technical papers is of U.S. origin. However, much significant work is being done in Europe that is not generally heard of until a particular machine is imported or licensed. To counter such provincialism, we will hear a survey and progress report of work in Britain and Europe by C. J. Duncan and James C. Dolby. Mr. Duncan is the director of the Computer Typesetting Research Project at the Univ. of Newcastle-upon-Tyne and is widely known for his penetrating surveys, often published in the *Penrose Annual*. Dr. Dolby returns from a year's study at Newcastle and was previously active in automatic syllabification studies at Lockheed.

The computer typesetting of straight text matter was slow to impress many compositors or scientific publishers, since the composition of a novel, for example, was not especially difficult, and there were many places in Europe and rural U.S. where inexpensive composition of fair quality could be obtained. The difficult problems, where page costs were 10 to 20 times higher, were in the composition of display formulae, chemical structures, and tabular matter. Joseph H. Kuney and his staff at the American Chemical Society have developed an operational system for the composition of complex scientific material which he will describe. Mr. Kuney is director of Publications Research and director of Business Operations at American Chemical Society.

The combination of computers and phototypesetting has enabled new techniques of composition to be developed that do not imitate human compositors, but rather make use of the calculating ability of the computer to precisely position data of many differing forms and fonts. One goal has been fully automatic page makeup including graphics; text, running heads, page numbers, etc.; and the consequent elimination of cutting and strip-
What's going on out there?

Ocean Drilling & Exploration Company of New Orleans has engineers, 300 miles away, who have to know. Otherwise, supplies and decisions needed for daily drilling operations could be delayed, which might result in costly downtime.

Bell System Data-Phone* service is the vital link in the chain of communications.

The information flows from the nine offshore drilling rigs to the company's warehouse via radio, and on to headquarters in New Orleans over Data-Phone data sets. Where tedious and time-consuming manual copying of reports had been the procedure between the warehouse and headquarters, copies are now quickly and easily transmitted using facsimile machines and Data-Phone data sets. And the information is sent over regular telephone lines.

"Reports are in every morning, and there is less chance of human error or omission," says Mr. Charles S. Howe, superintendent of the General Services Department.

Business operations depend on fast, effective information flow. Our Communications Consultant is ready and able to help you plan a communications system to meet your business needs.

See the Bell System exhibit, booths 909-911, at the Fall Joint Computer Conference, November 8-10, San Francisco.

* Service mark

AT&T Bell System
American Telephone & Telegraph and Associated Companies
THE SESSIONS . . .

piping of partial components. George Z. Kunkel of the Central Intelligence Agency has developed a page composition program which will be described in detail. The system uses Mr. Kunkel's unique variable set size justification method that avoids both hyphenation and letter-spacing (see DATA

MATION April '65, p. 42).

A Multiprogrammed Teleprocessing System for Computer Typesetting, by B. E. Nebel.

Integrated Automation in Newspaper and Book Production, by John H. Perry, Jr.

A Special-Purpose Computer for High-Speed Page Composition, by Constantine J. Makris.


Computerized Typesetting of Complex Scientific Material, by J. H. Kuney, B. G. Lazarchak, S. W. Walcovich, and Don Sherman.


Tuesday, 1:00 p.m.

Polk

Integrated Electronics and the Future of Computers

Chairman:

James B. Angell

Stanford University

Stanford, California

The rapidly growing ability within the electronics industry to fabricate large-scale integrated electronic structures promises to substantially alter the ground rules for optimizing the design, structure, cost, and flexibility of future generations of electronic data processing systems. This session has been organized to provide:

1) an introduction to the field of integrated electronics and how rapidly it has changed and is still changing,

2) a look at expected future costs of such structures,

3) a discussion of how the "economics" of future computers may be affected by this trend; in particular, how integrated electronics may affect the utilization of computers via the trade-off of software simplification for increased hardware, and

4) consideration of how the channels of communication between computer fabricators and their component suppliers may be affected.

The session's first two papers, prepared by two of integrated electronics' most renowned and qualified spokesmen, will present the most salient factors which have been responsible for the remarkable advances made and still coming in this field. It will be shown that the present status of commercially feasible integrated electronic structures, which is exemplified by perhaps 100 electronic digital components fabricated and interconnected as one small unit, has already taken us well beyond the cost and reliability limits achievable with discrete components of former years. It will also be shown that this present status is nowhere near the ultimate limit, insofar as cost, number of components per structure, or reliability is concerned, and that substantial advances are imminent.

The third and fourth papers will develop the following line of reasoning. If future computers, built using integrated electronics, employ the same principles of organization and usage (the same architecture) as are found with traditional computers at present, the impact of the new electronics technology will be slight indeed, because the electronics portion of most present-day large-scale computing systems does not represent a large portion of the overall cost of the service provided by that system. Thus, in order to exploit integrated electronics to its fullest potential, new forms of computer architecture, no longer based on the careful minimization of the number of electronic functions but rather on minimizing the overall cost of using a computing facility, will be developed. The prospect of improving the coupling between humans and computers through the use of far more versatile and complicated electronics now becomes a reality.

The final paper is concerned with a new challenge that has never before risen to anywhere near this extent in the electronics field. As integrated structures become more complicated and capable of performing far more sophisticated functions than could be achieved before in a single, irreducible structure, the problem of specifying and testing these structures grows rapidly. These problems become particularly acute when the system designers, who specify the desired functions of integrated structures, are physically or organizationally remote from the semiconductor fabricators. Various possibilities for establishing working channels of communication between these two groups, who have traditionally been rather separate and coupled mainly by component specification sheets, are considered in the final paper.

The scheduling of these five papers has been planned to allow 45 minutes of informal discussion among the speakers, and between the speakers and the audience, before the close of the session.

Technological Foundations and Future Directions of Large-Scale Integrated Electronics, by Richard L. Petritz.

A Look At Future Costs of Large Integrated Arrays, by Robert N. Noyce.

Effects of Large Arrays on Machine Organization and Hardware/Software Trade-Offs, by L. C. Hobbs.


The System/Semiconductor Interface with Complex Integrated Circuits, by Wendell B. Sander.

Tuesday, 1:00 p.m.

Main Auditorium

Time-Sharing Processors and Executive Systems

Chairman:

Gene M. Amdahl

IBM Corporation

San Jose, California

The rapid growth of interest and achievement in time-sharing necessitates increased reporting on the status of current developments in this field. This session concentrates on the central computing system's hardware and software facilities for real-time, multi-user operation. The hardware considerations for responsive utilization and flexible configuration, the moni-

tor system for fast and efficient control, the debugging techniques for program checkout, and conversational compilation and execution for program generation will be covered to provide an overview of time-sharing in the central computing system.

The hardware characteristics will be described of a system which is capable of achieving real-time response while operating in a multiprogramming, multiprocessor, space-sharing and time-sharing environment. The delineation of the problems and the philosophical considerations employed in their solution will be expanded upon for priority interrupts, duration of uninterruptible intervals, red tape time, system integrity, space-sharing, memory protection and recursive and reentrant routines.

The monitor program characteris-
Take it from Jack Hatcher:

“MRX-III computer tape is 3 to 5 times more durable than the leading competitor’s”

And Jack wasn’t easy to convince. He didn’t care how well the tape performed in its more than six months of pilot line and laboratory testing. He wasn’t impressed by the fact that 718,000 shuttle passes didn’t even begin to scratch the tape. He merely shrugged at the favorable reports from the more than fifty installations where exhaustive field-testing was performed. He just said, “Well, we’ll see.”

That’s Jack’s job, as an engineer in our product evaluation lab, to see for himself how each new Memorex tape measures up. He’s paid to break it down, if he can, subjecting it to any and every kind of use and abuse to which a computer tape could possibly be exposed. But on MRX-III, Jack broke his pick.

Now you test it. For a sample of MRX-III (on its new color-coded reel), write us at Santa Clara, Calif.
THE SESSIONS . . .

Tuesday, 1:00 p.m.
International Room,
Jack Tar Hotel

Hybrid Computers and Random Variables
Chairman:
A. C. Soudack
University of British Columbia
Vancouver, British Columbia

To date, the major use of the hybrid computer has been in solving deterministic problems. Since the vast potential of the hybrid machine is virtually untapped, we decided to have a session investigating the potential of the hybrid computer in another broad field, that of non-deterministic, or random variable type problems. Since there has been little publicized work on which to build a format, the session is self-contained and the following topics will be discussed.

1. The generation of random variables by the digital end of the hybrid computer. This needs no elaboration, since one obviously needs a random variable to simulate a non-deterministic problem.

2. Errors in hybrid loops. A great deal has been said about errors inherent in analog computation. But how about unforeseen errors, both deterministic and non-deterministic, that might arise in a complex hybrid system due to interfacing and data conversion? This topic should be of interest to all hybrid computer users.

3. Applications. Monte Carlo, or random walk, problems always pose interesting questions, and have interesting applications. The solution of parabolic and elliptic partial differential equations using random walk methods will be presented. In contrast to the first topic, we have the analog end of the machine generating the random data. Professor G. A. Korn and his ASTRAC II, a special purpose ultra-high speed analog computer have been working on the forefront of this field.

4. Applications of random search methods in control system optimization. A most important topic of current interest, treated by the hybrid computer.

A General Method for Producing Random Variables in a Computer, by Dr. George Marsaglia.

A Unified Approach to Deterministic and Random Errors in Hybrid Loops, by Dr. J. J. Vidal.

Hybrid Computer Solutions of Partial Differential Equations by Monte Carlo Methods, by Dr. W. D. Little.

Parameter Optimization by Random Search Using Hybrid Computer Techniques, by G. A. Bekey, A. E. Saboroff and M. H. Gran.

Tuesday, 3:45 p.m.

Larkin

For and Against Time-Sharing
Chairman:
Harry D. Huskey
University of California
Berkeley, California

Professor David Evans will set the stage by explaining why the sudden interest in time-sharing. He will describe those technical developments that make it feasible to have individual on-line computing. However, there are still problems which are not particularly suitable for solution on time-sharing systems. These will be described by Professor Abe Taub. Following this a pioneer in on-line computing, Dr. J.C.R. Licklider, will describe areas in which time-sharing systems have been used advantageously. Finally, the colorful Herb Grosch will discuss on-line information retrieval systems.

The session will be in two parts: a formal presentation followed by a discussion period. Each speaker will present his material in turn, and the audience will be encouraged to ask questions. After the formal presentations, the group of panel speakers will answer the questions.

To many people on-line computing (and implied time-sharing) is the most significant recent development in computers. Others are much less optimistic. Perhaps the enthusiasm is premature; it may take more effort than originally estimated in order to have usable time-sharing systems. Or perhaps existing systems already provide much more than batch processing systems can hope to provide!

The presentations and discussion are expected to bring out the relative importance of mass stores, trade-offs between large bulk core memories and sophisticated drum swapping systems, significant logical features which make re-entrant programs more efficient, and memory access priority schemes which substantially improve overall performance. Important char-
BENSON-LEHNER BREAKS THE ON-LINE PLOTTING BOTTLENECK...

and reduces computer plotting time up to 50 times

CARD INPUT DELTA INCREMENTAL PLOTTER

INEXPENSIVE OPERATION...
use computer as a computer, not as a plotter input device

EXPANDABLE...
on site up-dating to magnetic tape or multiplexing

1130 USERS...
plot off-line as well as on-line

IMMEDIATE DELIVERY...
Hardware and Software... on display at FJCC

benson-lehner corporation 14761 CALIFA STREET, VAN NUYS, CALIFORNIA • 781-7100
THE SESSIONS . . .

acteristics of computer languages for on-line systems will be discussed.

What is the relative importance of a language being "fail-safe" versus being concise and efficient? How much standardization should there be? What about "custom" systems that the user can modify and adapt to his personal taste? Are we coming closer to having significant building blocks which will permit the next generation of users to attempt larger problems, which could not be solved if the individual had to start from the beginning at the machine language level?

Is Dr. Bush's super-desk almost here not as a self-contained library-information retrieval and processing system, but as a terminal on a large central library and super-computer? Where will we be five years from now, ten years from now?

What is Time-Sharing? by David Evans.

Problems Which Should Not Be Run on Time-Sharing Systems, by Abe Taub.

Problems Best Solved on Time-Sharing Systems, by J.C.R. Licklider.

Tuesday, 3:45 p.m.

Main Auditorium

Engineering Design by Man/Computer Interaction

Chairman:

Thurber J. Moffett

Lockheed-California Company

Burbank, California

Academic, industrial and government interests alike are heavily involved in every phase of converting the present state of man-computer technology into usable and available systems. No longer in doubt is the coming widespread introduction of such systems for engineering design and related activity. Engineering managers have passed the point of questioning the "ifs" and "whys" and are becoming ever more concerned with the "whens." Competitive positions are beginning to be related to how soon particular companies can gear to design by man-computer interaction using the large multi-console time-shared systems now envisioned. How such systems are to be developed and introduced into the engineering environment is, in itself, developing into one of the most challenging efforts ever to be put to the computer and engineering managerial communities.

In this mounting fervor, the areas requiring attention and getting it are evolving an impressive array of possibilities and alternatives. The field is now too comprehensive for any technical session to do more than single out a relatively few items for concentrated attention. The selections for this session were made recognizing the present state of engineering management thinking and consequently favoring near-term utility.

The first paper concerns a typical time-shared, on-line design of electronic circuits and associated display technique, accompanied by a teletype display demonstration from Project MAC at MIT. The second discusses an operational system which time-shares multiple graphic consoles with provisions for running independent applications. Next, more of the extensive work underway at Lincoln Laboratory is presented with a description of an ultrasonic transmitting device to relate 3-D position information to a computer. The last two papers describe an experimental system for assisting the draftsman to translate circuit schematics into precise drawings for circuit fabrication, and an experimental system for reducing interconnections between separately packaged multipurpose logic elements in integrated circuits.


A System for Time-Sharing Graphic Consoles, by J. R. Kennedy.

The Lincoln Wand, by Lawrence G. Roberts.


Tuesday, 3:45 p.m.

Polk

Computer in Music

Chairman:

Heinz Von Foerster

University of Illinois

Urbana, Illinois

TACK TACK TACK . . . BOING . . .

VROOOOM . . . WHAMMY . . . are words not listed in Webster's Unabridged International Dictionary, although they are popular and legitimate onomatopoeic representations of familiar sounds. Are these sounds music?

A century ago this question would have been unanimously answered in the negative. Today, however, we have to be more cautious. Does this imply that today we are less sure of our judgments or, perhaps, have suffered a loss in acuity of audition from the permanent exposure to a noisy environment? Why is it that today a sizable number of people are willing to even pay admission to a concert which to an audience of two generations ago would offer cacophony rather than symphony?

The causes for this change in attitude are easily understood by a brief glance at the trends in the evolution of western music beginning with Pythagoras and terminating—open-ended—with the theories and experiments of those gentlemen who so kindly consented to present their ideas and results during this session. What are these trends?

They are most clearly understood in information theoretical terms—namely, as a gradual reduction of redundancy in works of music or, expressed differently, as a continuous increase of complexity in sound and composition, and hence an increase in the amount of auditory information transmitted during a given interval of time. Redundancy reduction has been achieved over the last two millenia by a steady abolishment of constraints on three levels: specificity of wave forms (sounds), selection of frequencies (scales), and rules of synchronism and succession (composition).

With the invention of new musical instruments through the centuries, and with their integration into an orchestra which originally consisted only of lyre and flute, musical sound acquired at the turn of our century the grandiose richness, depth and variety of dimen-
The Pythagorean seven-tone scale based on "pure" frequency intervals with ratios 2/1, 3/2 and 5/4 (corresponding, of course, to the second, third, and fifth harmonics) was found to be an "open" tonal system; i.e., new frequencies are generated if a tone, other than the fundamental, is taken as the start of a new Pythagorean scale. Consequently it was replaced in the 17th century by the "well tempered" scale of equal intervals with ratio 12\(\sqrt[12]{2}/1\), which for the first time, offered musicians a "closed" tonal system, the 12-tone scale.

With this new scale, transition from key to key is smoothly accomplished, and earlier constraints regarding harmony and melody have been abolished. Wagner, Richard Strauss and Stravinsky made full use of this possibility, but it was Hauer and Schönberg who recognized the crucial features of the well tempered 12-tone scale—namely, the equivalence of tones within a chord, and the invariance of ratios against translation in pitch. With this observation they opened new possibilities for the composer and further removed constraints regarding synchronism and succession.

Is it possible to push these generalizations even further? The answer is clearly "Yes." One may challenge the validity of constraints in sound by a given set of musical instruments; one may challenge the validity of the constraints given by a scale that divides the octave into precisely 12 intervals. The number 12 has nothing to offer to make it preferable over any other number, except that the 12-tone scale happens to give good approximations for the Pythagorean intervals 3/2 and 5/4. However, it can be shown that an 18-tone scale gives much better approximations for these intervals. Accepting the possibilities of extensions in sounds and scales, how does one determine the new rules of synchronism and succession?

It is at this point, where the complexity of the problem appears to go out of hand, that computers come to our aid, not merely as ancillary tools but as essential components in the complex process of generating auditory signals that fulfill a variety of new principles of a generalized aesthetics and are not restricted to conventional methods of sound generation by a given set of musical instruments.

The session "Computers in Music" will focus on three aspects in the use of computers in generating music.

First, hardware and software for implementing the generation of sounds will be discussed under the heading Programs and Systems. Second, the versatility of digital computers in exploring rules of succession and synchronism will be demonstrated in the section, Composition. Finally, the ticklish problem of judgment entering perception—i.e., what is "beautiful" and what is "ugly" or, to put it again into information theoretical terms: how we distinguish between signal and noise will be taken up in the final section, Aesthetics.

Simulation Models for Transient Musical Instrument Tones, by Dr. James W. Beauchamp.
The Computer as Orchestra, by Dr. Arthur Roberts.
Computer Generation of Music in Real-Time, by Dr. David Freeman.
Graphical Scores, by Dr. Max Mathews.
Operations on Waveforms, by Dr. J. K. Randall.
Composing Music with a Computer, by Dr. Lejaren Hiller.
Control of Consonance and Dissonance, by Dr. Max Mathews.

The Problem of Imperfection in Computer Music, by Dr. Gerald Strang.

Wednesday, 9:30 a.m.
El Dorado Room
Jack Tar Hotel

Error Analysis in Analog and Hybrid Computation
Chairman:
Robert Vichnevetsky
Electronic Associates, Inc.
Princeton, New Jersey

Since the introduction of analog computers as general-purpose tools for the simulation of dynamic systems (i.e., systems described by sets of initial value differential equations), the subject of error analysis and error prediction in their operation has been a subject of significant interest. More recently, hybrid and digital techniques have enlarged significantly the scope of analog computation, and, by increasing the scope of what can be done in simulation, as well as the complexity of what simulation problems are being solved, have introduced new types of errors and new problems in error analysis.

In approaching the general problem of error analysis and error prediction, it should be emphasized that it is, by its very nature, a qualitative problem. By this we mean that to understand the potential and limitations of computer simulation, it is necessary to formulate concepts regarding overall behavior of errors, rather than being able to predict in each specific case what the exact value of the errors will be as a function of solution time. Obviously, the latter would be quite useful and even desirable.

But in view of the multiplicity of sources of elementary errors in a single simulation, and of the uncertainty attached to the value of these elementary errors, one can at best hope to be able to predict the order of magnitude and the time-propagation properties of the total accumulated errors in the computer solutions.

Basingly, analyzing errors in the simulation of a dynamic system is similar to analyzing the response of the system itself to small perturbations. A study of these perturbations themselves (a microscopic study of computing elements and algorithms) and the study of their effect on the computed solution (a perturbation or variation of analysis, in the calculus sense) are two main aspects of error analysis.

A classic paper, stressing the variational aspect of error analysis in anal...
errors resulting from a non ideal implementation of the system’s differential equations, and is the Jacobian matrix, or matrix of partial derivatives of f with respect to x. A classical way to analyze the effect of specific sources of errors on the solution accuracy is by the introduction of parameter influence functions or sensitivity functions. This approach was essentially that taken by Meissinger.

It is interesting to note the parallelism between the tools used here, and those being used in different fields such as systems and control theory.

An approach to the problem of determining error sensitivity functions is to achieve this automatically on a fast-repetitive computer, as is suggested in the paper by Korn. The application of sensitivity methods to specifically hybrid problems has been done by Karolus in the case of the solution of partial differential equations.

The microscopic aspect of error analysis, or analysis of elementary errors, has received particular attention recently with the introduction of hybrid and digital processes in simulation. To that respect, the paper to be presented by Gilliland will emphasize one way of performing that analysis: spectral error analysis of discreet processes provides a description in the frequency domain well known to control engineers.

Along similar lines, Bekey will present an application of sensitivity techniques to the effect of sampling rate.

The discussions which are expected to take place will undoubtedly benefit the theoreticians in giving them fresh problems to ponder, and the users in giving them a better understanding of what tools are available to them to analyze their error problems.

Interrelation of Error Analysis, Sensitivity Analysis and Parameters Identification, by Hans F. Meissinger.


Error Analysis of Hybrid Field Simulations, by Walter J. Karpus.

The Analysis of Errors Due to Sampling Rate Variations, by George A. Bekey.

Error Analysis of Hybrid Computer Loops, by Elmer G. Gilbert.

Spectral Analysis of Hybrid Subroutines, by Max C. Gilliland.

Wednesday, 9:00 a.m.

Polk

Computer Memories

Chairman:
Jan A. Rajchman
RCA Laboratories
Princeton, New Jersey

Rapid addressable access to large amounts of information is the key to universal programmable data processing. In the relatively short history of electronic computers the demands for greater storage capacity and higher speed have been constant and, regardless of the progress achieved, still further demands were and are being made. Some reasons for this are: the use of higher order languages, the attack of more ambitious problems, time-sharing and, generally, the more convenient use of computers to ever-growing applications.

At the center of the hierarchy of storage devices is the computer’s internal random access memory; therefore, it is not surprising that substantial and continuing efforts in research, development, production methods and usage are devoted to it. The state of the memory art and a realistic appraisal of the often optimistic promises from the laboratories is always of great concern to the computer community. The subject is featured in this conference as it was in past conferences and will be in many future ones.

The core memory remains the mainstay of the art; its speed and capacity are constantly increasing and its cost decreasing. As in any mature business, economic factors are becoming the subject of a detailed art; this is reflected in the first paper in the session. Thin magnetic film memories are emerging from the laboratory into the factory and the next three papers show how well the long-standing promise of high speed and batch fabrication economy is being realized. All-semiconductor memories are becoming an economic feasibility due to the phenomenal success of integrated circuits and are likely to provide a good scratchpad in the near future. This is the subject of the next paper. An interesting approach to economic large capacity memories is the notion of random access to blocks of serially accessed bits. The last paper illustrates the progress of this approach with sonic scanning of strain-sensitive magnetic materials.

The session gives a good but only a partial panorama of the field, which is very broad. Among the important approaches not included are the monolithic ferrite memory, work on the constantly-changing superconductive memories, the popular read-only memories, content addressable or associative memories which are still in the laboratory, and early attempts in the area of optical memories.

A Cost/Performance Analysis of Integrated Circuit Core Memories, by Dana W. Moore.

A 200-Nanosecond Thin-Film Main Memory System, by S. A. Meddough and K. L. Pearson.

A Rotationally Switched Rod Memory with a 100-Nanosecond Cycle Time, by Bruce A. Kaufman, Paul B. El­linger, and H. J. Kuno.


Sonic Film Memory, by H. Weinstein, L. Onyshkewych, K. Karstad, and R. Shahbender.

Wednesday, 9:00 a.m.

Main Auditorium

Management of Multi-Access Systems

Chairman:
Richard G. Mills
Massachusetts Institute of Technology
Cambridge, Massachusetts

In the current flurry of activity in hardware design and system and application-software development for large, multi-access time-sharing systems, it is easy to overlook the problems of control and management of the resources these systems provide. To do so would be a serious mistake; the issues of multi-access system management are inseparable from the more obvious technical considerations influencing system design.

After all, the proof of multi-access system technology will lie in its routine, day-to-day use. In the cold world of practical application, considerations such as economics, business practices and even politics, will have important effects, both on the overall system design and details of its implementation, and on the functional appearance and utility of the system as viewed by its users.

In this session the entire constellation of such issues as computer service as a resource; the economics of computation; control, including metering, accounting, billing and auditing problems; pricing structures; services offered, and a host of others, are
How good are Datamec Tape Units?

Ask any of the people who build or use these computer systems.*

1. Astrodata Inc.
   Automatic Data Acquisition System
2. Benson-Lehner Corp.
   B-L 120 off-line Microfilm Printer/Plotter
3. Cubic Corporation
   Computer Tape Synchronizer
   for European Air Defense System
4. Digital Equipment Corp.
   Programmed Data Processor-7
5. Digitronics Corporation
   Model 522 Dial-o-verter
   Magnetic Tape Terminal
6. Raytheon Computer Operation
   Raytheon 520 System

Perhaps you, too, have a program that would profit from low cost/high reliability in computer tape handling. Check with the company that stresses service to its customers. Write Tom Tracy at Datamec, 690 Middlefield Road, Mountain View, California 94041. Better yet, phone Tom at (415) 968-7291.

* Sorry there’s space for so few pictures. If you’d like a lot more names, contact Tom.
somewhat loosely heaped together and assigned the label “management problems.” If there is a theme threading the positions of all the panelists, it is that one should not expect the tried-and-true business practices of the past to be suitable for controlling the new kind of resource which a multi-access system represents.

Most of those who use the currently available systems for either business or scientific problem solving have found that time-sharing offers much more than convenient access to a computer. Even at this early stage it has been repeatedly demonstrated that the real potential of these systems can be realized only by treating them as a new kind of tool—basically different from a batch-processing computer—for solving the problems at hand. New kinds of problems become approachable, and new approaches become appropriate. Old problem formulations are often profitably replaced by substantially different ones which exploit the new capabilities. Extrapolating from experience of this kind, it is reasonable to suppose that the coming generation of systems will permit—and demand—even further innovation.

Just as imagination and innovation are called for in multi-access system applications, so also in their management. Different computational resources are available; different management issues arise, and different policies and practices are in order. As an illustration, consider the fundamental issue of accounting for system use. The machine organization and system configuration required for large, general-purpose time-sharing systems are naturally amenable to much more detailed and precise usage metering than are those of conventional computer systems. Time-sharing system supervisory programs must have highly detailed, precise metering for control of system operation, and system accounting and billing sub-systems can simply “tap off” as much of this information they can use. As a result, the bill that a user receives at the end of the month may be quite extraordinary by present standards. It may show separate charges for per-user core (down to the microsecond), core-memory occupancy (in “world-microseconds”), plus complete details of the use of secondary storage, peripheral devices, and so on. The old standard billing unit for computer use, the “system-hour,” can and should be discarded, but the appurtenant problems are numerous.

Other management issues surround the question of what the operator of a multi-access system, either as a private enterprise or as the internal computer-service facility of an organization, offers to his “market,” and what obligations he assumes when a customer signs up for service. An illustrative key issue is that of file system safety. A user tends to place his trust, however misguided, in the safety of the available file system, regardless of disclaimers and despite objections of the management. By doing so, he, in some sense, forces an unsolicited obligation on the system proprietor to the extent that a user who loses a file has a moral and possibly even a legal basis for claiming damages. This phenomenon (it was actually observed at an early stage in the development of CICS at Project MAC) at least suggests that the file-system component of a service offering had better be based on a thoroughly safe system implementation. Anything less is likely either to be considered unusable by the system users, or worse, to be used as though it is perfectly safe with the consequent inevitable calamity. A “fairly safe” file system is like a “fairly safe” airplane; the value of its contents is usually high enough to force a decision not to use it at all rather than risk a malfunction.

The foregoing attempts to convey an indication of the large and ill-defined territory encompassed by the session title. Written questions from the audience will be accepted for discussion.

The panelists offer a large and varied experience with one phase or another of multi-access system management. All draw from general backgrounds of participation in development of advances in the technology of computer systems and their applications.

There will be no "program conversion" item to budget for when Burroughs B 5500 users move up to the new, more powerful B 6500. Their present programs will run on the B 6500—even if the configuration is different—as efficiently as if they had been written for their new computer.

No need to rewrite. No need to revise. We’ve given our B 5500 users a place to grow without reprogramming. The money they have invested in programs has been fully protected.

The full third-generation Burroughs B 6500 features a very fast thin film memory, and monolithic circuitry throughout. It’s about eight times as powerful as the intermediate scale B 5500. Yet it uses the same proven software, perfected through six years of refinement and made fully operational in the “real world” of customer installations.

You can see the B 6500’s software demonstrated today. And test your B 6500 programs today, with confidence, on a B 5500. Or put them to work on a B 5500 now until you’re ready for a B 6500.

Why not ask your Burroughs representative for more facts today? Or write us at Detroit, Michigan 48232.

Burroughs Corporation

Will you have to reprogram for your next computer?
THE SESSIONS . . .

B. Thompson.

Wednesday, November 9
2:30 p.m.

Larkin

Impact of Computers on Government: Federal, State & Local
Chairman:
Norman J. Ream
Center for Computer Sciences & Technology
U.S. Department of Commerce
National Bureau of Standards
Washington, D. C.

This session will deal with the interaction between computers and government service on the federal, state and local levels. The federal government pioneered in the use of electronic digital computers which had been initially developed to meet military requirements. In the Bureau of the Budget's Report to the President on the Management of Automatic Data Processing in the Federal Government (Senate Document 15, March 4, 1965) Kermit Gordon said:

No single technological advance in recent years has contributed more to effectiveness and efficiency in Government operations than the development of electronic data processing equipment . . . Furthermore, the computer is becoming increasingly useful to managers in solving complex problems involving interrelated types of information. The most notable of these have been in military areas and in supply management, but the use of computers to support advanced management techniques is becoming common in a broad range of governmental activity. Based on results achieved to date, this latter type of use of computers holds a potential of outstanding importance in the public service.

In addition, there is the largely unexplored area of integrating related information systems that cross organizational lines.

Accordingly, it seems reasonable to assume that the impressive advantages to the Government already achieved through automatic data processing are but stepping stones to the future.

The session will have one paper dealing with organizational staffing and procedural changes arising out of the application of a computer to a large-scale clerical operation at the federal level. This operation in the Treasury Dept. has had ramifications throughout the Federal Reserve System on the banking operations of the nation. Additional papers in the session will deal with problems of designing computer-based information systems to meet the needs of state, county and local government organizations.

Although present employment of the computer in the federal government exceeds in costs and variety of tasks performed the use of these systems in state and local government, the possibility for future development of beneficial uses in state, county and local government are challenging and demanding, and call for the employment of the best talents available.

President Johnson recently emphasized in a memorandum of June 28, 1966 to the heads of all departments, "I want the head of every federal agency to explore and apply all possible means to use the electronic computer to do a better job and to manage computer activity at the lowest possible cost." In this same letter he said, "I want every agency head to give thorough study to new ways in which the electronic computer might be used to provide better service to the public, improve agency performance and reduce costs."

This session will not attempt to cover all of the tasks which computers are performing at the four governmental levels. It will attempt to report some progress, identify some problems, and raise some issues which warrant study and discussion.

The Paycheck Payment and Reconciliation Program of the U.S. Treasury: Present Status and Future Prospects, by George F. Stickney.
The Impact of Computers on Local and Regional Government, by Herbert H. Isaacs.
An Information System for the Los Angeles Police Department, by L. Farr and L. B. McCabe.
advancement toward the objective. Also, as on-line, time-sharing computer hardware systems develop more sophisticated multiple user access capabilities, new software is being developed to further the objective.

The formal papers to be presented may be thought of as a natural extension of problem oriented languages in the realm of present day hardware. The authors refer to their work as on-line mathematical analysis, operation oriented on-line with distributed control, and user-oriented. In their oral presentations the authors will deviate from their published papers as appropriate to bring you the current status of their work. Each speaker will orient his presentation toward the utilization of the system from the users' problem solution standpoint rather than emphasize the hardware and software aspects. At least one presentation will utilize a motion picture (in real-time, of course) to show a user solving a problem on a terminal of the time-shared system.

Following each paper a member of the panel will give a critique of the paper and forecast the impact of the authors' work. The panel will consist of Dr. Charles R. DeCarlo, IBM Corp.; Francis V. Wagner, Informatics, Inc.; and Dr. William H. Wattenburg, Berkeley Scientific Laboratories. In conclusion, a featured speaker, Dr. Charles DeCarlo, will summarize the session and prophesy the future of computing in the scientific field.

The Lincoln Reckoner: An Operation-Oriented On-Line Facility with Distributed Control, by Dr. Arthur N. Stowe, Dr. Raymond A. Wiesen, Dr. Douwe B. Yntema, and James W. Forgij.


Man-Machine Communication in On-Line Mathematical Analysis, by Dr. R. Kaplow, Dr. J. Brackett, and Dr. S. Strong.

Thursday, 9:00 a.m.
Main Auditorium
The Man-Machine Interface
Chairman: Sidney Fernbach
Lawrence Radiation Laboratory
Livermore, California

The man-machine interface is a very important item in a time-sharing system. At present many keyboards, cathode ray tube displays, light pens, printers, card readers, and even small computers are being designed and manufactured for use as remote stations. What is it that may be necessary or desirable as such a station? Is it the same for all users? In an attempt to answer questions such as these and get some understanding of what educators, physical scientists, medical scientists, and engineers think of currently available systems, a panel discussion will be held with a representative of each of the above mentioned disciplines participating. A summary of this discussion along with predictions for the future will provide the conclusion to this session.

Despite the fact that technology involved in computer components has made remarkable strides in the past 20 years, comparatively little has gone into the improvement of input-output equipment. Even though display tubes and keyboards have been associated with computers from the very early days, they provide substantially the same capability today as then. Is there something new that may replace these? In a search for possible stations of the future, we are presenting two papers, one on an electroluminescent screen and the other concerning a plasma display panel which is inherently digital in nature. Perhaps these will displace or supplement the tube with which we are now familiar. We expect to hear the advantages and disadvantages of these devices for man's interface with the computer. These papers will be presented first, so that our panel members may be in a position to comment on them.

Recent Progress on a High Resolution Meshless Direct-View Storage Tube, by Norman H. Lehrer and Richard D. Ketchpel.


Thursday, 9:00 a.m.
Larkin
High Quality Papers of General Interest
Chairman: Rex Rice
Fairchild Research Laboratories
Palo Alto, California

Three outstanding papers on independent topics have been chosen from the many good papers submitted to the conference. The authors have been asked to talk about their subjects rather than merely duplicating the material published in the proceedings. Each presentation together with audience participation will occupy about 45 minutes. A 15-minute break will occur to allow audiences to change.

The first paper, discussing automatic value exchange, examines in some detail what the authors feel is an inevitable trend. The concept of automatic credit transfer has been around for some time and is not new. The authors, however, assert that all the necessary technology required now exists, and describe many of the underlying concepts and requirements in some detail. They have provided an interesting package for study. The audience will find this presentation provocative and are invited to share their opinions, both agreement and disagreement, in the question period.

The next presentation, "Real-Time Recognition of Handprinted Text," describes a scheme already in operation which allows an on-line computer user to hand print text naturally and then have it recognized accurately. A film showing the operations, together with comments about experiences using the system, should provide interesting material for system users and designers. Some of the difficulties and areas yet to be explored will also be discussed.

The third paper describes the Basic Hytran Simulation System for programming the EAI 8400 digital computer; it is a digital simulation-oriented subset of the EAI total systems approach to software aids for hybrid simulation. The basic aim of BSHS is to provide a problem-oriented vehicle for the representation (description) of continuous dynamic systems that can be modelled by sets of ordinary differential and/or difference equations in one or more independent...
variables. The language includes an interesting set of command-control statements which allow the simulation analyst (programmer) to exercise control over the solution of equations representing his problem. The system depends on FORTRAN IV for its sophisticated procedural coding.

A System for Automatic Value Exchange, by Vern E. Hakola and Sherman C. Blumenthal.

Real-Time Recognition of Handprinted Text, by Gabriel F. Groner.

Basic Hytran Simulation Language (BHSiL), by Jon C. Strauss.

Thursday, 9:00 a.m.

Polk

Selected Applications Using Numerical Analysis

Chairman:

R. W. Hamming

Bell Telephone Laboratories

Murray Hill, New Jersey

Numerical analysis and statistics lack glamour and are generally regarded as dull fields as compared with multi-programming, multiprocesssing, real-time, remote consoles, visual displays, etc. And while the selection of one particular machine over others may be based on some of the above features, often the economic justification for the machine itself lies in applications which depend centrally on numerical analysis and statistics.

Both numerical analysis and statistics are old fields with large, well-developed bodies of knowledge that have been organized in standard texts and courses, and thus they require a long, hard apprenticeship as compared to most other computer fields. It is a mistake, however, to suppose that they are complete and frozen; as the tutorial paper on the Fast Fourier Series methods shows, significant new developments are still occurring which take previously important but impossible problems and make them very practical.

The Use of Semi-Recursive Polynomials in the Design of Numerical Filters with Applications in Processing Missle Flight-Test Data, by C. B. Stallings.

Fast Fourier Transforms — For Fun and Profit, by W. M. Gentleman and G. Sande.

Programs for the Computer Analysis of Finite Groups, by Harold V. McIntosh.

Thursday, 1:30 p.m.

Larkin

Technologies and Systems for Ultra-High Capacity Storage

Chairman:

J. D. Kuehler

IBM Corporation

White Plains, New York

The scientific community has been aware of the capabilities of high energy optical and electron optical transducers and the storage capacity potential of photographic materials for many years. The slow development of these exciting technologies has been largely due to a lack of real need for systems capable of storing and retrieving data in the capacity range of $10^{11}$ to $10^{12}$ bits. Now the rapid growth of time-sharing systems, and the requirement for massive data banks under full machine control from remote terminals, are creating a need for these huge mass stores. Based on this need, industry is experimenting with photo material as the best candidate for a storage medium to achieve orders-of-magnitude cost reduction per bit of storage while maintaining direct on-line accessibility to date. The record/read head becomes the laser or the electron beam. The magnetic mechanism is replaced with schlierenoptics, back-scattered electrons or modulated light. A description of these technologies and a discussion of their potential is the intent of this session.

The paper by H. R. Kerby and J. D. Kuehler describing a trillion-bit storage system sets the stage for this session. Direct electron beam recording on a photo material, on-line chemical development of silver film, CRT readout using air slider bearings for precision film registration, and many other new technologies have been taken from the laboratory and integrated into this complex device. The technologies of this system will be discussed in detail.

Dr. C. C. Higgins and R. L. Lamberts will describe a "System of Recording Digital Data on Photographic Film Using Superimposed Grating Patterns." Using this system, each bit is recorded as the image of a small diffraction grating. As many as eight simultaneous bits can be recorded by superimposing the exposures of grating images of different spacings. The information can be read out by using the photographic image as a diffraction grating and reading the first-order line photoelectrically. Each frequency in the image will produce its own first-order line. Resolution of photo materials today is no longer the key limiting factor when using high areal bit densities. Practical problems such as mechanical tolerances of access mechanisms, dust, dirt, and material imperfections are more serious limitations. The system of recording and read-out to be described in this paper circumvents many of these difficulties.

Sterling P. Newberry has been pioneering in the use of new technologies for many years. At the Wescon conference of 1958, the author proposed a class of electron optical memories of very high storage density. His new paper shows a continuation of his explorations. He will describe an electron optical analogy of the "fly's eye lens" which could allow the use of a memory surface small enough to remain permanently enclosed in a vacuum chamber with a minimum of mechanical access motion.

Dr. C. H. Becker will show another facet of the use of these new technologies. This system utilizes signal modulated coherent laser radiation in a rotating optical system to create and detect (record and reproduce) binary information elements in two dimensions through diffraction-limited evaporation of a special storage medium. Information is stored in a helical line pattern of 1 micrometer bits, providing 600,000 bits per line (unit record) at a packing density of 745 million bits per square inch, with a total capacity of $8.8 \times 10^{10}$ bits per UNICON memory (100 foot reel, 16mm unidensity film). Information retrieval of the UNICON Computer Mass Memory takes place instantaneously during storage, as well as by means of secondary readout. Rates of storage and retrieval are in the megabits per second range.

In summation, the papers in this session promise to stretch the imagination of the listener and show a path toward future systems that we believe will be followed by the industry as the needs continue to develop.


An Electron Optical Technique for Large Capacity Random Access Memories, by Sterling P. Newberry.

A System of Recording Digital Data on Photographic Film Using Superimposed Grating Patterns, by R. L.
THE SESSIONS...

Lamberts and G. C. Higgins.
A Photo-Digital Mass Storage System,
by J. D. Kuehler and H. R. Kerby.

Thursday, 1:30 p.m.
Polk

Computer-Oriented Data Analysis
Chairman:
Geoffrey H. Ball
Stanford Research Institute
Menlo Park, California

The availability of digital computers with on-line displays and other capabilities for man-machine interaction makes qualitatively different data analysis techniques possible. This session, which should be of interest to experimental workers in all fields of the physical and social sciences, as well as to those developing new data analysis techniques will examine the significance of computers for data analysis in papers dealing with:

1. Data analysis vis-a-vis statistics—as it has been and likely to be.
2. A working computer program for preparing n-dimensional histograms from empirical multivariate data and for calculating some information theoretic measures of the amount of difference between different probability distributions.
3. A progress report on an on-line system for the analysis of data from biological experiments—a system now being implemented at the California Institute of Technology.
4. A progress report on an interactive computer system with graphical display for the analysis of multivariate data—a system now being implemented at Stanford Research Institute.

Each paper will be discussed by the other panel members and the audience after its presentation. (The papers providing progress reports of new computer data analysis systems will not be published in the Proceedings due to the recentness of the work.) A final 30-minute period for discussion between panel and audience will allow general comments and questions.

The goals of computer-oriented data analysis are flexibility in viewpoint and facilities, convenience and rapidity in the exploration and description of the data, and sufficient simplicity in the final result of the analysis to allow communication of those results.

The trends in computer-oriented data analysis are toward:

1. More man-machine interaction that allows: a) Examination of the intermediate results so that later analysis can be based on results up to that time; b) Obtaining immediate response to a need for analysis using a particular technique; and c) Investigation of many alternative working hypotheses.
2. Using a CRT to display intermediate results in graphical form rapidly without burdening the operator/analyst with reams of hard copy.
3. The use of new and special-purpose devices for input and output—e.g., light pens.
4. The development of high-level languages oriented toward data analysis.

Major problems in computer-oriented data analyses are:

1. Specifying and presenting the complex (multi-variate) relationships found in the data. This includes:
   a) Organizing the data so as to minimize the combinatorial growth of complexity of these interrelationships, and
   b) Human factors problems related to organizing the data analysis so that fundamental human limits for information absorption are not exceeded.
2. Developing new techniques.

*Seek out your REWARD by visiting our principal’s booths at the Fall Joint Computer Conference, San Francisco, November 8-10.
The elts or conceptual viewpoints of the graphical display. With an interactive quencing of the analysis techniques it is possible to proceed around the con­venience and the rapidity with which that are applied to the data. The con­cept specification of analysis and the deduction-inductive loop should thus be more nearly matched to the ability of an analyst to remember why he wanted to perform a particular anal­ysis in the first place.

Another trend is that toward shifting the responsibility for specifying the language he writes in, together of course, with the machinery for processing the language. One paper will describe methods for enriching an existing language by adding new syntactic features to the language and new procedures to the compiler. A second paper describes a system which places the task of language and processor specification completely in the hands of the user, thus expediting the development of experimental languages.

Giving the programmer more responsibility for the language he uses is, in a sense, an admission of the impossibility of designing a truly acceptable universal language. The two trends alluded to above tend to diverge, and an opportunity is afforded here to contrast these trends.

The two remaining papers illustrate the continuing need for programming languages to reflect new hardware organization and new programming and software concepts. One of these papers deals with the problem of specifying parallel processes in a program, a problem growing out of the development of multicomputer sys­tems and multi-tasking software. The other paper discusses the pros and cons (mostly pros) of using natural language in computer programming. Both subjects are relatively new and lacking in experimental data, so much of what the speakers say will necessarily be of a theoretical nature.

A Processor-Building System for Experimental Programming Languages, by Terrence W. Pratt and Robert K. Lindsay.

The Introduction of Definitional Facilities Into Higher Level Programming Languages, by T. E. Cheatham, Jr.

Thursday, 1:30 p.m.

International Room,

Hybrid Applications and Techniques

Chairman: Walter Brunner

Electronics Associates, Inc.

Princeton, New Jersey

The theme of this session is the application of the unique high-speed predictive display capability of analog and hybrid computers in engineering design.

Analog and hybrid computers now operate in compressed time, while digital computers have new capabilities for real-time operation. Compressed time operation now makes it possible to conduct effective, eco­nomical feasibility evaluation of more complex dynamic physical systems in less time.

Papers in this session are directed toward aerospace and nuclear engineering application. However, the techniques in which they deal, such as sensitivity analysis, high-speed iteration, and multiplexing operations have application far beyond these fields.

The emphasis of the session is on hybrid simulation techniques and the benefits derived from the utilization of a hybrid system. The speakers will direct their comments to:

1. System programming: assignments, program checkout, read-out, display, etc.

2. Analytical techniques: mathematical manipulation, iteration schemes, convergence, integra­tion algorithms, error analysis, etc.

Hybrid simulation of nuclear reactors, aerospace, and control systems provide a framework for the discus­sions illustrating such achievements as a 100:1 reduction in costs, 1000:1 decrease in computer time, improved displays for optimum man-machine
Where else can you find this method of recording, less than 1 bit in $10^{12}$ bits transient error rate and less than 3 microseconds write to read recovery time—all at one megacycle data rate?

At Magne-Head these are standard features not extra cost “options.”

Comparison is the key to your best buy.

For Magnetic Drum Memory Systems—designed...engineered...and manufactured to your exact requirements, contact Magne-Head today.

October 1966
interaction, and improved accuracy in comparison to digital computer methods presently available.

Simulation, the development and use of models for the study of ideas, systems, and situations, has been an integral part of the synthesis and analysis phases of science and engineering for many years. The analog computer, because of the one-to-one relationship between computer model (program) and system model, is the main tool used to assist the engineer in simulation. Recent software developments have enhanced the utilization of the digital computer in simulating systems defined by ordinary differential equations.

The hybrid computer, an integrated analog digital linkage system, appeared in the late 1950’s as an answer to the requirement for simulation of high performance aircraft and space vehicles. It extends the computational capability available to scientific workers by combining the inherent high speed, flexibility, and excellent man-machine interaction of the analog computer with the stored program, precision, and memory of the digital computer.

Early efforts in hybrid computation were directed primarily towards the definition, design, and checkout of hardware and software. In many instances the delay in getting the “home-made” hybrid system operational exceeded the time available for obtaining information from the simulation which established the original need for the hybrid computer.

With the experience gained over the past few years, and the availability of completely “packaged” hybrid systems as a commercial product, the scientist and engineer requiring a hybrid system for simulation can direct his attention and effort to sophisticated techniques, methods, and analysis in optimal control, non-linear partial differential equations, and stochastic problems for a variety of problems in aerospace mission analysis, fast nuclear reactors, and the life sciences.

Comparison of perturbation techniques (calculus of variations, maximum principle, steepest descent) and their computer mechanization, time-sharing of analog components for economical solution of sets of non-linear partial differential equations, and eigenvalue search techniques are some of the specific activities in this field.

As a result, hybrid simulation will be found on the frontier of all areas of modern technology, and associated with it will be the elite of the men of science and engineering who are developing the system of tomorrow's world.


A General Purpose Analog Translation Trajectory Program for Orbiting and Reentry Vehicles, by Arthur I. Rubin and Lloyd Shepps.

Near Earth Satellite Long-Term Orbital Stability Program (On the Hybrid Analog Computer), by J. Stricker and W. Miessner.

THE SOFTWARE EMphasis

by ROBERT T. BAUST

The October issue of the Computer Characteristics Quarterly includes in Section I the newly-announced computers listed below. Only one new family, the Univac 9000 series, made its long-awaited debut with the announcement of the 9200 and 9300 models and a promise of more to come. The remaining four new arrivals are expected additions to previously-announced families.

These six bring to a total of only nine the number of new computers announced thus far this year. From it seems clear that the manufacturers have slowed down expected additions to previously-announced families. They are concentrating on firming up their current product lines into fairly well-planned families. Moreover, software commitments are placing a mounting burden on expansion plans as software is taking on a competitive role of increasing importance. The cost of software development is already approaching hardware cost as a major factor in the price of a system.

Hence more and more manufacturers, almost in self defense, are developing and supplying standardized software packages. It appears that in each price range a "standard" set of system software is being offered. Even executive or monitor systems are becoming stereotyped. In fact, it seems that a single monitor is no longer adequate; now families of monitors—basic, real-time, time-sharing, to name but a few—are becoming commonplace. All this emphasis on packaged programs cannot help but cause many to wonder, in the light of increasing diversity of applications, how much the customer may be paying in the long run for unwanted software and unnecessary generality.

* Mr. Baust is editor of "Computer Characteristics Quarterly," published by Charles W. Adams Associates, 575 Technology Square, Cambridge, Mass., 02139. The publication is available from that firm for $10 a year. Adams Associates also holds the copyright to this tabulation.
SUCCESSFUL STEPS TO COMPUTER AIDED GRAPHIC DESIGN

Take a giant step with Benson-Lehner’s new family of graphic digitizing and reduction systems. Now, for the first time, you can build a system to fit your current requirements or your future needs — easily, efficiently and economically.

With the Large Area Record Reader (LARR-V), digitizing of engineering drawings, plans, and maps with output to punched paper tape or punched cards is quickly accomplished. For high volume jobs, an IBM compatible 556 bpi magnetic tape output is available.

For precise printed circuit artwork, the field proven Graphic Artwork Reduction Digitizer (GARD) system has unequalled capabilities. The GARD is adaptable for use with all coordinatographs or the LARR-V.

GARD output is directly usable for numerical control, computer or drafting systems. Resolutions of .001”, .010”, .050”, .100”, .250” and .500” are standard. Grid offset, absolute and incremental outputs, and special commands are all included with GARD.

For computer aided design — simple or complex — rely on Benson-Lehner for proven systems every step of the way.

benson-lehner corporation 14761 CALIFA STREET, VAN NUYS, CALIFORNIA • 781-7100
news briefs

EXPLOSION DESTROYS H-200 AT PHELPS-DODGE

When an explosion destroyed a $290,-
000 Honeywell H-200 system, leased by the Phelps-Dodge Copper Prod­ucts Corp., Fort Wayne, Ind., Honey­well replaced the computer five days later, according to Jack Carmean, the company's systems and data process­ing manager.

The blast, caused by escaping gas, occurred Aug. 23, a Tuesday. The replacement was flown from Bright­on, Mass., to Fort Wayne, arriving in the Indiana city at 1:30 Sunday morn­ing, the 28th. By 8:00 a.m., said Car­mean, Honeywell engineers had it in operation.

The computer, with a 16K core memory and four tape drives, was for "all practical purposes destroyed." It was insured for Honeywell by the St. Paul Fire and Marine Insurance Co.

Also destroyed and immediately re­placed without cost to Phelps-Dodge was IBM gear, contained in a room ad­joining the computer center. It con­sisted of a 407, a sorter, and a "roomful of keypunch and verifier equipment." About 150 magnetic tape files were stored in a Diebold fireproof safe. With these files, the data process­ing staff was able to continue work the next day, using an H-200 at Mich­igan Blue Cross in Detroit.

"We bought the safe two years ago and thought it was a big white ele­phant," said Carmean. He was smiling.

ASA SUPERSEDED BY
USA STANDARDS INSTITUTE

The United States of America Standards Institute has been established to expand the program of the American Standards Association, which it re­places. One reason for the new name is the custom in other countries of con­sidering American as the word to de­scribe all of North and South Amer­ica, rather than just the United States.

First president of the new institute is Harry E. Chesbrough, a vice presi­dent at Chrysler Corp. Donald L. Pey­ton, formerly general manager for government relations of the U. S. Chamber of Commerce, has been ap­pointed managing director.

All previously approved ASA stand­ards will be labeled USA Standards.

EDP REORGANIZED
AT GENERAL ELECTRIC

In a major reorganization, GE last month chopped up its huge Informa­tion Systems Division to form a new Industrial Process Control Division, and shuffled people, assignments and lines of communications. Dr. Louis T. Rader will head up the new IPC di­vision, while Hersher Cross, vp and group executive, Industrial and In­formation Group, serves as the acting general manager of the revamped ISD.

GE pulled most of its information processing activities into one large In­
formation Systems Division last Jan­uary, evidently in an attempt to focus previously decentralized and some­what loosely connected operations into one powerful assault on the edp market.

Dr. Rader, brought back to GE in 1964 after a tour of duty as top man at Univac, was picked to head up the new division. Under Rader, process control, general-purpose com­puters, peripheral equipment, com­munications, semiconductors, etc. were brought into the divisional tent. It appeared to be a reversal of the ancient and honored tradition within GE of autonomous department prof­it/loss responsibility along functional lines. Thus, the computer department in Phoenix became essentially the focal point for equipment engineer­ing and manufacturing under Louis E. Wengert, while marketing and field engineering—among other activities—were assigned to Jerome T. Coe, out of NYC.

Under the new setup, the Phoenix operation again centralizes market­ing, field engineering, engineering and production under Wengert, who as head of Information Systems Equip­ment, is one of four deputy division general managers reporting to Cross, who continues as vp and group execu­tive. The others are Coe, who heads up Information Services, including the data centers, Medinet and Internal...

The Telemax Reservation System, a communications network for travel organizations scheduled to begin operations this month. Set up by Telemax Corp., a subsidiary of Max­son Electronics, the service will use two Univac 491's, a 1004, Fast­rand, and tape units—backing up thousands of terminal units in the U.S., Canada, Mexico, Bermuda, Puerto Rico, and Hawaii. With headquarters in East Orange, N.J., the Telemax service will go into action in the spring, starting with about 2500 subscribers, including hotels, motels, car rental agencies, and travel agents. At a demonstra­tion of the system, a reservation was made and hard-copy confirma­tion produced within five seconds. The Telemax computer center will be managed by Aries Corp.
Why do so many buyers come to CEC for "traceable" tape?

When the new CEC Magnetic Tape was introduced, we expected it would start a revolution. And that it did. For this tape, created and produced for CEC by Eastman Kodak, has eliminated virtually every tape problem in data recording.

The key is traceability

All CEC tape is numbered—color-coded on the box, reel; even digitally numbered on the back of the tape itself for instant identification.

For example, on every 15 inches of tape there appears an internal Kodak reference number which immediately identifies the tape by type; and every 30 inches there is a numbered tape signature which provides an index to the coating and test records for that particular production block. So efficient is this coding method, it is possible to trace any roll of tape all the way back to the master web from which it came.

As a result, reel mixups and misplaced data have become problems of the past.

A tape for every recorder

CEC tapes are divided into four specific categories. Collectively, they meet the most advanced requirements of every data recorder. Yet each tape records at the highest applicable resolution and sensitivity—with the greatest uniformity and lowest tape and head wear obtainable today.

Because only CEC has it.

Now add these other advantages:

- Only CEC tapes provide a standard nomenclature for simplified identification and ordering: S-1 standard, 100 KHz; SX-1 standard extended, 300 KHz; M-1 medium band, 600 KHz; W-1 wide band, 1.5 MHz.
- Only CEC tapes are so precisely differentiated that users are no longer subjected to the time-consuming burden of performance evaluation.
- Only CEC tapes come shielded in metal containers—packed in cardboard filing boxes covered with protective plastic sleeves.
- Only CEC tapes are protected from shipping and storage damage by means of a plastic waffle hub, thus preventing tape serration and flange deformation.

Yet, with all these exclusive benefits, CEC Instrumentation Tape costs no more than the conventional tape you may still be using.

Write now for your free CEC INSTRUMENTATION TAPE CHART. This special chart lists CEC tape categories, applications, and models of recorders for which each tape is recommended. Ask for CEC Chart DM-47-X3.

CEC
Data Instruments Division
CONSOLIDATED ELECTRODYNAMICS
A SUBSIDIARY OF BELL & HOWELL/PASADENA, CALIF. 91109
INTERNATIONAL SUBSIDIARIES: WOKING, SURREY, ENGLAND AND FRIEDBERG (HESSEN), W. GERMANY
news briefs

Automation Operation: Leonard C. Maier, Jr., Systems Development and Components (essentially R&D), which includes a Planning and Resources operation as well as Semiconductor and Remote Access operations; and Harrison Van Aken, who continues as deputy division manager, overseas operations.

The major effect of the reorganization is to streamline communications, especially between marketing, engineering/production and field engineering, and to centralize the responsibility for product line success in sales, service and performance. The move appears on the surface to be a demotion for Rader, who now heads up only one portion of what used to be his total responsibility. But GE says the move is intended "to place increased emphasis on the booming process control business."

What GE calls "immediate software" activity—software for established machines—has been assigned to Paul Quantz, who reports to the head of engineering at the Computer Equipment department in Phoenix. John Weil, who is acting head of engineering, will head up long range hardware and software development as manager of the Advanced Systems and Technology operation under Maier. Bob Bemer will continue to serve as software consultant to Weil, while Pierre Abetti, formerly manager of large-scale systems applications for both Olivetti-GE and Bull-GE, will serve as manager, Applied Management Information & Control Systems under Maier.

The reorganization was interpreted by some outsiders as a retrenchment and a weakened faith in time-sharing. But there have been no personnel or budget cuts, according to the company. And our understanding is that GE will continue to offer the 645 (time-shared version of the 635) to interested parties, although there will be no software guarantee. What is likely to happen is that GE will offer people interested in the 645 the alternative of later delivery of a more expensive, faster version of the 645 with proven software.

GE took the early time-sharing play away from IBM with prestigious orders at Project MAC and Bell Labs, but IBM made one of its patented rapid recoveries, announced the 360/67 as its answer to the 645, and has walked off with a bundle of orders (perhaps 60-70). The success of the 360/67 suggests that GE's new management alignment must come up with a significant improvement over the 645 and the /67 if GE is to maintain a successful assault on the large-scale t-s system market. Even then, it's not clear how many t-s enthusiasts will accept the delayed delivery.

NIPPON ELECTRIC CO. OFFERS COMPUTER SERIES

A new series of computers, the NEAC 2200, has been announced by Nippon Electric Co. The character machines—models 50, 100, 200, 300, 400 and 500—will offer 2K to 16K core and an I/O transfer rate of 819K cps. Rentals will range from around $722 to $2500/month, according to one newspaper report. "Three E" software will include Japanese-language Easy Bill (for banking), Easy Pull (a version of FORTRAN), and Easy COBOL. It's believed to be the first major Japanese-language software package. A time-sharing system is being planned, with work to take place at Osaka Univ. on a 2200-500, to be delivered in December.

DPMA ANNOUNCES SIXTH ANNUAL CDP EXAMINATION

The Data Processing Management Assn. will offer the sixth annual examination for the certificate in data processing at 99 sites in the U.S. and Canada on Feb. 25, 1967.

A total of 7304 have now passed the test, open to applicants with at least three years of full-time job experience in data processing who have also met certain college course requirements. A study guide, which includes information on these requirements, application forms and a list of test sites will be available from local DPMA chapters and from international headquarters at 505 Busse Hwy., Park Ridge, Ill. 60068. Applications for the next test must be filed by Dec. 1.

CHICAGO FIRM PLANS RAILROAD DATA CENTER

RAILDATA Corp., a newly-formed Chicago company, is setting up a computer and communications system that will record, store, and retrieve freight car information. It will be known as the Car Information Clearing House (CICNCH), according to Marvin W. Ehlers, president.

Ehlers said that his company will use two IBM 360/40's with 400 million characters of disc storage, up to eight tape drives, and several video displays. Total cost is expected to be $2.5 million.

To make the operation practical,
Now, from Decision Control

proven memory systems in any size you want!

How big? New mainframe VersaSTORES are available in 65 K size, in 16 K increments, with word lengths to 36 or 72 bits.

Same reliable integrated circuit design with DTL interface.
Same flexible input levels, 3 v. to 12 v.
Same servoed current drive for unsurpassed operating margins at temperature.
Same compact packaging, 65 K in only 52" of 24" rack space.
Remember—same great VersaSTORE performance—only the sizes are bigger.
For a fact filled brochure, write to Decision Control, Inc.
news briefs

Ehlers says, his company will have to serve railroads whose combined ownership of freight cars amounts to at least one million of the estimated million-and-a-half in operation. Later this year, Ehlers and his associates will decide, based on letters of intent from railroads, whether there is enough interest to go ahead. Thus far, he says, "the results have been much better than we have expected."

The subscribing railroads will provide data in any convenient form. "We seek to be as flexible as possible," says Ehlers.

Initially, he anticipates that each of the subscribing railroads will ask car location questions of RAILDATA from a central point. He reasons that since they now have this kind of information in one location and in one individual, centralized system, it will present few difficulties in hooking up to the RAILDATA computing center. Ultimately, however, he thinks car location data may be furnished from switching points and transfer yards across the country.

Ehlers points out that freight car locations will be only the first—though most important—service offered. Others he anticipates:

Correlation of "piggy-back" trailers and containers. The shipper now has information on the trailer only, not on the car carrying it.

Clearinghouse per diem charges for cars used by other railroads. A centralized system could provide a service similar to a bank when it clears checks.

Message switching to let all railroads use a central system to communicate with each other by computer or Teletype is another service being considered.

Ehlers is executive vice president of Ehlers, Maremont & Co., Inc., of which RAILDATA is a wholly owned subsidiary. He was a midwest representative for C-E-I-R, Inc. Serving as vice president and general manager of RAILDATA will be Robert L. Bell, formerly manager of systems and procedures for The Milwaukee Road.

IBM DATATEXT STARTS ON WEST COAST; VIP SYSTEM WILL START IN EAST

An on-line editing service called DATETEXT that allows up to 80 customers access to a computer has been announced by IBM, with the first system now operating in San Francisco. It's basically the same as their Administrative Terminal System, with the addition of housekeeping routines to clock charges.

This is the second time-sharing service to be sold by the new Information Marketing organization, a part of the Data Processing Div. They also have QUIKTRAN and Industry Information Service, a computer-based marketing analysis plan.

Users need type any document just once, using a 2741 terminal, for entry into a 1440. The text can then be edited, corrected, or updated and a new copy requested at the terminal. For large jobs, a 2741 printer will be available that can handle both upper and lower case letters. Only 40 terminals can be in action at once, the total of 80 being arrived at by operating two six-hour shifts. Costs are the usual mishmash of lease or buy, installation charges, line usage, minimums, and options, but IBM estimates a typical customer would be in for about $600 a month.

Other DATATEXT centers are planned for Chicago, Cleveland, Los Angeles, New York, and Philadelphia.

Meanwhile, a nearly identical service has been underway in the east, to be offered by VIP Systems Corp. President Joan Van Horn will open the first center in Washington, D.C., about Nov. 1 and plans to add New York and Boston next year in June. VIP's system uses the same IBM equipment but it's to be available on one eight-hour shift instead of two of six hours. Another important difference is that VIP's prices are scheduled to be lower than IBM's. Basic charge will be $375 a month, with some ups and options too. Plans include a later switch to System/360's as well as further expansion to other cities.

COMMERCIAL TIME-SHARERS SEE PROFITS ON HORIZON

Time-sharing marches on. In Boston, KEYDATA—a test case for commercial t-s—is moving toward viability. The firm has over 60 terminals on-line and some 50 subscribers, half of whom are paying customers, all in New England.

Over in Princeton, N.J., Applied Logic Corp.'s PDP-6 has 10 customers in action (up to four simultaneously) with 18 waiting in the wings while a drum interface is installed, when the system will be able to handle 12 users concurrently . . . probably this month.

At MIT's Project MAC, the granddaddy of t-s, the GE-635 is running with a 645 simulator and the 645 is being shaken down. It looks as though the 645 will be operative in the spring, with "customers" on-line by June.

GE's Los Angeles service bureau,
Disc Memories! No one has more to offer than Librascope. Librascope Group offers the most complete line of disc memories. There's a Librascope memory to meet your requirements. Librascope head-per-track memories are proven in performance in computer, communications, and control systems designed for military, business, engineering, and educational applications. With Librascope, you design with confidence.

**MASS MEMORIES**

**LIBRAFILE** mass memories are your answer. Large-capacity, high-speed memory systems easily adaptable to any large data-base application presently being performed by a mix of computers.

**LIBRAFILE 4800:** 48"-disc mass memory capable of transferring data at up to 432 megabits/sec.

**LIBRAFILE 3800:** 48"-disc mass memory capable of transferring data at up to 342 megabits/sec.

Now finding use in document retrieval, communications, intelligence, simulation, management information, command and control, process control, and time-sharing. New OEM prices.

**Series L100:** Inexpensive 10"-disc memories with capacities to 300,000 bits.

**Series L200:** Low-cost, high-performance 10"-disc memories with capacities to 2 million bits.

**Series L400:** Versatile, high-performance 16"- and 24"-disc memories with capacities to 50 million bits.

**Militarized Series:**

Small, compact 6½"-disc memories designed for airborne (MIL-E-5400, Class 2) applications, and larger, high-speed random-access 14"- and 24"-disc information storage systems for shelter, van, or shipboard applications.

**ENGINEERS:**

For career openings, call or send resume in confidence to L.C. Kelley, General Precision, Inc., Librascope Group, 808 Western Avenue, Glendale, Calif., 91201. An equal opportunity employer. A Plan-For-Progress Company.

**See the Librascope disc-memory line at the Fall Joint Computer Conference. Booth 528-534.**
news briefs

using a 265, is sold out and there is talk of adding another system.

Also on the west coast, but spreading out fast, is Allen-Babcock Computing. ABC has offices in Los Angeles and Palo Alto, site of their 360 Model 50, custom-modified for time-sharing to the firm’s specifications. President Jim Babcock has just added a 2-megabyte mass core which is in operation, will soon have a Datacell as well. They now have 20 terminals going, all being used by paying customers. Most are on the coast, but some have been installed in Houston and New York. A real novelty: ABC offers PL/I to customers. The company is waiting for delivery of 40 more terminals, adding Telex and TWX users Nov. 1, and planning a demonstration at the FJCC.

In Washington, D.C., CERN’s experimental time-sharing service, using a GE-265, has 62 customers—each averaging about 60 hours a month—and is about at the break-even point.

And as a prelude to future timesharing systems linking incompatible computers, the TX-2 at Lincoln Lab and Q-32 at System Development Corp. have been joined by a 1200 bps, 4KC, dial-up broadband service. The project, funded by existing ARPA contracts, will permit users at each location to work problems using remote programs, including graphic software. The Q-32’s replacement, a 360/67 due late this year, and MAC's 645 may also join in. First description of the effort will be at the FJCC.

ACM NATIONAL CONFERENCE ATTRACTS 1,500

The 21st national conference of the ACM (Assn. for Computing Machinery), held last month in Los Angeles, came off very well in terms of technical content. It drew more than 1500 paid registrants. Notable among its accomplishments was the awarding of the prize for best technical session to a group discussing the social implications of computing. Organized by Paul Armer of the RAND Corp., The Social Responsibilities of the Computer Professional and the Industry featured Richard Hamming of Bell Labs as moderator, and panelists Emmanuel Mesthene and Anthony Oettinger of Harvard, and Robert Ryan of the Regional Industrial Development Corp. of Southwestern Pennsylvania.

The changing technology, of course, affects both the lay public and people in the industry. And so the ACM Council, meeting before the confer-

"...after lunch we went to a demonstration of a great idea...an electronic writing tablet that allows you to write actual instructions to a digital computer. Know what they called it?"

Oh, that's the commercial version of the ‘Rand Tablet’ built by Bolt Beranek and Newman’s Data Equipment Division. They call it the GRAFACON® 1010A, and it’s one of the most advanced developments in the man-computer communication field. Some people are using it with pattern recognition programs for writing information into computers—just like writing a memo, with a resolution of ± 0.005 inch at writing speeds up to 40 in/sec.

In production data processing operations, it’ll digitize graphic and pictorial data without the inconvenience of mechanically restricted cursors, shaft encoders, A/D converters and the like. It’s even built for rear-projection of graphic information from film. I know a company that uses it as a highly-flexible keyboard—touch a spot on the tablet and it serves as an operator command to the program.”

BBN/DE also produces GRAFACON interface circuitry for card punches, paper tape punches and digital magnetic tape recorders; PDP-1, PDP-4, PDP-8 and CDC-160 computers; IBM 2250 display consoles; and Teleputer time-shared computer consoles. Write us for complete details.

"Oh, that’s the commercial version of the ‘Rand Tablet’ built by Bolt Beranek and Newman’s Data Equipment Division. They call it the GRAFACON® 1010A, and it’s one of the most advanced developments in the man-computer communication field. Some people are using it with pattern recognition programs for writing information into computers—just like writing a memo, with a resolution of ± 0.005 inch at writing speeds up to 40 in/sec. In production data processing operations, it’ll digitize graphic and pictorial data without the inconvenience of mechanically restricted cursors, shaft encoders, A/D converters and the like. It’s even built for rear-projection of graphic information from film. I know a company that uses it as a highly-flexible keyboard—touch a spot on the tablet and it serves as an operator command to the program.”

BBN/DE also produces GRAFACON interface circuitry for card punches, paper tape punches and digital magnetic tape recorders; PDP-1, PDP-4, PDP-8 and CDC-160 computers; IBM 2250 display consoles; and Teleputer time-shared computer consoles. Write us for complete details.
news briefs

ence convened, voted an additional $20K to the already-available $25K for the association's professional development program. It also created the position of a full-time director whose job will include holding courses on compilers, information retrieval, etc.

The feature of the Undergraduate Student Papers session was the presence of a 13-year-old boy from Poughkeepsie, John D. Sybalsky. The seventh grader presented a paper, "A General Purpose Translation Demonstrator." The prize for the best paper, however, went to a student at Carnegie Tech, Robert N. Chanon, for his Almost Alike Programs. This is a software that analyzes the way student programs solve an assigned problem, picks out similarly-written programs, and leads instructors to any cheating by students.

DPMA Fall Conference MEETS IN LA OCT. 25-28

The fall conference and business exposition of the Data Processing Management Assn. will be held late this month in Los Angeles, with headquarters at the Biltmore Hotel. Running from Oct. 25 to 28, it will feature technical sessions, audience-participation workshops, tours, and exhibits.

Keynote speaker on Wednesday, Oct. 26, will be Dr. Lee L. Davenport, president of General Telephone and Electronics Laboratories Inc., the advance research arm of GT&E. Associates with developments in laser systems and data communications, Dr. Davenport will speak on The Challenging Future of Business Communications.

In the 48 seminar sessions, with some 80 speakers participating, topics such as these will be covered: statistical decision making, management simulation techniques, new development in languages, graphics and videos, optical scanning, and medical dp and hospital administration. There will also be 16 workshop sessions devoted to specific problem areas. No advance registration for the conference is required.

- The Richland, Wash., computer center of Computer Sciences Corp., has opened a link to Boise, Idaho, for on-line use of its Univac 1107. This is the third city to get the service, which is called Remotran; Seattle and Vancouver, B.C., hooked up in April. CSC now has about 40 customers in the Pacific Northwest.

- With a 301 donated by RCA, the Roper Public Opinion Research Center at Williams College, Mass., will set up a massive file of public-opinion information, covering some 400 million answers to questions gathered since 1936. Plans for next year call for linking the system to UC Berkeley, MIT, and the Univ. of Michigan, with help from the National Science Foundation. A data bank will then be built up from the results of more than 7000 studies conducted in the U.S. and other countries by Roper, Gallup, and 101 other domestic and foreign polling organizations. Social scientists at the universities will then have access to the data, with the computer handling statistical breakdowns of 74 major subjects.

- The results of a three-year project of controlling traffic signals by computer have convinced the city of San Jose, Calif., to install an IBM 1800 data acquisition and control system. The experiment, conducted jointly by IBM and the city, involved a three-mile thoroughfare with a traffic rate of 35,000 cars/day and 32 traffic lights. Under computer control, the lights permitted a reduction of time for the trip to 10 minutes from 11 and saved drivers about 50,000 stops per day, an improvement of 17%.

- Ford Motor Company has established a communications link between Ford of Germany in Cologne and their Technical Computing Center in Dearborn, Mich. The center has a Philco 212, with a GE-265 and Datam- net 30 tied into telephone lines. Rout-
Now... a complete audio response system with vocabularies up to 189 words that you can add-on or design into your data processing, communications, or instrumentation system. The new Cognitronics line of Speechmakers also offers an unlimited multiplexing capability for the distribution of independent, simultaneous audio responses providing maximum equipment utilization and flexibility.

Messages or words up to 1.6 seconds long are pre-recorded on a unique photographic film memory drum and selected at random through a built-in solid state decoding matrix. Modulated light sensing techniques eliminate wear and assure high quality audio reproduction without signal deterioration over extended operating periods. Mechanical components, including precision pre-loaded ball bearings, are designed for years of service with minimum maintenance.

If your application requirements include an audio response to digital or switch interrogation—contact Cognitronics, we have 3 standard lines of Speechmaker equipment to do the job.
Old Faithful—
that's Remex

Read, read, read, all
it ever does is read.
Remex gives you
predictable reliability.
That's why it's
the top tape
reader around. It's
built simple; so
it's rugged. We
make rugged reliable
readers in all
sizes and types. We
make spoolers the
very same way.
That's the reason
you'll find our
equipment used by
leading manufac-
turers of computers,
numerical controls
and automatic test equipment. Call us
at 213-772-5321 or write Remex
Electronics, 5250 W. El Segundo Blvd.,
Hawthorne, Cal. 90250.

news briefs

ing through the lines of five tele-
phone and cable companies completes
the connection with Teletype termi-
nals in Cologne. This is the second
overseas hook-up for the center; Ford
of Britain at Basildon went on-line in
June. The system also includes 57
U.S. remote terminals.

• Another plan to make the tele-
phone serve as a computer input de-
vice is being proposed, this time by
the Stromberg-Carlson division of Gen-
eral Dynamics. Their experimental
model, which may be demonstrated
in October, includes both inquiry
and voice response units in one in-
strument, a modified Stromberg-Carl-
son Tone-Dial telephone. It has 12
push buttons and one of them acts
as a shift to let the others serve dual
functions. The “4”, for example, is also
a square root instruction and the “8”
is also a plus instruction. Another key
is used either as a decimal point or
to request the verbal response after
transmission of input. The experi-
mental unit is at the Rochester, N.Y.,
plant.

• Changes to the model 465 Data-
bosser, manufactured by Dashew
Business Machines, make it possible
to produce plastic dialing cards di-
rectly from punched cards. The auto-
matic dialer cards can be punched,
embossed, or stamped with both al-
phabetic and numeric data. Since
Touch-Tone phones are becoming
widely used for data collection and
transmission, with cards the most con-
venient means of supplying static
data, large-scale production capacity
for the cards has become significant.
The modified model 465 can turn out
3000 per hour.

• The Digital Computer Assn.,
LA’s original computer, marching
and chowder society which paved the
way for more orderly professional
organizations, will conduct its annual
nostalgic bash aboard a sternwheeler
Nov. 18. Thirsty newcomers who
wish to brush up on the industry’s
highly informal past and prepare to
perpetuate disorderly traditions are
invited to join the oldtimers. Reserva-
tions for the event, being sponsored
by DATAMATION, can be made by call-
ing 213-399-2225.
Sometimes we worry about Jim becoming a Narcissist.

It all started with Celanar Polyester Film. We go to extremes to make it the cleanest, clearest, smoothest film available to precision tape manufacturers. Then challenge Jim, and our quality control experts, to find a flaw in it. But stare as he may, it's a rare day when Jim finds a wrinkle, cross-buckle or other visual defect to mar his own reflection on a roll of Celanar. Which is enough to turn anyone into a narcissist.

The cleanliness of Celanar starts in our "White Room" production area at Greer, S.C., where air filtration systems trap dirt specks as tiny as 0.3 micron. This emphasis on cleanliness makes Celanar film a better base for computer and instrumentation tapes. It's one reason why Celanar gives higher production yields in film conversion.

Of course, clean just begins to describe Celanar. It's more uniform than the other polyester film. We assure its gauge uniformity by radioactively inspecting every foot of every roll before it's shipped. Celanar is also stronger—in both tensile break and tensile yield strengths. And we go a long way to supply it in the roll lengths, widths and gauges most convenient to manufacturers. Even guard it during shipment with temperature recording flags. Or impact recorders, when necessary.

Send for complete details about Celanar Polyester Film—and how we can help you make the best use of it. Celanese Plastics Company, Dept. 113-J, 744 Broad Street, Newark, N. J. Celanese Plastics Company is a division of Celanese Corporation of America. Celanese® Celanar®
On November 8th Tasker unveils the Series 9000 Modular Display Console... a true building-block system you design to your requirements ... with the speed, options and capability you’ll need in coming years. See it at the Fall Joint Computer Conference.

BOOTH 701-703

For ahead-of-time display techniques...

look to Tasker

Tasker Instruments Corp. / 7838 Orion Ave. / Van Nuys, Calif. 91409 / (213) 781 3150
The end of the card game.

Fold, staple, and mutilate to your heart’s content. Because there is a new generation of computer input that makes punched cards old hat.

It’s the NCR 735 Magnetic Tape Encoder. It has a keyboard like a card punch, it’s about the same size as a card punch, but it doesn’t work like a card punch. It works like an NCR Data Encoder. It “writes” directly on mag tape. It eliminates a computer run, saves computer time, and increases throughput speeds.

You have no cards to buy, punch, read, store, or insure. You have one device that both “punches” and verifies. Your input media is magnetic tape . . . storable and reusable and less costly than cards.

So play your cards right. Get rid of them in favor of magnetic tape. Your NCR representative can tell you how. Or write to us at NCR, Dayton, Ohio 45409.
This New 3M Asynchronous Digital Recorder writes data at the rate of 2000 characters per second

Revere-Mincom's new ADR-100 records during the start interval — that's why you never lose any data in the asynchronous mode, and why this 3M system accepts data at least four times faster than any other asynchronous digital recorder available to date. 2000 characters per second, internally produced inter-record gap if required.

See it at Booth 1139, Fall Joint Computer Conference, Nov. 8-10, San Francisco

Revere-Mincom Division
3M COMPANY
300 SOUTH LEWIS ROAD • CAMARILLO, CALIFORNIA 93010

CIRCLE 73 ON READER CARD
Types like twins

Take one typist. Add a Dura® Edit Control and she'll turn out the work of two. When revised or updated material has to be retyped, only changes are typed manually. The Dura Edit Control automatically retypes all unchanged material at up to 175 w.p.m. And because of its application flexibility, the Dura Edit Control can be “time shared” with other departments.

Before you buy another typewriter at any price, see a demonstration of the Dura Edit Control. Call your local Dura office or send in the coupon today.

DURA

CUT your typing costs!

Dura Business Machines
Dept. D 277-116
32200 Stephenson Highway
Madison Heights, Mich. 48071

Gentlemen:
Please send me your new brochure on the Dura Edit Control System.

NAME ____________________________ TITLE ____________________________
COMPANY __________________________
ADDRESS __________________________
CITY __________________ STATE ______ ZC __________

DURA BUSINESS MACHINES
DIVISION OF Dura Corporation
*Trademark Dura Corporation

October 1966

CIRCLE 74 ON READER CARD 139
An anthology of selected humor from Datamation magazine

This spoof of the computer world by professionals in the field will leave you limp with laughter. The tongue-in-cheek treatment of both the software and hardware fields is sprinkled with delightful cartoons to further enhance your reading pleasure. The material, edited by Jack Moshman, is based upon humorous articles that have appeared in Datamation magazine and will be thoroughly enjoyed by all readers in and out of the computer community.

Order yours today — just for fun!

Also now available —
"PROCEEDINGS OF 21st NATIONAL ACM CONFERENCE"
8½"x11", 576 pages, permanent cloth binding — $14.40
(50% discount to ACM members if ordered direct)
Now, any ten-year-old can feed data to your computer.

Now anyone, anywhere in your organization, can talk to your computer. All they need is a No. 2 pencil. All you need is a Digitek Optical Reader: $29,750.

October 1966
One Conrac X-Y CRT display costs less than 1000 dollars.

SPECIFICATIONS:

X and Y deflection input: 2 to 6 volts differential for full scale deflection.

X and Y deflection amplifier response:
- Small signal rise time: less than 2μsec. for 100mA yoke current (represents approx. 0.25" screen distance on a 90° deflection angle 23" CRT).
- Small signal sine wave response: 3db down at 200KHz.
- Corner to corner retrace: 50μsec. including settling time.

Z axis amplifier input: digital, between 2 to 6 volts to unblank. Grey scale available.

Z axis amplifier response: less than 200nsec.

Z axis blanking protection: standard.

Linearity: 2% of full scale, nominal.
(Depends on CRT used)

CRT sizes and phosphors: Most any commercially available 70° to 90° angle, magnetically deflected tube, with any EIA registered phosphor.

Buy it for its specs.

The Conrac CD Series X-Y CRT display costs less than 1000 dollars, even if you buy only one. You could pay up to three times as much and get less for your money. Just see our specifications, above. And because we built all of the circuitry on modular, plug-in boards we can usually modify it to suit your needs exactly. We use only one rectifier tube in the display. All the semiconductors are silicon. The Z axis amplifier input is an integrated circuit to give you still more performance and reliability. Check our price. See our specs. Then call Al Landsperger at 335-0541 (Area Code 213). Ask him about production quantity prices.

CONRAC

GIANNINI CONTROLS CORPORATION

GLENDORA, CALIF. / A DIVISION OF

DATAMATION
**products**

- **upgraded displays**
  If there's a 360 in your future, the 2250 mod 2 and 2840 mod 1 have been replaced by improved units. The new 2250 mod 3 and 2840 mod 2 display and control systems are said to perform simultaneous lightpen operations on up to four display terminals without computer support, and sketch, modify, move and highlight images with little or no computer support. Larger and faster buffers have also been added, improving image stability while displaying more vectors. IBM DP DIV., White Plains, N.Y. For information: CIRCLE 103 ON READER CARD

- **accounting machine**
  The E1400 is a low-to-intermediate-range unit that operates on business forms with a magnetic-ink stripe. It includes a console with features of the firm's accounting machines, plus special-purpose control keys and lights. The processor has a 52-position core memory, as well as a wired mem-

---

**PRODUCT OF THE MONTH**

For the experimenter, this desk-top fluidic systems lab demonstrates capabilities of fluidic logic and control, using turbulence amplifiers. Serving as a logic breadboard, the unit is designed to show how turbulence amplifiers can be used in logic systems, control systems, and industrial applications.

Heart of the unit is a Universal Logic Module which has eight turbulence amplifiers with a supply and an output manifold. The output passes through an interconnection block that is ported to give five output connections to each amplifier. Logic functions (or, nor, and, not, memory) can be set up and tested. Circuits can be tested for condition sequencing, programming, counting, or checking industrial operations.

The lab consists of the universal logic module, fluidic limit switch, supply level manometer, six manometers for indicating signal levels, air stream detector, two interruptable jets, pressure regulator, etc. FLUIDIC DIV., HOWIE CORP., Norristown, Pa. For information: CIRCLE 104 ON READER CARD

---

**punched tapes**

Punched tapes with thickness 0.0043 to .0015 inch have been added to the firm's line. They are in 1/16, ⅛ and 1-inch wide without splices. The firm's paper/Mylar/paper foil/Mylar, and multilayer combinations. ARVEY INC., Ill. For information: CIRCLE 104 ON READER CARD

---

**gp computer**

Available as a rack console, the Series 460 is a byte-oriented processor with an 8-usec cycle time; a 2-usec core memory is also available. Memory is expandable from 1K to 64K characters. The memory is character-organized, and 10-bit character consisting of eight data bits plus parity and word-mark bits. Each 8-bit byte can contain two digits, a character, or eight bits of binary data. A word consists of any number of characters.

The 460 can be fitted with up to four I/O channels, three of them having simultaneous compute capability. Each channel can address six I/O devices. Peripherals include paper tape readers and punches, 80-column card punches and readers, printers and plotters, discs, drums and magnetic tape drives. There's also data communication gear, keyboards, and a-d and d-a converters. BUSINESS INFORMATION TECHNOLOGY INC., Natick, Mass. For information: CIRCLE 101 ON READER CARD

---

**PRODUCT OF THE MONTH**

For the experimenter, this desk-top fluidic systems lab demonstrates capabilities of fluidic logic and control, using turbulence amplifiers. Serving as a logic breadboard, the unit is designed to show how turbulence amplifiers can be used in logic systems, control systems, and industrial applications.

Heart of the unit is a Universal Logic Module which has eight turbulence amplifiers with a supply and an output manifold. The output passes through an interconnection block that is ported to give five output connections to each amplifier. Logic functions (or, nor, and, not, memory) can be set up and tested. Circuits can be tested for condition sequencing, programming, counting, or checking industrial operations.

The lab consists of the universal logic module, fluidic limit switch, supply level manometer, six manometers for indicating signal levels, air stream detector, two interruptable jets, pressure regulator, etc. FLUIDIC DIV., HOWIE CORP., Norristown, Pa. For information: CIRCLE 104 ON READER CARD

---

**punched tapes**

Punched tapes with thickness 0.0043 to .0015 inch have been added to the firm's line. They are in 1/16, ⅛ and 1-inch wide without splices. The firm's paper/Mylar/paper foil/Mylar, and multilayer combinations. ARVEY INC., Ill. For information: CIRCLE 104 ON READER CARD

---

**gp computer**

Available as a rack console, the Series 460 is a byte-oriented processor with an 8-usec cycle time; a 2-usec core memory is also available. Memory is expandable from 1K to 64K characters. The memory is character-organized, and 10-bit character consisting of eight data bits plus parity and word-mark bits. Each 8-bit byte can contain two digits, a character, or eight bits of binary data. A word consists of any number of characters.

The 460 can be fitted with up to four I/O channels, three of them having simultaneous compute capability. Each channel can address six I/O devices. Peripherals include paper tape readers and punches, 80-column card punches and readers, printers and plotters, discs, drums and magnetic tape drives. There's also data communication gear, keyboards, and a-d and d-a converters. BUSINESS INFORMATION TECHNOLOGY INC., Natick, Mass. For information: CIRCLE 101 ON READER CARD

---

**punched tapes**

Punched tapes with thickness 0.0043 to .0015 inch have been added to the firm's line. They are in 1/16, ⅛ and 1-inch wide without splices. The firm's paper/Mylar/paper foil/Mylar, and multilayer combinations. ARVEY INC., Ill. For information: CIRCLE 104 ON READER CARD

---

**gp computer**

Available as a rack console, the Series 460 is a byte-oriented processor with an 8-usec cycle time; a 2-usec core memory is also available. Memory is expandable from 1K to 64K characters. The memory is character-organized, and 10-bit character consisting of eight data bits plus parity and word-mark bits. Each 8-bit byte can contain two digits, a character, or eight bits of binary data. A word consists of any number of characters.

The 460 can be fitted with up to four I/O channels, three of them having simultaneous compute capability. Each channel can address six I/O devices. Peripherals include paper tape readers and punches, 80-column card punches and readers, printers and plotters, discs, drums and magnetic tape drives. There's also data communication gear, keyboards, and a-d and d-a converters. BUSINESS INFORMATION TECHNOLOGY INC., Natick, Mass. For information: CIRCLE 101 ON READER CARD

---

**punched tapes**

Punched tapes with thickness 0.0043 to .0015 inch have been added to the firm's line. They are in 1/16, ⅛ and 1-inch wide without splices. The firm's paper/Mylar/paper foil/Mylar, and multilayer combinations. ARVEY INC., Ill. For information: CIRCLE 104 ON READER CARD
DATA PROCESSING SPECIALISTS FOR A GROUND FLOOR CAREER OPPORTUNITY

PROGRAMMERS ARE DOING THE MOST ADVANCED SCIENTIFIC PROJECTS YOU CAN FIND...NOW AT RCA MOORESTOWN...INTERESTED?

Ambitious for more advanced projects now, not sometime in the future?

At RCA Moorestown programming technology is taking giant strides at the newly-expanded Scientific Information Processing Center. Our management is highly aware of the importance of the digital computer in advancing the state-of-the-art in all areas of technology.

RCA Moorestown is located in suburban New Jersey close to Philadelphia and its cultural and educational advantages for you and your family.

Openings exist now for:

Scientific/Real-Time Programmer Analysts—To develop large scale advanced programs for simulating complex weapon systems or real-time programs for digital computers operating on-line with high performance instrumentation radar systems. You should have experience in programming large scale scientific data processing systems or complex real-time applications. Background with orbit determination or powered flight applications would be helpful. BS in EE, Mathematics or Physics.

Write today to:
Mr. W. J. Henry, Dept. V-8
Radio Corporation of America
Missile and Surface Radar Division
Moorestown, New Jersey

An Equal Opportunity Employer M & F

The Most Trusted Name in Electronics
DELEGATE SOFTWARE PACKAGES?

Are you going out of your software pickin' mind? Have you ever tried to delegate even a software program? Results pretty disappointing? How about a meeting near the completion date and a request for a major time extension? The original funds have been spent and there is an urgent appeal for more money to complete the project? With any kind of luck the documentation manuals will be started under the new price and time target extensions? And this is beginning to set your entire organizational objectives back by umpteen months? And the chief executive wants a summit meeting of the whole software matter tomorrow afternoon? And you want me to delegate software packages? To whom? To IDC? Who's that? Well, don't let your bad taste with previous companies embitter you against the ideal IDC can be defined this way...

IDC is a management-oriented software organization that has built its growth and reputation on the basic concept that "gung-ho" in business is a logical and profitable way of operation. IDC is a company that takes absolute pride in not only meeting its time commitments, but in beating them. Not once has IDC ever gone back to a customer and requested more money or more time to complete their firm fixed price contract. No wonder computer manufacturers and computer users alike have seen fit, time after time, to delegate their trust in IDC...to deliver entire software packages as well as hundreds of other programs of all types. If your computing requirements need an understanding and capable assist—a new perspective to your software management problems—perhaps you should call IDC now. 1621 East 17th Street, Santa Ana, Calif. Phone: (714) 547-8861.

INFORMATION DEVELOPMENT COMPANY

SOFTWARE PERSPECTIVES

October 1966

CIRCLE 78 ON READER CARD
Let yourself grow at NCR's expanding electronics division in Los Angeles.

Take Southern California's largest commercial computer facility, multiply by two, and you have a quick picture of today's expansion at NCR Electronics Division. You can accelerate your own future by joining this dynamic organization now. At NCR, you will share new challenges with men who have already placed some of the world's most advanced digital systems hardware on the market. And you'll help create systems to bring business automation to more than 120 countries. The Southern California skies are clear and the track is fast. On your mark, get set, grow.
new products

buffer, which can accommodate data at 200,000 bytes/second. The units are models 4554 and 4555 (1350-lpm) and 4560 and 4561 (750-lpm) ENGLISH ELECTRIC-LEO-MARCONI COMPUTERS LTD., London, England. For information: CIRCLE 108 ON READER CARD

engineering software

For the PDS 1020 computer, an advanced engineering interpreter is available. The PR5464 enables the use of everyday mathematical terms for such computations as square root, sine, cosine, arctangent, etc., from a single command. PACIFIC DATA SYSTEMS INC., Santa Ana, Calif. For information: CIRCLE 109 ON READER CARD

disc video store

The Videodisc stores up to 20 seconds of real-time signals from a TV camera or other video signal source on a 12-inch aluminum disc coated with a nickel cobalt recording medium. The 20-second recording consists of 600 video signal frames. Applications include vehicular traffic flow, real-time x-ray exams, and aircraft landings and take-offs. The portable unit weighs from 25 to 50 pounds. MVR CORP., Palo Alto, Calif. For information: CIRCLE 110 ON READER CARD

forms cutter

Marginally-punched continuous forms are cut and trimmed, leaving four clean edges, by the models 20 and 25. Both single and double cuts are made by both models, which handle one- or multi-copy forms with or without interleaved carbons. Speeds range up to 25 forms/minute on the 25, and up to 160/minute on the 20. The unit is also equipped with a sequential forms stacker. The mod 25 is controlled by a paper tape, and the mod 20 is controlled mechanically. STANDARD REGISTER CO., Dayton, Ohio. For information: CIRCLE 111 ON READER CARD

upgraded computer

The DATA 620 processor can now be had with a microprogramming capability. The MicroExEc makes it possible—externally to the processor—to control memory, registers, bus connections, I/O, adder and shift logic. Interfacing to the I/O bus the added capability is available in several forms. The micro-bus and interface logic can be in the mainframe, or the micro-bus is available with the main-frame logic and a remote console, enabling manual execution of macro functions. In a third configuration, the micro-bus, mainframe logic and I/O chassis are wired to the micro- and I/O-buses and logic power; the customer then implements his own algorithms. DATA MACHINES INC., Newport Beach, Calif. For information: CIRCLE 112 ON READER CARD

coordinate digitizer

Model IDP 40 has a working surface of 36 x 36 inches, and IDP 60 30 x 60 inches. Both have a resolution of 0.0005 inch and an accuracy of ±0.001 inch. Designed for use as an image plane digitizer, for graphical digitizing, and use as a layout table, the systems feature incremental encoders coupled in the X and Y axes to produce 2,000 bi-directional counts/inch of travel. The resultant position is displayed in six digits (±99,9995 inch). DATA TECHNOLOGY INC., Watertown, Mass. For information: CIRCLE 113 ON READER CARD

random-processes software

The RAYAN (random vibration analysis) program performs various statistical analyses of such random processes as vibration, acoustics, and fluctuating pressure. It also analyzes Gaussian, Rayleigh, auto- and cross-correlation, power spectral, and similar functions. The program runs on a 7094 with a 1401 off-line printer and S-C 4620 plotter. If a plotter is not available, there's also a print-plot option. NASA COSMIC, Athens, Ga. For information: CIRCLE 114 ON READER CARD

display systems

Featuring a 23-inch CRT, the series 9000 console can be equipped with a standard keyboard, five other control devices, four display devices, and four different memory subsystems. Typical random position access time is 4 usec to traverse and settle on any part of the CRT: formatted characters are function-generated at 4 usec each, including spacing. Information displayed
**new products**

Can be digital, analog or a combination, and dynamic data can be superimposed on static data. The operator can edit, create, update, delete and retrieve information. Optional controls include lightpen, joystick or bowling ball (vector controls), transparent address grid and slide format projection. Also optional are vector generator, static grid generator, hard-copy output and symbol writer. Store/refresh memories available are delay line, drum, disc or core. TASKER INSTRUMENTS INC., Van Nuys, Calif. For information: CIRCLE 115 ON READER CARD

**computer tape**

The No. 777 mag tape is certified error-free at all densities up to and including 1600 bpi. 3M CO., St. Paul, Minn. For information: CIRCLE 116 ON READER CARD

**optical reader**

For banks and other financial institutions, new optical reader/sorter can be added to existing GE MICR document handlers. It reads the new COC-5 type font that can be printed on continuous forms and documents by GE-200 and 400 series computers. Document handlers with the expanded capability are said to process paper imprinted with both the COC-5 and E13B fonts as though only one font appeared. Unlike the 7-bar magnetic-ink font used in Europe, the COC-5 character is made from five vertical bars or lines irregularly spaced. GE INFORMATION SYSTEMS, Phoenix, Ariz. For information: CIRCLE 117 ON READER CARD

**digital voltmeter**

The model 3430A is a reduced-cost unit with an accuracy of 0.1% plus 1 digit. It can make measurements up to ±500 volts dc removed from ground, and input impedance is 10 megohms on all ranges. Price is $595. HEWLETT PACKARD, Palo Alto, Calif. For information: CIRCLE 118 ON READER CARD

**dp tape safe**

Data-Vault safes are available for mag tape, disc packs, data cell, aperture cards, and microfilm. Available as free-standing and walk-in models, they feature hermetically-sealed pressure doors with a single closing bar. Tests show that inner temperatures are about 110° F after being subjected

**PROGRAMMER — JUNIOR**

To $8,500

Must have experience to comprehend normal I/O standards, develop program logic and code in Cobol and RPG.

**PROGRAMMER — SENIOR**

To $11,000

Minimum 2 years experience in any English and machine language coding. Some operating experience and college preferred.

**SYSTEMS ANALYST**

To $12,000

Functional background must include manufacturing or finance. Successful candidate will have personally designed, tested and installed at least one major system. No programming will be required but programming knowledge is necessary.

**SYSTEMS PROJECT LEADER**

To $13,500

Must be able to demonstrate a comprehensive knowledge of systems work and a strong record of successful system design installations in manufacturing or finance.

Send complete resume stating salary requirements to:

MILTON BRADLEY COMPANY
64 Park Street, Springfield, Mass.
2½D or 3D. Lockheed offers both.

Model CD-65.
650 nanosecond full cycle time—less than 400 nanosecond access time. Capacity, up to 65,536 words and word length of 80 bits.

Model CC-100.
1.0 microsecond full cycle time—less than 400 nanosecond access time. Capacity, up to 32,768 words in 4096 word increments. Word length up to 120 bits.

Applications:
Commercial digital computer manufacturers; instrumentation system manufacturers; suppliers of computers for process control systems; government and military installations requiring real time monitoring and control systems; large-scale communications facilities requiring automated switching for telephone and teletype operations.

The customer proven performance of the CC-100 series derives from their Lockheed designed-in reliability. This same designed-in reliability has been coupled with the 2½D organization to bring you the faster CD-65 Series. They both are demonstrations of Lockheed's wide capability in the design, development and manufacture of core memory systems.

Tell us about your memory system application, so that we can supply you with the most useful information about the CC-100 and CD-65 Series. Write to Lockheed Electronics Company, 6201 East Randolph Street, Los Angeles, California 90022.

LEC
Lockheed Electronics Company
A Division of Lockheed Aircraft Corporation

If you are a qualified engineer interested in working on memory systems, we can offer you challenging and stimulating work in this field. Join the technological leader in high-speed memories. Write or call collect to Mr. Ed Haas, (213) 722-6810. We are an equal opportunity employer.

October 1966
new products

to oven temperatures of 2,000° F for four hours. DATA-AMERICAN EQUIPMENT CO., Chicago, Ill. For information:

CIRCLE 119 ON READER CARD

off-line printer
The PS-6010 consists of an MT-36 vacuum-column tape drive and the 3502 chain printer. It operates at 600 lpm, and has up to 192 characters in 120 or 132 columns. Tape speed is 45 ips, data transfer rate is 36KC, and tape loading time is 15 seconds. POTTER INSTRUMENT CO. INC., Plainview, N.Y. For information:

CIRCLE 120 ON READER CARD

farmer’s computer
The Feed Formulation Computer is an analog machine designed for the solution of feed-mix blending problems on a least-cost basis. The basic formula is entered by setting up the analog machine designed for the corresponding to a pre-determined cost. Manual adjustment is performed on dials. The percentage of each ingredient required is displayed on a digital voltmeter and printed on an electric typewriter. ELECTRONIC ASSOCIATES INC., West Long Branch, N.J. For information:

CIRCLE 121 ON READER CARD

multiprocessor software
The Associated Support Processor (ASP) program enables a 360/40 or 50 to perform routine clerical tasks and job scheduling when it’s linked to a mod 65 or 75. In addition to handling local job I/O, the support computer can also send work to and receive work from remote computers that act as high-speed terminals for card reading, punching and printing. Locally, the support unit also performs media conversion. Software availability is scheduled for the first quarter of 1967. IBM DF DIV., White Plains, N.Y. For information:

CIRCLE 122 ON READER CARD

marketing software
Market analysis system reportedly facilitates the projection of new-product profit and loss statements. It projects statistics up to three years into the future. Produced are estimates of sales, expenditures, production and shipping volume on a monthly basis. As sales results on a new product are entered into the computer, they are compared with previous estimates to generate new estimates. One of the statistics produced is the predictable net income of the product by unit, city, region and sales area. It takes into account promotional expenditures, shipping costs, etc. INFORMATICS INC., Sherman Oaks, Calif. For information:

CIRCLE 123 ON READER CARD

optical page reader
The model 3030 page reader/computer system reads the firm’s 12L font, which can be preprinted, type-written or high-speed printed at 10 characters/inch or wider. Optionally, it reads the a5a-a font, which can be intermixed with the 12L. Output at 400 cps can be on mag tape, punched cards or tape, or combinations of these. The Data Machines computer, with memory expandable from 4K to 32K, is for control purposes, but in expanded form can be used as a gp processor. Software available includes an assembler and FORTAN IV.

Paper size accommodated is 4½ to 8½ inches wide and 5% to 13½ inches long. Lines to be read are normally spaced five or six to the inch, but lines can also be selectively skipped. Optionally, 26 underscored capitals can be read to produce upper and lower case characters in the output. FARRINGTON ELECTRONICS INC., Springfield, Va. For information:

CIRCLE 124 ON READER CARD

numerical control software
Postprocessors for APT III, written entirely in FORTAN IV, make the output of an APT processor acceptable to machine tools controlled by DynaPath Control systems. Applications of the postprocessors currently available are to a family of multi-axis tool changing machines, 2-axis lathes, and 2- and 3-axis milling machines. The new software can be run on the CDC 3600, Univac 1108, Philco 212, GE 635, and IBM 7094 and 360’s. INDUSTRIAL CONTROLS DIV., BENDIX CORP., Detroit, Mich. For information:

CIRCLE 125 ON READER CARD

MAGNETIC TAPE DEGRADATION CAN BE PREVENTED DURING STORAGE OR SHIPMENT...

with NETIC CONTAINERS

Widely adopted for military and industrial use since 1956, Netic Containers protect your valuable tapes from unpredictable, distortion-producing magnetic environments. Long life rugged containers withstand the rigors of repeated shipment. Available in a variety of shapes and sizes to solve your shipping or storage problems...they're non-retentive, impervious to shock or vibration, and require no periodic annealing.

A low cost form of insurance...the loss and inconvenience avoided are incalculable. Request Manual 106.
How would you like to help us develop Data Processing Systems in London, Paris or Tokyo?

We’ve created a new Data Processing Systems Department for our International Division. It will be headquartered in New York City and will provide consulting and systems services to affiliates, which are centered in principal cities around the world... Melbourne, Caracas, Rome, London, Paris, Tokyo, etc. What we now need are qualified Senior Systems Analysts and Consultants to staff these overseas positions.

The work is exciting, challenging... the locations not too hard to take. Working independently in most instances, our Systems Analysts and Consultants will assist and guide our affiliate companies in the development, implementation and review of computer and non-computer systems. These systems may function independently or may be part of a larger, integrated, management science system.

To qualify, a college degree is essential. An advanced degree and/or a degree in the engineering or computer sciences is highly desirable. Data Processing experience of 2 to 5 years should include a portion in the development, or direction, of major projects or independent studies in one or more of the following areas: Scientific Inventory Control, Order Entry, Accounts Receivable, Accounts Payable, or General Ledger. Computer programming experience is required with high level language and knowledge of IBM 360 operating system being beneficial.

Overseas tours will range from 2 to 3 years with rotation back to Mobil Headquarters for technical updating between assignments and for vacations. The salaries are good and will include attractive overseas allowances and cost of living adjustments along with a good benefit program.

We are an equal opportunity employer and will consider any qualified candidate without regard for race, creed, national origin, age or sex.

To further explore these career opportunities send, in confidence, your resume indicating current salary and requirements to: Mr. P. J. Harbaugh, Dept. 3280, Mobil Oil Corporation, 150 East 42nd Street, New York, N. Y. 10017

Mobil
International Systems Department
An Equal Opportunity Employer/A Plans For Progress Company
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™ memory stack.

It's faster.
DATA TRANSMISSION SYSTEM: Tele-speed 1200 EDC paper tape sending and receiving equipment, which operates at 1,200 or 1,050 words per minute and automatically detects and corrects errors in transmission, is described in information sheet. TELE-TYPE CORP., Skokie, Ill. For copy: CIRCLE 140 ON READER CARD

MEMORY SYSTEM: Four-page brochure describes the NANOMEMORY 900 with a capacity of 16,384 words of up to 84 bits, access time of 650 nsec and cycle time of 300 nsec. Specifications are listed, including a functional diagram and clear/write, read/restore and split cycle timing charts. ELECTRONIC MEMORIES INC., Hawthorne, Calif. For copy: CIRCLE 141 ON READER CARD

REVISED MANUAL: Dynamic Storage Allocation Language in FORTRAN II is based on a series of 80-odd FORTRAN subroutines which include dynamic storage allocation, list processing procedures, character manipulation, ranking and sorting routines, statistical and matrix operations. 308-page manual provides instructions in the use of DYSTAL, including exercises and answers. Cost: $3. SOCIOLOGY COMPUTER LAB., Brown Univ., Providence, R.I.

TAPE OPERATING SYSTEM FOR 360: Handbook for programmers acquaints the inexperienced programmer with the scope of tape operating systems and provides a convenient reference to TOS techniques and control card formats. Among the subjects covered are system concept, job control, linkage editor, supporting a typical installation. Single copy: $1.50, or bulk rates. COMPUTER USAGE DEVELOPMENT CORP., Mt. Kisco, N.Y.

TYPESetting GLOSSARY: 112-page book is an encyclopedia of automated typesetting progress and practice containing over 1,000 entries emphasizing computerization and associated use of photographic procedures. In addition to descriptions of systems, hardware and typesetting machines, the glossary also covers basic and advanced terminology in related subjects such as tape-controlled typography, photographic composition, data transmission, text editing, optical character recognition, cathode ray tube character generation. Free to CIS members; non-members: $15. COMPOSITION INFORMATION SERVICES, 1605 N. Cahuenga Blvd., Los Angeles, Calif. 90028.


A-D CONVERTER: Four-page bulletin covers operating modes, accuracies, control signals and resolutions (from 7 bits to 11 bits or three BCD and sign) and input impedance (over 100 megohms) for model 761A. ELECTRONIC ENGINEERING CO., Santa Ana, Calif. For copy: CIRCLE 142 ON READER CARD

TAPE READER AND SPOOLER: Brochure details reliability test of 143 million lines and 50,000-hr redundant light source, plus specifications of the 100- cps, five to eight-level reader, which has one moving part. PHOTOCOPY CO., Garden Grove, Calif. For copy: CIRCLE 143 ON READER CARD

PHOTOTYPESETTER: Producing metropolitan telephone pages at a page a minute, Photon ZIP 901 inserts headings, page number and advertisements. Setting type across page width, the machine composes lines in all columns in each forward and backward pass producing a fully made up page. Six brochures describe this system, discuss operating methods, speeds in various applications, show samples of the work, detail computer require-

URS needs data systems analysts, operations research analysts, military analysts, mathematicians, and systems and applications programmers.

NO TWO JOBS ALIKE.

URS has grown for 15 years, and yet retains an environment in which the contribution of each individual is unique and important.

Individual effort comes first.

URS Systems Centers are engaged in system design, programming, and information processing operations in the United States and other parts of the world. (In addition, our Research Center performs research and development in the physical sciences and engineering.)

Are you currently engaged in systems design or programming in the following areas?

Simulation • Logistics • Management information systems • Computer programming aids, languages and applications

If you have such qualifications and are interested in a position offering professional growth and compensation based on your effort, send your inquiry or resume to:

URS

CORPORATION

1811 Trousdale Drive Burlingame, California 94010

*Still known to some of our older friends as Broadview (BRC), United Research Services (URS), and various other aliases reflecting a spirit of experimentation. AN EQUAL OPPORTUNITY EMPLOYER—B Y CHOICE.

CIRCLE 308 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

---

**APT COMPUTER PROGRAMMERS**

**Application:** Experienced computer programmers to implement and maintain the APT System for Numerical Control on IBM 7090 and System/360 Computers.

**Qualifications:** Should have engineering or mathematics degree. Should be familiar with APT and have experience in systems programming.

Please send resume including qualifications, experience, and salary requirements to:

MANUFACTURING DEVELOPMENT
Personnel Department
Attention-Technical Placement

GENERAL MOTORS TECHNICAL CENTER
Warren, Michigan 48090

An Equal Opportunity Employer M/F

---

**What computer system manufacturer has the edge in tomorrow’s market for industrial process control?**

We have the edge in tomorrow’s industrial control market because we already lead the field today. For years, Foxboro has been the foremost supplier of systems and instrumentation for controlling the production of chemicals, food, cement, metals, paper, power, textiles, petroleum and other products vital to a better way of life. Until recently these systems and instrumentation have been analog in nature, but in the past few years digital computer technology has provided an increasing number of companies with a better control capability. And who’s in a better position to provide this capability than the company with the established process control market, a company long conversant with the terminologies and technologies of these complex processes. However, to stay on top we must continue to develop the best computer capability in the business—which means hiring the best digital engineers and programmers available.

- DEVELOPMENT ENGINEERS • CIRCUIT DESIGNERS • PRODUCT ENGINEERS • SYSTEMS ENGINEERS
- PROJECT ENGINEERS • SCIENTIFIC PROGRAMMERS • SERVICE ENGINEERS • STAFF SALES

The Foxboro Company can now offer the rare combination of circumstances that makes for real opportunity. You will be (1) getting in on the ground floor with (2) a company that’s the leader in industrial control. You’ll be taking more responsibilities and getting better and broader experience than you may be getting elsewhere.

Please consider carefully the areas listed above.

**FJCC**

For an interview during FJCC please call Mr. J. G. Willett at our San Francisco office 562-0956 November 8 through November 10 from 8:00 a.m. to 10:00 p.m. Resume not required.

---

**IF:** You are unable to attend FJCC . . . You don’t see your area listed . . . You wish to be kept posted on future openings.

**THEN:** With no red tape and under no obligation, forward your resume (inquiry) in confidence to:

Professional Staffing, Central Recruiting Office
THE FOXBORO COMPANY
100 Neponset Avenue, Foxboro, Massachusetts
AN EQUAL OPPORTUNITY EMPLOYER
Meet new challenges in digital and hybrid computation.

EAI is a leader in the field of digital, analog and hybrid computation and the only company with in-depth capability in all three scientific computing disciplines.

Rapid expansion of our digital computer efforts now requires the addition of new members to our professional staff. We need men who can help us grow even faster — men who are ready to take on broad responsibilities in sophisticated programming and design.

In return, we offer an opportunity to join a select group of professionals working in a dynamic atmosphere of technical challenge. You will be able to prove your abilities against new tasks that demand creative answers. You will be evaluated and rewarded by a company that places great importance on your contributions.

Equally important is our need for digital simulation engineers, sales support specialists and field engineers.

For more information about current positions, write or call collect (201-229-1100) in confidence. Contact Mr. L. C. Fons. Arrangements will be made for local interviews as well as for personal discussions with senior technical staff members at the FJCC.

An Equal Opportunity Employer
At Lockheed, the young and vital field of Information has created the industry's broadest range of outstanding opportunities. Scientific computing, satellite tracking, real-time data processing, hospital, educational, business, and governmental administrative information systems offer a unique opportunity for a varied and fulfilling career.

To accomplish its highly diversified assignments Lockheed maintains a centralized data processing facility—one of the largest computer centers in the country.

Scientific computing at Lockheed plays many important and varied roles in Flight Mechanics, Trajectories, Thermodynamics, Electronics, Propulsion, Structures, Flight Technology, Hydrodynamics, Navigation Guidance and Control, and other vital fields.

In other areas of activity, Lockheed has developed a revolutionary process for handling patients' records to free doctors and nurses to perform their primary duties. Lockheed also leads the way in state-wide information systems such as the one planned for the State of Alaska.

In addition, the planning and control of all U.S. Air Force orbiting missions is conducted at the Satellite Test Center, which also maintains one of the world's largest and most powerful real-time computing facilities with assignments ranging from simple ballistic missile shots to highly complex, classified satellite missions.

Engineers and scientists are invited to write Professional Placement Manager, Lockheed Missiles & Space Company, P.O. Box 504, Sunnyvale, California. Lockheed is an equal opportunity employer.
new literature

journal bibliography. Cost: $100. Subscription: four quarterly studies $325. ECONOMIC INDEX & SURVEYS INC., 10550 Park Ln., University Circle, Cleveland, Ohio 44106.

DIGITAL PLUG-IN MODULES: 40-page catalog describes Versalogic and contains circuit diagrams of the modules and engineering data to aid the design engineer. Versalogic is designed around the NAND gate, flip-flop and power amplifier, and is available in three speeds, 200KC, 2 and 8 MC. Included are flip-flops, gates, clock and timing modules, system interface modules, drivers and A/D modules. DECISION CONTROL INC., Newport Beach, Calif. For copy: CIRCLE 151 ON READER CARD

FLUIDLESS PROCESSOR: Model 1380 records CRT-displayed data, processes it, and produces positive and negative film records in approximately 3 minutes. Bulletin describes the camera/processor/viewer system which uses Kodak Bimat, a photographic developing material that requires no free fluids. PHOTOMECHANISMS INC., Huntington Station, N.Y. For copy: CIRCLE 152 ON READER CARD

MEMORY SYSTEMS: Eight-page brochure describes and illustrates the construction and operation of FX-12. Random access memory, read-only memory, time buffering, format-conversion buffering and split sector are explained with block diagrams and examples of applications. FERROXCUBE CORP. OF AMERICA, Saggerties, N.Y. For copy: CIRCLE 153 ON READER CARD

TELEMETRY DATA SYSTEM: DATACORE, the launch-area system for acquisition and processing of telemetry data from Saturn/Apollo and other vehicles launched from Merritt Island or Cape Kennedy, is described in four-page folder. Each system accepts PCM, PAM/PDM, and continuous analog telemetry data and time information simultaneously from sources via radio receivers, tape recorders, and wideband transmission lines. The system then converts analog data to digital form, identifies individual data samples, and stores data samples and time information in a magnetic core memory for pick up on demand. MONITOR SYSTEMS INC., Fort Washington, Pa. For copy: CIRCLE 154 ON READER CARD

Apollo - Poseidon Deep Submergence Systems
-at M.I.T.

The Instrumentation Laboratory's professional staff now exceeds 600 — engineers of all major disciplines, mathematicians and physicists.

They work on problems, from definition to solution, that consume their interest and challenge their abilities within an organization known for strong group and individual autonomy.

Opportunities exist across a broad span, with emphasis on the following:

Software — Systems Analysis, Simulation, Synthesis: Advanced degree engineers or mathematicians are sought to develop guidance concepts and equations with application to spacecraft, missiles and submersible vehicles.

Control Systems Engineers with backgrounds in optimal control, servo control or airborne computers. Requirements range from recent BSEE to heavily experienced M.S.

Digital/Analog Evaluation: Experienced EE's to design, test and evaluate digital and analog circuitry (phase detectors, VCO loops, etc.). Solid state design feedback theory required.

Systems Simulation: Aeronautical Engineers or Mathematicians for analysis, simulation, development and design of navigation and guidance techniques for spacecraft and aircraft.

Programmers: Design procedures and data for testing complex computer programs within Real Time systems.

If you're interested, no personal sacrifice is required — salaries are competitive, benefits are liberal, and you may take graduate courses at MIT at full salary with generous tuition assistance. Your resume will receive immediate, thoughtful consideration. Reply to Mr. John D. McCarthy, Professional Staffing, Building 10D, 68 Albany Street, Cambridge, Massachusetts, or call (617) UN 4-6900, Ext. 3544. MIT is an equal opportunity employer.

Instrumentation Laboratory
Massachusetts Institute of Technology

CIRCLE 312 ON READER CARD
Mike Parr is a computer professional
Mike's background is quite unique—but, typical of our entire staff. Aside from his academic achievement and professional association (he served as a member of the Systems and Procedures Association International Board of Directors), Mike brings to our firm eleven years of successful experience in the computer field. He was previously associated with Fibreboard Paper Products Corporation as Manager of Operations Research and Computer Applications until March, 1965, when he left to head up the new systems group at Fairchild Semiconductor, a Division of Fairchild Camera and Instrument Corporation. As Director of Management Information, Mike was responsible for all systems and procedures, programming, data processing and communications activities at Fairchild.

Mike Parr is a computer professional
On September 16, 1966, Mike opened our new suite of offices in San Francisco. If you are career oriented, this is important to you since Mike's addition enables us to extend our philosophy of selective career guidance and placement across the country.

Mike Parr is a computer professional
Through the experience of his own successful career, Mike is able to understand your background in depth. He realizes the importance of individual differences in both abilities and career objectives. He knows the career oriented person cannot be "pigeon-holed". He is able to provide intelligent and discriminating guidance. In short, you will have confidence in Mike Parr and our entire staff since we are all computer professionals. We think this is important. Don't you?

If you are unable to visit our offices in person, please call, send a detailed experience resume or write in confidence for our FREE Computer Opportunities Bulletin.

source edp
"exclusively data processing"
FORMERLY EDP PERSONNEL, INC.
In San Francisco—M. R. Parr, 111 Pine Street, Suite 1015, 415-434-2410
In Chicago—D. N. Grimes, 100 S. Wacker Drive, Suite 212, 312-782-0857
CLIENT COMPANIES ASSUME OUR CHARGES

FREE! CAREER OPPORTUNITIES BULLETIN

A complete and comprehensive listing of outstanding positions at salaries from $6,000 to $30,000 with National Companies for:

ENGINEERS • ANALYSTS • PROGRAMMERS

Our professional staff combines Customized Service with technical know how to insure for you maximum career development in the following areas:

- Circuit Design
- Digital or Logic Design
- Switching
- Communications
- Hardware Design
- Manufacturing
- Reliability
- Software Development
- Scientific Programming
- Real Time Systems
- Business Systems
- Commercial Programming
- Diagnostic Programming
- OPS Research

No charge to you for our custom service. All expenses paid by client companies (fees, interviewing & relocation). Expedite your development by sending resume in confidence with present salary and geographic preference to Frank Daniele, Director:

La Salle Associates
Professional Search Dept.
2136 Locust Street, Philadelphia, Pa. 19103
For your free bulletin without any obligation, circle subscriber service card. Please use home address only.

Information System Director
CREATIVE OPPORTUNITY

This is a rare opportunity to create an entire computer effort as you think it should be with top management support and adequate financial backing.

Large, rapidly growing multiplant division of a major international company has ordered an IBM 360-30 with discs for its initial computer installation. The primary objective will be to provide information for production and purchasing, working toward using the computer for routine decision making such as scheduling rather than just financial information. The director, who will report directly to the division president, will have the opportunity to hire his entire computer staff.

Please send resume, including present salary, to:

Judd Goldfeder
TRW ELECTRONICS
1100 Glendon Avenue
Los Angeles, California 90024

CIRCLE 315 ON READER CARD
CIRCLE 316 ON READER CARD
CIRCLE 317 ON READER CARD

DATAMATION
of four 1108's, lots and lots of 1004's and massive backup storage arranged in two double-1108 configurations. They've just installed a fourth 494, will now be handling the mission command and telemetry as well as communications processing. The 1108's go into the Computation & Analysis lab, where there is also an 1107. In addition, Univac is doing some $1 million/year worth of programming for the MSC.

Meanwhile, back at the labs, there are rumors of new products which may continue to make Univac salesmen smile in the years to come. Like the company may be near a lab version of an NDIR laser memory, consisting of a garnet crystal surrounded by an electromagnetic field which can be switched in either direction. Read-write cycles are described as a combination of optical & magnetic. A laser beam records on the crystal in a thermal fashion... hence the nondestructive readout by the output laser beam. Storage density is up to 10K bits/in.².

The PDP-10, running with an improved version of the PDP-6 software, will be the next out of Digital Equipment Corp. Announcement is expected at the FJCC. This all-new computer will come in four versions: a 4K (36-bit) word basic system, 16K extended, 16K multiprogramming system, and 32K time-sharing.

Business Information Technology, Natick, Mass., is readying announcement of a 900 series of data communications terminals, built primarily around its new 480 processor (see Sept. look ahead). Models 902-908, selling under or around $20K, will have the 480 as a buffer control unit for the Potter Instrument chain printer and/or a card reader, punch or reader/punch. The 901 will be a slave printer terminal selling for under $16K. Interfaces for standard 2- and 4-wire data sets will be provided. Later extensions of the stored-program series will include Potter mag tape drives in various combinations with card equipment and printers. Not stopping there, BIT also plans to come out with media conversion equipment competitive with Mohawk Data Sciences' line.

Delivery on the Honeywell mass memory devices (mag tape strip) has slipped from third quarter '66 to mid-1967, but needy customers can substitute the H-259 disc drive, whose deliveries begin the end of this year. The drive, announced to the field in June, has a 9.66 megacharacter storage capacity on a six-disc pack, a 97.5 msec average access time, and 208K cps transfer rate. Control unit can handle 8 drives... We hear Fairchild will announce a 60 sq.-mm. monolithic i.c. chip soon which will contain 80 gates... Computer Control Div. of Honeywell will soon reveal its new i.c. computer, supposedly the "smallest, fastest, most powerful" 16-bitter on the market. Delivery should be fast too...The faltering municipal bond market has contributed to the demise of Munitype, New York firm which offered on-line bond calculation on a GE-215. Ultronic, which suspended its bond service several months ago due to equipment problems, will resume it sometime in the future, along with other services, on new equipment...Certron, L.A.-based tape certifier, is teaming up with an Australian firm to offer the service Down Under. The company is also test marketing in the midwest and Texas, thinking about other overseas ventures after it digests the new Aussie operation.
Engineers, Scientists, Programmers, Systems Analysts
Computer Professionals with B.S., M.S. or Ph.D. degrees

Present your qualifications to over 25 leading employers during FJCC.

Interviews will be held in San Francisco on November 8th to 11th. Use the coupon even if you cannot attend.

Over 25 employers from throughout the country are sending their top technical staffs to San Francisco for another important CAREER CENTER interview session the week of November 7. A number of employers will have several divisions present, so that approximately 50 different employment units will actually be interviewing. Literally thousands of new opportunities are available.

Whether or not you intend to visit San Francisco during FJCC, you can register and have your qualifications reviewed by sending in the coupon below. Please act now, so we will have enough time to send you the necessary registration material, and so the employers will have sufficient time to review your qualifications.

Your registration materials contain a simple data sheet. When the completed data sheet is received by us, we eliminate your name and address and rush the sheet to those employers which plan to attend. They then indicate their interest in meeting you by contacting us. Of course, there are never any fees for the CAREER CENTER service.

Partial List of Attending Employers:
General Electric Jet Propulsion Laboratory
Eastman Kodak Ling-Temco-Vought
Raytheon Control Data
Texas Instruments Douglas Aircraft
General Dynamics Lear-Siegler
AC Electronics

Register Now! Take advantage of this unique opportunity. Clip out the coupon below and mail (air mail if you reside outside a 500 mile radius of New York) today!

For those attending FJCC in San Francisco, the CAREER CENTER will be held at the San Francisco Hilton, at Mason and O'Farrell. Telephone: (415) 776-4722.

To: Mr. Bob Sherwood, Career Center Headquarters, 635 Madison Avenue, New York, N.Y. 10022.
I am interested in having my qualifications reviewed by the employers attending FJCC. (Please mail to New York before November 1. After that date mail to CAREER CENTER at the hotel address listed above.)
Name ____________________________
Address __________________________
City State Zip Code
I (do) (do not) expect to be in San Francisco for FJCC. circle one

CAREER CENTER Equal Opportunity Employers

McFADDEN ASSOCIATES
15 years successfully recruiting for industry coast to coast

Salaries $10 - $30,000
Current recruiting requirements include multitudinous opportunities for: Management Information Systems Analysts/Computer Staff Consultants/Real-Time Programmers/Publication Writers/Contract Administrators/Business Programmers/Buyers/Sales Engineers.

Fees, Relocation & Travel Expenses are paid by Client-Companies.

Please Forward Resumes in Confidence to:
D. KERR McFADDEN
McFADDEN ASSOCIATES
1411 WALNUT STREET—SUITE 1200
PHILADELPHIA, PA. 19102
LO 3-2343
CIRCLE 320 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 • SCIENTIFIC PROGRAMMERS
• SYSTEMS APPLICATIONS • DIGITAL/LOGIC DESIGN
• SYSTEMS PROGRAMMERS • SYSTEMS ANALYSTS
• OPERATIONS RESEARCH • SOFTWARE SYSTEMS
• REAL TIME 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 318 ON READER CARD

CIRCLE 319 ON READER CARD
2,000 CURRENT EDP JOB OPENINGS

in the nation's top companies, coast to coast.

EDP Managers $10,000 to $30,000
EDP Systems Analysts 8,000 to 20,000
EDP Programmers 7,000 to 15,000
EDP Operators 5,000 to 8,000
Key Punch Operators 4,000 to 7,000

If you have a minimum of six months' EDP experience and are looking for permanent or temporary EDP employment, call, write or visit . . .

TABULATING SEARCH & DEVELOPMENT AGENCY

in the following cities:

LOS ANGELES
3156 Wilshire Boulevard/(213) DU 8-3205
Alan Strong — Manager

HONOLULU
Alexander Young Building/(253) 510-547
Leslie Jackson — Manager

WASHINGTON, D.C.
1417 F Street, NW/(202) 347-1077
J. W. Colleran — Manager

HOUSTON
808 Travis Street/(713) 227-6581
Joseph Merchant — Manager

We have been providing a nationwide EDP personnel placement service since 1959. Our service is confidential, prompt and we represent the majority of the leading firms in the country. Your career is at stake, so talk to a specialist!

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
- Digital or Logic Design
- Real Time Systems
- Circuit Design
- Software Development
- Operations Research
- Applied Systems
- Commercial Programming
- Systems Design
- Mathematics
- Consulting
- 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.

EVERETT KELLEY ASSOCIATES
Consultants to the Computer Industry
121 So. Broad Street (Suite 300) Philadelphia, Pa. 19107

CIRCLE 321 ON READER CARD

Information Processing

WE CONSULT EXCLUSIVELY IN THE AREA OF INFORMATION PROCESSING PERSONNEL. ALL FEES ARE PAID BY OUR CLIENTS. SALARIES RANGE FROM $8,000 TO $30,000. QUALIFIED CANDIDATES ARE URGED TO CALL OR WRITE FOR APPOINTMENT.

"Replies are held in confidence"

RO - MAC & ASSOCIATES
PERSONNEL CONSULTANTS
950 BOYSLTON STREET
NEWTON HIGHLANDS, MASS. 02161
(617) 244-8989
94 AUBURN STREET
PORTLAND, MAINE 04103
(207) 797-2191

CIRCLE 323 ON READER CARD
If you want...a computer specifically designed to meet your system requirements—with such useful system features as MicroExec for sub usec processing rates— independent GP memories for simultaneous operation—two memory access channels, 555 KC and 200 KC—16 or 18 bit words—1.8 usec core memories, and 0 to 12 v. logic levels.

If you want...Input/Output flexibility, DATA/620 has six types of I/O facilities and up to sixty-four devices for simultaneous I/O rates of more than 500,000 words per DMA.

If you want...complete software, DATA/620 includes FORTRAN, Assembler, Aid, Maintain—all open ended—and more than 100 machine commands.  

If you want...a computer built for your system, the DATA/620 rack mounts in only 26½ inches of space with front access, and offers highly reliable operation with 7,500 hours MTBF. And, DATA/620's low initial cost of $28,800 will not break your system budget.

If you want...90 day delivery you can still have it—although 52 DATA/620's have been sold and 27 delivered.

There is a lot more we would like to tell you about the DATA/620 in a fact filled 36 page brochure. If you would like one, write to:

DATA MACHINES
1590 Monrovia Avenue, Newport Beach, Calif. Tel. (714) 646-9371 • TWX (714) 642-1364
Division of DECISION Control, Inc.

See the DATA/620 at booth 1022, F.J.C.C.
CIRCLE 81 ON READER CARD
Britain's Ministry of Technology is attempting to attract top American university personnel across the Atlantic for periods of one or two years to join in a new programme of post graduate research and education. This is not a deliberate ploy to reverse the persistent flow of scientific brainpower from east to west but is part of a campaign to resolve the U.K.'s computer manpower shortage. Manufacturers still provide the bulk of training for all types of computer and dp jobs in Britain, and a Ministry-sponsored survey showed that for the quarters ending March and June '66 manufacturers had pushed through their training schools a total of 14,000 people. The job breakdown figures show that the schools handled 464 systems analysts for the manufacturers' own services and 469 for users' staffs. The comparable figures for programmers were 1,615 and 6,588. The remainder of people covered in the survey were on appreciation courses.

Main conclusions drawn by the Ministry were that the rate of intake in the computer field was not high enough to meet the manpower needs of 1970 forecast by the Ministry of Labour, and that the small number of systems analysts under training was particularly alarming. Recommendations have now been made for a drive to recruit at least 400 key people into this area with post-graduate scientific, higher accountancy, advanced business or operations research qualifications. These will provide a nucleus for spreading advanced computer management techniques throughout commerce and industry. Says the working party reviewing manpower, courses for post-graduate advanced systems must be established immediately at all major universities and the new business schools to meet the shortage. Recruitment of top teachers and researchers from the U.S. is recommended if they can be tempted to join a British unit for either long or short-term periods.

A General Electric process control machine (made in the U.K. by Associated Electrical Industries under GE license and with the label Con-Pac 4060) will form the multiplexer in a typically British hardware-oriented system specified by the U.K. Atomic Energy Authority. It will be part of a time-shared installation based on an IBM 360 and providing computing service via typewriters simultaneously for up to 160 scientists and engineers. The 4060 will perform straightforward functions of polling and queuing. At $140,000, a Con-Pac processor is expected to yield a cheap and effective hardware-software compromise for implementing multi-access.

Britain's Paymaster General's Office has reversed a decision on document handling methods which could have wrought chaos among the cheque and money voucher systems being introduced into the U.K. As it is, there are major differences in adopted standards between banks.

(Continued on page 165)
a logic circuit that shrank from improvement

In an age of persistently expanding technological complexity, we've used a different approach to sophisticated electronics. Simplicity.

Our simplified magnetic logic system uses a magnetic core to compare and store its information. It makes decisions, then responds.

We've told here before about fundamental studies of ferromagnetism itself, and about development of square loop ferrites. Now we've developed techniques, components, and circuitry for improved magnetic logic.

A ferrite memory core, a silicon diode, and a resistor combine into a logic module. Put modules together and you can build complete control circuits. Add to these the simple driver circuits we've engineered—to provide the needed input pulses—and the output stage to feed continuous control information to a machine.

True, all-semiconductor logic circuits can do this same job. And they can act much faster than magnetic circuits. But sometimes you don't need all that speed. This magnetic circuit will handle up to 50,000 information pulses per second. And it needs only one-half to one-fifth as many parts.

Its cost approaches that of a relay logic system. It has low impedance, too—10 ohms in the core circuit—providing a high immunity to electrical noise.

These systems aren't out of the laboratory yet. But we think they have a great future.
credit houses, and government organisations.

As the first institutions into the automatic document handling field, a joint committee of the cheque clearing banks opted for the ABA's E13B font. Some credit and insurance houses expressed a later preference for the Continent-developed CMC7 bar code, which has a full alphanumeric character set plus special symbols. With its greater range of characters and easier legibility, this more recent method for document sorting was the first choice of the Paymaster General's Office, which issues millions of money orders a year to government employees and contractors for payment through the commercial banking system.

Now the Paymaster's office will use a document handling system which is compatible with that of the banks. In its Giro banking and money order schemes, however, the Post Office is to use a mixture of magnetically readable CMC7 and optical ISO B character reading machines. Small wonder that peripheral equipment developers view computer users with a jaundiced eye.

HONEYWELL PUSHES NEW APPLICATIONS

Since acquiring 3C as the mainstay of its computer control division, Honeywell has been extending its European organisation to cover the simulation, process control and scientific computing fields. New applications for the DDP computer series include the digital end of a flight simulator for Britain's Phantom jets and the French Concord supersonic jet airliner, on-line data reduction linked to a spark chamber, and data recording and analysing at a Swiss mountain-top radio & optical telescope observatory.

BITS & PIECES

Algol compilers for the 360 are due from IBM's Nordic Lab, Stockholm, in August '67. To many Europeans, this acknowledgement of Algol looks like a "mountain to Mohammet situation"...Software labour is cheaper in Europe, as Honeywell has found in deciding to establish an advanced programming centre in the U.K. under Louis G. Edwards. Plans are to have 40 people recruited from throughout Europe by year-end working on operating systems and compiler designs...Four Univac 9300's worth $700,000 have been ordered by Mills Assoc. Computer Service, Monmouth. They will supplement computer bureaus operating in South Wales and the West Country...Ferranti won out in a battle with Cossor-Raytheon for CRT displays for British Overseas Airways. Eventual contract value is $7 million. The displays, 700 in total, are organised with one Argus 400 computer providing character generation for each group of 12 CRT's...Cossor-Raytheon will supply displays to the British Navy for twin Univac 492's to be installed for stores control of Polaris submarines and the operational fleet...Britain's new Ministry of Social Security has ordered 100 data terminals and 270 data preparation units from Creed and Co., a U.K. subsidiary of ITT. ICT won the contract to supply the prototype system for a machine centre linked to 84 branch offices via telephone lines. If successful, the system will be copied for six other regions in the country with the Creeds order presumably escalating from today's $700,000 to $4,200,000... ICT has received a $2.8-million order for 1900's from British Railways.
Scientific Programmers
Systems Analysts

In No Other Programming Center in the World are Problems so Complex and Hardware so Varied.

In Washington, at the nerve center of the nation's world-wide and space-wide intelligence, there is a computer complex that offers a challenge and a satisfaction to Programmers and Systems Analysts on many levels of skill and experience.

You will be working with a team of seasoned professionals in real-time, multi-programming/multi-processing/remote access systems. Analysts should have computer query systems experience.

The career opportunities are broad and rewarding. Positions include full Civil Service benefits. Send resume to Mr. Roger Fowler, P.O. Box 8217, Southwest Station, Washington, D.C., 20024.

CENTRAL INTELLIGENCE AGENCY

By Any Computation
DATA PROCESSING PROFESSIONALS
Select
FOX-MORRIS PERSONNEL CONSULTANTS

We have a select group of clients offering unexcelled starting salaries in the $10-30,000 range. (all fees and employment costs paid by client companies).


Our National Data Processing Division is professionally recognized as the most complete, effective and 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 8-2535.

CIRCLE 326 ON READER CARD

INSTITUTE OF TECHNOLOGY

COMPUTER-AIDED DESIGN

The Computer-aided Design Project of the Electronic Systems Laboratory, M.I.T. has challenging and career-building opportunities for well-qualified mechanical engineers with professional experience in writing computer programs for use in design. The assignment will be in the Computer Applications Group with Mr. D. T. Ross and will consist in the development of design application systems using AED Language, the CADET Processor, and time-share computer graphics. APT and 3-D shape description experience is desirable.

M.I.T. offers a liberal benefit program, including educational opportunities at the Institute and competitive salaries.

Candidates are invited to send resumes to:
Mr. R. J. Nelson

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
77 Massachusetts Avenue (617) UN 4-6900, Ext. 4275
Bldg. E 19-285 Cambridge, Massachusetts 02139

An Equal Opportunity Employer
DATA PROCESSING personnel

$9,000 to $30,000

Being the leading data processing personnel search firm in the New York Metropolitan area, we have situations available with clients in all EDP disciplines. Among them are:

- Commercial Programming
- Realtime Systems
- Scientific Programming
- Systems Design
- Software Development
- Communications
- Operations Research
- Applied Systems
- Mathematics

URGENT NEED — New and exciting positions available within a recently formed Research & Development group of an international corporation. Candidates should possess undergrad degrees plus one years programming experience. Advanced degrees, in any area, highly desirable and one or more years industrial experience in any of the following fields (computer oriented) — Management Information Systems, Telecommunications, Mathematical Programming, Operations Analysis, Systems Engineering or Probability & Statistics. Starting salaries range from $9000 to $30,000.00. Location, Midtown New York City; Relocation expenses paid by the client. Little or no travel involved. Large scale computer programmers are also desired to support projects in the above areas.

To further explore these or any other position in New York City or the nearby Long Island, New Jersey or Connecticut areas please send a detailed resume including Present Salary, Approximate Desired Salary and personal preferences. Naturally all inquiries are treated as confidential and all our fees are paid by the client company.

(212) 661-0725

ROBERT SAXON ASSOCIATES INC.
485 Fifth Avenue Suite 1042 New York, N.Y. 10017

CIRCLE 328 ON READER CARD

PROGRAMMERS — SYSTEMS ANALYSTS

If you . . .

— Are imaginative and want an opportunity to excel
— Have DP experience (prefer subscription fulfillment or similar field)
— Can help build the finest Data Processing capability in the industry

... ACCEPT A PROFESSIONAL CHALLENGE IN BEAUTIFUL BOULDER IN COLORFUL COLORADO WITH A DYNAMIC GROWING COMPANY WHOSE PRIMARY FUNCTION IS PROCESSING DATA

Send Resume to:

NEODATA SERVICES, Inc.
1255 Portland Place Boulder Colorado 80302

CIRCLE 328 ON READER CARD

ELECTRICAL ENGINEERS

CIRCUIT DESIGN • LOGIC DESIGN • PROGRAMMERS

SWEDA INTERNATIONAL, a new Division of the Business Equipment Group of Litton Industries, has recently begun organization of a U.S. research and development facility in suburban New Jersey. It will develop new commercial data processing products using computer technology.

Interesting opportunities exist for circuit designers and logic designers with experience in the development of data processing and peripheral equipment. Openings also exist for Programmers with machine language experience.

We offer growth potential and salaries commensurate with your technical achievements. Our full range of company benefits include participation in Litton employees stock purchase plan, educational refund and vested pension plan.

For prompt, confidential consideration, call collect to Mr. L. H. Ryan, c/o Professional Development, at (201) 673-6600, Extension 482, or send your resume to 550 Central Avenue, Orange, New Jersey.

SWEDA INTERNATIONAL
A DIVISION OF LITTON INDUSTRIES

An equal opportunity employer

October 1966
we don't mind making the second fastest large scale memory system.

That's because we also make the fastest. How fast? 650 nanoseconds for a full cycle with an access time of 300. That's our Nаномеморий™ 650. It handles up to 16,384 words of 84 bits. They don't come any faster.

Right behind it, our Nаномеморий 900 completes a cycle in 900 nanoseconds with an access time of 350 for the same capacity.

We've been able to reach these speeds by using a simple but ingenious magnetic organization. We call it 2½ D. It combines the speed potential of linear techniques. We've also reduced stack connections by 80% and widened operating margins to increase reliability.

Both these compact memory systems fit perfectly into real time or high speed computers and checkout systems.

If you've been looking for a memory system that delivers close to thin film speeds at magnetic core prices, stop looking. We've got two. For complete details on our Nаномеморий 650 or 900, write or phone

**Electronic memories**

Memory systems, stacks and cores for commercial, military and space applications

17627 Chadbourn Avenue, Hawthorne, California

(213) 772-5201

See the demonstration of our Nаномеморий and Military Systems at the FJCC.
A leaseback contract covering an IBM 360/30 may be sought by the Dept. of Agriculture before the end of 1966. Last month, the same agency became the first in the federal government to negotiate such a deal when it contracted with LMC Data Inc. for the purchase and leaseback of 190 units of punched card equipment at rates 23.6% below IBM's charges.

The pending negotiation, by expanding the leaseback concept to computers, would vastly expand the potential savings to the government. At least five other agencies reportedly are exploring the idea; among them is the Veterans Administration, which has about $400K worth of EAM equipment that appears to be eligible. State governments are also leasing back dp equipment. Last month, Maryland signed a contract with MAI which will produce savings "in excess of $100,000 a year," says a company spokesman.

According to the release announcing last month's contract between the Agriculture Dept. and LMC Data, the federal government could save nearly $40 million in annual rental charges by making maximum use of leaseback. About $7 million of this represents rentals on tab gear; the rest, computer charges.

LMC Data will save the Agriculture Dept. about $5,820 a month, and $69,840 a year. This represents 12.3% of the department's total punch card equipment rental costs.

All GSA dp management activities are now centralized. They've been shifted horizontally on the organization chart, from the Office of Finance and Administration to a new Office of Automated Data Management Services. Ed Dwyer remains in charge. He has a new title (acting assistant commissioner), a new boss (H.A. Abersfeller, Federal Supply Service Commissioner), and, reportedly, more clout. Instead of being an advisor and coordinator, Dwyer's role is now management and operation. Also, OADMS has been given several jobs formerly dispersed throughout GSA — e.g., supervision of annual FSS negotiations with dp suppliers, and control of excess equipment reutilization.

Hill observers are not especially impressed with the change. "Basically, personnel capability, not organization, has slowed implementation of the Brooks Bill over there," says one source. "GSA now has new spurs, but it remains to be seen whether the horse will gallop."

Federal dp managers apparently find attractive the National Bureau of Standards' service center. Set up in 1964 to demonstrate the feasibility of operating such facilities in-house, the pilot center provides 220 hours of processing time weekly, primarily on a 7094, H-1200, and CDC 3100. And non-NBS government agencies use roughly 65% of the machine time.

Now the center is being upgraded, and establishment of more centers seems likely. The new system will double the present capacity. NBS, which expects to reduce its need for private service centers about 10%, will benefit most.

The RFP specs call for a CPU with 300K characters of main memory expandable to 1 million characters;

(Continued on page 171)
What Are Computer Applications?

These are Applications:

- PROGRAMMING SYSTEMS
- BUSINESS DATA PROCESSING
- REAL-TIME APPLICATIONS
- SCIENTIFIC PROGRAMMING
- FACILITY MANAGEMENT
- MARKET RESEARCH
- SYSTEMS ENGINEERING & SYSTEMS DESIGN
- D.P. SERVICE CENTERS

This is Computer Applications:

- Designers and programmers of COBOL, FORTRAN and special purpose Compilers for major computer manufacturers and the U.S. Government.
- For U.S. Industry and Government we have analyzed, designed and programmed such information processing problems as Sales Analysis, Inventory Systems, Traffic Analysis, Automated Budgets and Complete Management Information Systems.
- Designed and programmed large-scale War Games; programmed evaluation of problems in Engineering, Space Physics, and Nuclear Physics.
- For NASA, manage computer activities at the Goddard Institute for Space Studies and the Automatic D.P. Facilities at Kennedy Space Center.
- Broad range of market research services to industry including SPEEDATA, a company developed system providing product movement information to Grocery Manufacturers.
- Developers of Computerized Reliability and Maintainability Systems for Federal Government and designers and implementers of special hardware/software system needs.
- Operate 5 facilities providing general and specialized D.P. Services to Business, Industry and Government.

These are only some examples of the broad range of application areas that our company has served in the past 6 years. Our approach to these and other problems is based on 3 prime tenets:

- Thorough understanding of the problem.
- Ability to develop & apply new technology in conjunction with existing problem-solving procedures.
- Complete knowledge of hardware and software capability.

COMPUTER APPLICATIONS INCORPORATED is a company which has grown in its six-year history to its current level of approximately $25 million annually in revenue, with a staff in excess of 1800 people. The company operates from sixteen facilities throughout the country in such major cities as Boston, New York, Philadelphia, Washington, San Diego, Los Angeles, and San Francisco.

If you are in any of the professional disciplines involved in application areas, and want to be associated with one of the leading and most rapidly growing organizations in the computer-oriented Professional Services Field, please forward résumé to Manager—Industrial Relations Department 34.

COMPUTER APPLICATIONS INCORPORATED
555 MADISON AVENUE, NEW YORK, NEW YORK
an equal opportunity employer

CIRCLE 346 ON READER CARD
200 million characters of auxiliary storage; 28 remote I/O stations; located at NBS headquarters in Gaithersburg, Md., or in Washington; a less-than-30-minute turnaround time (versus 24 hours at present); capacity to handle 600 debugging runs per 8-hour shift, each containing an average of 500 statements; batch processing mode operation with on-line interrupt capability. Bids are due Nov. 14; an award is planned a month later, and the startup target date is June 25, 1967.

Congressman Jack Brooks believes that patenting computer programs may not be a good idea. He fears application of dp — inside, outside the government — would be hindered if program users had to pay royalties and developers had to go through the red tape of applying for patents. "Deciding whether one program infringed on the patent for another would be particularly sticky," says a spokesman. "Everyone's long-term interest might be better served if the present patent law were clarified to specifically exclude computer programs."

Assistant Secretary of Commerce J. Herbert Holloman has assured the Texas Congressman that action proposed as a result of the current Patent Office study of computer program patents will be reviewed by the Commerce Department's front office. Brooks has similar reservations about the advisability of copyrighting programs.

A federal court last month told AT&T it must obey a 1965 FCC order by "unifying" Telpak A and B rates with private line charges. A major goal of the order is to lower the latter. Instead, AT&T, which does not plan to appeal the ruling, expects a rise in Telpak rates "which may be substantial"...The Baltimore dp center of the Social Security Administration probably will be in the market for a 360/65 or similar-capacity system within the next year. SSA's newly-acquired 7080, obtained from Greyhound Leasing last July, is loaded, officials report, and the workload (primarily processing of Medicare and retirement benefits) is rising fast. A final decision on the new computer awaits completion of a planning study which just began...Hearings may be held this month on Sen. Ted Kennedy's bill (Senate Joint Resolution 187); it authorizes a feasibility study of a computerized information retrieval system, replete with remote I/O stations, which would help local governments prepare applications for federal aid programs, and help federal officials evaluate programs...The Patent Office plans to issue an RFP this month for a computer complex to be installed in fiscal '68 and '69, at a projected cost of $900K. The system will take over work now farmed out to computers in other government agencies and commercial service bureaus...The Census Bureau plans to buy a Stromberg-Carlson tape-to-microfilm converter this fiscal year, and, next fiscal year, a Univac 1108. The computer will replace two 1105's and supplement two 1107's.
Programmers  
Systems Analysts  
Computing Engineers

We have the 360-30 hardware in our plant to replace second generation computer equipment and within a year the 360-50 will be delivered. Several excellent positions are open for experienced programmers, systems analysts and computing engineers in all phases of application and use of this new equipment. BS in math, engineering, or accounting, or equivalent in experience, is desired. Should have experience with COBOL or FORTRAN higher-level computing language.

Please send resume to:  
MR. J. H. PAPIN  
NORTH AMERICAN AVIATION, INC.  
PROFESSIONAL EMPLOYMENT OFFICE,  
BOX DA-834, 4300 EAST FIFTH AVENUE,  
COLUMBUS, OHIO 43216.

All qualified applicants will receive consideration for employment without regard to sex, race, creed, color, or national origin.

North American Aviation  
Columbus Division

GOOD JOBS are open EVERYWHERE  
For  
Computer Programmers  
and  
Systems Analysts

We'll Help You Look With a  
COMPUTERIZED JOB SEARCH

As a member of a nationwide organization of employment agencies known as National Personnel Consultants (NPC), we can compare your qualifications with an established file of available positions (Computerized Applicant Search, Evaluation, and Selection system) (CASES). Jobs are open in all areas of the country. Tell us where you want to relocate (even locally) and we’ll let CASES help do the looking for you, without charge to you. Send us a resume and CASES will help pinpoint your spot.

SYSTEMAT  
1107 Spring Street,  
Silver Spring, Maryland 20910  
587-3650

HOW DO WE DESIGN COMPUTERS AT ASI?

With supreme confidence, competence, authority, speed and know-how.

Only we need many more artful programming hands, especially in the areas of systems, scientific applications and commercial applications.

Although a relatively young company, the ASI Computer Division of EMR, Electro-Mechanical Research, Inc. has already established quite a reputation in the scientific computer field with successfully operating installations throughout the country and overseas.

Our programmers are involved in all applications necessary to maintain our state-of-the-art leadership.

Our future and possibly yours lies ahead looking bigger and brighter all the time.

If you’re in San Francisco between Nov. 6-10th please call Mr. Max E. Curtis at (415) 771-0749. Or you may write or call collect Mr. Peter J. Schroth in Minneapolis, (612) 888-9581.

Tell them you’d like to lend a hand.

ASI COMPUTER DIVISION
programmers & analysts
for new long-term Apollo/Gemini projects
with Lockheed at the Manned Spacecraft Center in Houston

At the NASA Manned Spacecraft Center in Houston, Lockheed finds the answers to challenging problems on Apollo/Gemini space projects through scientific, business, and data reduction programming and analysis. We want your help in career openings with great growth potential in these long-term contracts.

You'll work with large, third-generation computers. You'll have opportunity to assume responsibility and develop tomorrow's technology. You'll be at the center of man's expansion into space.

A magnificent community with fine schools, sailing, golf, and attractive homes has grown up around the Manned Spacecraft Center where you will work. Theaters, museums, fine stores, and all good metropolitan things are a few minutes drive away in the exciting city of Houston.

Investigate this opportunity to move up in your field now. Lockheed has immediate openings in all phases of:

- Systems analysis
- Programming and operations in all areas of computer technology
- Scientific analysis and programming
- Data reduction
- Management data systems
- Business programming
- Computer software and operations.

Phone collect to: Mr. R. K. Glasgow, at (713) HU 8-0080,
or write: Professional Placement Manager

We know something you don't.

We're in daily contact with a select group of companies throughout the U.S.—including universities, research consultants and users—who have retained us to find qualified candidates for them.

Often some of their finest opportunities are not advertised. In addition, many attractive positions exist in smaller companies or in new, fast-growing divisions within large firms. Salaries range from $10,000 to $25,000 annually. Perhaps one of these opportunities is what you've been looking for.


FICC interviews available at the headquarters hotel.

Call collect to (617) 329-1040 or write
Mr. Thomas V. Heffelfinger, President.

heffelfinger associates
Computer Personnel Consultants
886 Washington St., Dedham, Mass.
(Route 1 at Route 128)

CIRCLE 334 ON READER CARD

CAREERS IN COMPUTERS

Dataman* Associates, leading national personnel consultants in the EDP field exclusively, have been retained by client companies to search for outstanding individuals with experience in:

- Scientific Computational Analysis
- Language and Compiler Development
- Digital and Logical Design
- Applied Mathematics
- Computer or Systems Sales
- Command and Control Systems
- Systems Development and Design
- Business Applications Programming
- Real Time Programming

All expenses are assumed by our client companies. Qualified professionals with experience in any of the above areas, please submit complete resume with present salary and acceptable locations.

CONTACT US AT FJCC
Pre-register for employment interviews during the conference by submitting resume now.

DATAMAN* ASSOCIATES PERSONNEL CONSULTANTS
1330 Beacon Street Boston, Massachusetts 02146
(617) 232-2253

*DATA MANAGEMENT... Recruiting Specialists for Electronic Data Processing Personnel Exclusively.
Because making certain that no one's idea goes without a full hearing (or its author without full credit) is one reason we're racking up such a fast growing score in the computer systems business these days. It's the way we do business.

Right now we're tapping the military computer systems market with militarized versions of General Electric's “Compatibles/600.” The potential is enormous. For you and for us.

MISTRAM is one of the contracts we've already salted away. MISTRAM is impressive because of its ability to measure a missile's position to fantastic accuracies and to utilize this information in real time. But it's unique because the computer is so utterly integral that you can't tell where it ends and the other hardware starts without a program.

Currently you'll find abundant (and, in some cases, monumental) challenges to your creativity, both at the proposal and at the advanced development level. In the latter case, nanosecond speeds are the present state-of-the-art. At the systems and hardware end this means everything from advanced circuit developments to memory developments, to man-machine interface developments. (Did we mention our aerospace computer development program?) Related to all this, at the software end of things, we're developing advanced languages as well as advanced real time and time-sharing executive and diagnostic programs.

You'll be working for a company that is 100% committed to the success of your project. You'll be working for a management that has real savvy for your achievements. And, you'll be working in an organization where mutual respect and team motivation, not formal regulation, is the rule.

Like they say, when you have good ideas you don't have to shout.

SOME CURRENT OPENINGS:

COMPANY SYSTEMS AND APPLICATION ENGINEERING

Analyze performance requirements, determine configuration, specify interface and performance requirements for hardware, software, and equation design groups. Develop application techniques for real-time systems. Analyze trade off between hardware and software techniques and organization. Positions available through group leader. Engineering or science degree and experience in computer field covering hardware, software and systems.

More openings are listed to the right

Please write (include resume if available) in full confidence, to Mr. M. D. Chilcote, Special Information Products Department, General Electric Co., Sect. 47K P.O. Box 1122, Syracuse, New York 13201.
DATA SYSTEMS ENGINEERS
Program management and/or system engineering for major real-time control and information management systems using military computers with equipments and programs for data sensing, conversion, transmission, processing and display. Analyze mission performance requirements, determine system elements, configuration, and specifications. Conduct product requirements analyses. Broad data systems experience with emphasis on communications.

PROJECT LEADER, PROGRAMMING SYSTEMS
Provide high technical competence and project leadership to team of computer programmers in the specific areas of executive systems, compiling systems, hardware design support and diagnostics and applications programming. Computer programming and team leader experience. Also, formal education in Numerical Analysis—Machine Language—Computing Systems—Computing Applications.

ENGINEERING COMPUTER PROGRAMMERS
Program in the areas of executive systems, compiling systems, hardware design support and diagnostics and application programming. Computer programming experience. Also, formal education in Numerical Analysis—Machine Language—Computing Systems—Computing Applications.

LOGIC DESIGN ENGINEERS
Advanced design and development of military computer systems equipment, i.e., processors, memories, peripherals, I/O controllers and adapters. Engineering degree with experience in advanced, high-speed logic design of digital equipment.

MICROELECTRONIC CIRCUITS AND PACKAGING DESIGN ENGINEERS
Advanced design and application of high-speed microelectronic circuits for computers and related digital equipments. Engineering or physics degree with experience in design, application and packaging of advanced high-speed microelectronic circuits.

COMPUTER PERIPHERAL EQUIPMENT ENGINEERS
Support product line equipment design, development and production following. Interface equipment design and factory following. Systems test and checkout support. Engineers to design the following peripheral equipment: magnetic tape and mass storage, display and control, digital data acquisition, analog data acquisition, and telemetry. Experience in at least one of the above equipments. Experience or education in logic design, computer hardware and computer software. BSEE or MSEE.

books
The New Utopians, by Robert Boguslaw, Prentice-Hall, 1965

The "new utopians," according to Dr. Robert Boguslaw (a senior social scientist with the System Development Corporation), are today's system engineers, operations researchers, computer programmers—that is, the readers of Datamation. They are the professionals who create large-scale systems, for example, "(to) link the peoples of the world together in communication networks; insure the timely production, transportation, and distribution of bananas, beewax, and bombs; and increasingly use high-speed digital computers in the process."

These great systems are becoming more than just isolated hardware artifacts. They are affecting us as people. Under the name "automation" they are said to be taking people's jobs away, or forcing them to upgrade their skills, or obsoleting them two or three times in a lifetime. This lack of concern for the effects of their systems on people is the blind spot of the new utopians, says Dr. Boguslaw.

In this lack of social concern, the new men are in sharp contrast to the "classical system designers," such as Sir Thomas More, author of Utopia, Plato of The Republic, Francis Bacon of New Atlantis, and many more. These old utopians had a "basic humanitarian bent." They designed their systems around people. Even the most recent utopian, 1984's George Orwell drew his repulsive utopia-in-reverse to warn of what life would be like if non-human values ran wild.

The dominant value orientation of the "utopian renaissance," Dr. Boguslaw writes, can best be described as "efficiency." The emphasis is upon the hardware, computers, and programs. While man as a "human factor" may be given some design consideration, the human being as the underlying reason for all this bother in the first place is considered outside the bounds of the system requirements.

Dr. Boguslaw would bring man back into the center ring. He wants scientists and engineers to become more sensitive to human purposes. He wants their training broadened to include "all significant variables in designing systems—rather than merely those that lend themselves to hardware implementation or formal modeling." He would like to see more funds available for research on these matters. Furthermore, dropping the other shoe, he feels that union leaders and managers, military men, philosophers, and social scientists need to become more at ease with the concepts of computer systems. They should be involved in the human implications at the time of design, not afterward when it may be too late.

This brief summary of the book's thesis hardly does justice to the author's subtlety and insight, nor to the flashes of humor which illuminate his writing. Knowledgeable in both computer technology and the social sciences, Dr. Boguslaw will be found intelligible, I believe, by both system designers and laymen. That is, by discussing utopian schemes of the past in the language of modern system design, he makes these humanitarian concepts more meaningful to the engineer. Similarly, the union man or the philosopher, watching Dr. Boguslaw apply system thinking to social and economic plans, will gain some appreciation of the power of the system approach.

The main body of the book reviews four of these approaches. The first approach, formalist design, employs precise models, such as linear programming. Francis Quesnay's Tableau Economique, produced in 1758, attempted to model the economics of a country. Most of the early utopias, including those of Charles Fourier and Robert Owen, were formal designs.

The second and heuristic approach, which uses principles to provide guides for action, can work even in "completely unanticipated situations," where there could be no formal model. For example, Pierre-Joseph Proudhon, rather than blueprinting a formal utopia, chose to set forth certain principles which would lead to the ideal society. These principles were liberty, equality, fraternity, and justice. H. G. Wells, Baron de Montesquieu, and Jean-Jacques Rousseau were among those working this street.

In the operating-unit approach to system design, on the other hand, it is the components which are planned. To build a utopia, the individual humans (the operating units) are selected or trained to possess the desired characteristics. The society which results, then, is the outgrowth of these characteristics. B. F. Skinner's Walden Two and Orwell's 1984, published in 1948 and 1949, are said by Dr. Boguslaw to be examples of this approach.

So, too, are Isaac Asimov's robot sto-
We're building a computer network that will electrify every businessman in the United States.

There is something in this FORTUNE ad that could change your whole future.

Judge for yourself. The ad announces that SBC is building a tremendously exciting, nationwide computer network of inter-connected data processing centers equipped with more than 125 IBM System/360s. Model 20 to the most powerful and complex configurations. Coast to coast, over 70 SBC offices will tie into this national grid.

Can you imagine what this could mean in terms of programming experience and career possibilities for yourself? In terms of interesting and creative work on real time and network systems?

And when we say “creative” and “interesting” we're not just talking “blue sky.” We mean that the tremendous potential of such a network has barely begun to be tapped. That we shall really need your help in finding ingenious new ways of solving all kinds of modern problems. What's more, you do not have to relocate to the big city to work with big city computer power. With this new network, every SBC office becomes a major computing center.

All this explains why we are looking for a lot of people with programming experience. Much experience, or just a little.

This explains why we are ready to train you while paying a full salary. And why we offer you every opportunity to prosper, learn and progress. And why we'd like you to get in touch with us right now. Address your initial inquiry to The Service Bureau Corporation, 1350 Avenue of the Americas, New York, New York 10019 or call collect (212) Plaza 6-1771.

A subsidiary of IBM An equal opportunity employer.
books

ries, with the robots constituting the operating units.

The last method, the *ad hoc* approach, starts with present reality and moves by small, practical steps to another stage. Dr. Boguslaw regards the mercantilism economic system of the seventeenth and eighteenth centuries and the subsequent laissez-faire system as examples of this approach.

Unfortunately, by limiting his analysis almost entirely to just two areas, the old utopias and the new system design, Dr. Boguslaw fails to develop the great area in between. For example, out of the heuristic thinking of Montesquieu (and scores of others) came the United States Constitution. Its principles set up a game—of elections, branches of government, the rights of the first ten amendments, and politics—within which for almost two hundred years we have adjusted human values to completely unanticipated situations.

Similarly, out of *ad hoc* economic beginnings have developed the heuristic principles of John Maynard Keynes and his followers. Originally applied to the great depression of the 1930's, these principles are now being applied to the opposite—and perhaps unanticipated situation—the long-continuing boom.

Furthermore, we have developed heuristic principles of organization and management, sometimes unknown to physical-system designers, but often used by managers.

The point is that modern system designers do not really work in a physical-science vacuum even though, in their ignorance of political science, economics, and management, they may feel isolated. Actually, it is the function of politicians and lawyers, economists, and business men to apply the heuristic principles of government, economics, and management to our problems, as it is the function of physical scientists and engineers to use the principles of system design.

Of course, the efforts of all these professions still fall short of achieving the ultimate utopia. But progress has been made since the old utopians first spun out their dreams. Undoubtedly, better appreciation of computers and system design by the one side and of politics, economics, and management by the other side, as Dr. Boguslaw urges, will help the social-physical interface in large-scale systems, currently a sticking point hampering further progress.

—WARREN MYERS

Expanding opportunities for Programmers in real time computer applications with 3-8 years experience in software diversification, diagnostics, design automation, compilers, assemblers, or I/O libraries. Your interest is invited. Send resume in confidence or call collect: Martin Dorfman (617) 235-6220.

Honeywell

COMPUTER CONTROL DIVISION

OLD CONNECTICUT PATH, FRAMINGHAM, MASSACHUSETTS

Opportunities exist in other Honeywell Divisions. Send resumes to Fred C. Laing, Honeywell, Minneapolis, Minnesota 55408. An equal opportunity employer, M&F.
PROGRAMMER ANALYSTS...

Management Systems EDP Analysts

Why be satisfied with a dull routine job when there are now exciting opportunities in the Aerospace field with Avco/MSD.

New areas of computer applications at Avco/MSD require a significant expansion of our programming and management systems staffs. If you have experience and interest in one or more of the following areas you will find challenging and rewarding opportunities for personal and professional development in the Avco Computer Center.

- Scientific and Engineering Problems
- Numerical Control of Machine Tools
- Management Information Systems
- Management Control Systems
- Information Retrieval
- Software Systems

You will program for some of the most advanced computers available, such as IBM 360/75 and 7094 11, dealing with sophisticated problems in both Scientific and Management Applications. Programming experience in COBOL and/or FORTRAN IV helpful.

Avco/MSD offers a liberal benefit program and excellent salary commensurate with your educational background and professional experience. The company offers a liberal assistance program to those desiring advanced study.

Send resume to: Mr. P. C. Dowd
Supervisor of Employment, Dept. JSD-18

AVCO CORPORATION
MISSILE SYSTEMS DIVISION
201 LOWELL STREET
WILMINGTON, MASSACHUSETTS 01887

An equal opportunity employer
PROGRAMMED ENNUI?

Here, Programmers are not tied down to the same old project, month after month, after month, after month, after month, after month.

At RCA Service Company, the assignments change before you have time to grow tired of them. Therein lies the challenge and the spice.

Openings now in...

**Scientific Programming**
Developing computer programs for advanced systems. Applying current disciplines and creating new concepts. Should have 2 years experience, including some in real-time programming, communications, or scientific applications on medium to large scale computers.

Locations: Cape Kennedy, Florida and Cherry Hill, N.J.

**Communications Programming**
Per diem assignments, on the new Automatic Data Information Network—one of the largest real-time store and forward data communication systems. Experience with large-scale data switching systems preferred.

**Business Programming**
Developing programs for a wide variety of problems. Opportunity for training on the new RCA Spectra-70 Series. Some positions in this area involve travel. Location: Cherry Hill, N.J.

Send resume to: Mr. J. H. Barnes Jr., Manager of Recruiting, RCA Service Company, Dept. Y-257E, Bldg. 201-2, Cherry Hill, Camden, New Jersey 08101.

An Equal Opportunity Employer M & F

The Most Trusted Name in Electronics

SEE US AT THE FJCC IN SAN FRANCISCO

October 1966
WE WANT TO PUT YOU ON THE SPOT

The right spot - where you can rightfully realize the full potential of your own ability and have your creative efforts rewarded with stimulating and challenging assignments in broad areas of the total system concept.

Burroughs has an 80 year record of accomplishment in the field of computation, with Corporate profits up 20% in 1964 and 71% in 1965. Newly announced systems such as the B-2500, B-3500 and B-6500 are adding significantly to Burroughs' reputation of developing "firsts" in the Information Processing Field.

Professional individuals whose background and interests are in systems, engineering or applications programming will find the right spot at Burroughs. Submit a resume to Mr. F. P. Wilson, Employment Manager, 460 Sierra Madre Villa, Pasadena, Calif.

Burroughs Corporation
PASADENA, CALIFORNIA • An Equal Opportunity Employer

SCIENTIFIC and
SYSTEMS PROGRAMMERS
New Opportunities in Florida

Openings at all levels for real-time, data reduction and software techniques and development, associated with the space programs at the John F. Kennedy Space Center in Florida. You will be engaged in implementing KSC's GE 635 Multi-programmed/multi-processor computers to the task of real-time and post test telemetry reduction, data transmission, real-time display, software techniques, and compiler/assembly development.

Requirements include a degree in math or related field and applicable programming experience with a strong desire to achieve results in your chosen field.

Please forward your resume, in confidence to Mr. H. B. Arnold or Mr. W. Zunz, Federal Electric Corporation, Suite 501, Cape Royal Bldg., Cocoa Beach, Florida.

FEDERAL ELECTRIC CORPORATION
An Equal Opportunity Employer
JPL's Systems Division
Needs Programmers

This Division is responsible for mission analysis design, planning and conducting flight operations in support of Lab projects, and for overall system analysis and design of the Deep Space Network.

This is the "lifeline" of space missions, from mission study to trajectory design and analysis, orbit determination, in-flight control, programming and data processing.

The Systems Division integrates the activities of JPL engineers in various disciplines into a team effort. It's nice work ... and you can get it.

IF...

COMPUTER PROGRAMMING RESEARCH is your long suit, then this is for you:

Be responsible for telemetry data recovery by computer techniques, utilizing data pattern recognition procedures which lead to adaptive programs for telemetry data decommutation and identification, data editing and suppression, and information retrieval. Included is investigation of special application compiler methods for generation of object decommutation and identification programs. Also involves program reliability studies in the areas of program testing, validation methods, rapid recovery or reinitialization in the event of program failure, and program operation in a degraded state.

AND IF...

TRAJECTORY PROGRAMMING is a good deal for you, here's the score:

Be responsible for the development of computer programs for precision trajectory computation and analysis and interplanetary orbit determination. Should be skilled in the development of high precision planetary ephemerides and trajectory-oriented languages. Experience in celestial mechanics desirable.

POSITIONS OPEN FOR BS, MS & PH.D.'S.

Send complete resume in confidence to Mr. Wallace Peterson, Field Recruitment Supervisor, Professional Staffing Dept. 551... or visit

JET PROPULSION LABORATORY
4800 Oak Grove Drive, Pasadena, Calif. 91103

"An equal opportunity employer." Jet Propulsion Laboratory is operated by the California Institute of Technology for the National Aeronautics and Space Administration.

CIRCLE 351 ON READER CARD
We invite you to participate in a significant development in the field of computerized systems management:

the new Douglas MSSD Information Systems Subdivision.

Long a leader in the development of hardware and systems for space exploration and defense-oriented missile programs, the Douglas Missile and Space Systems Division long ago recognized the increasing importance of computers as technical and management tools.

Thus, to extend even further our present-day capabilities in computerized systems management, Douglas has created a new Information Systems Subdivision. This new group will serve as an important adjunct to the large inventory of technical and management tools already serving MSSD General Management, other Subdivisions, and our Program Directorates.

The Subdivision will immediately begin to help develop improved and integrated information management systems, provide effective computer operating systems, and supply expert systems analysis on new operational techniques.

The Subdivision’s specialized services will require skilled and imaginative professionals. We would like to talk to you if you are a senior-level scientist or engineer with interests in the following areas:

- INFORMATION SYSTEM TECHNIQUES
- INFORMATION SYSTEMS SPECIALTIES
- SUPPORT SYSTEMS
- COMPUTER TECHNOLOGY

If you would like to participate in the formation and growth of our new Information Systems Subdivision, please send your resumé to:

H. V. MacDonald, Douglas Missile and Space Systems Division, 5300 Bolsa Ave., Huntington Beach, California

DOUGLAS MISSILE & SPACE SYSTEMS DIVISION
An equal opportunity employer
"I'm glad to give. The Community Chest is a fine idea."

(Mr. Coolidge was one of the first Presidents to endorse the United Way of voluntary support of community health, welfare and recreation services while in office.)

"I'm glad to give. The Community Chest is a fine idea."

"The true hope of progress is in the spiritual field, and these are the helpful actions in the world and the worthwhile things in the community. The Community Chest stands for this spiritual growth. It occupies a position that must constantly be built stronger if we would build the spiritual side of American life...."

"Care of the aged, service to demoralized families, hospitalization of the needy sick, home nursing, settlements, guidance of youth, care of the children without a chance —these and hundreds of other services are in the hands of your local welfare organization...they must not be forgotten...."

"The Community Chest gives us a chance to make sure our help will really count. When we give to the Chest, we can be sure that we are helping our neighbors and our neighborhood in the right way. And when we do that, we are making our country a better place to live in for ourselves and our children."

"We can't possibly know about all our neighbors in need. Somebody must show us the way to help them. This is the purpose of these United Campaigns in over two thousand communities across the land. They provide us with a splendid opportunity to express the traditional neighborly concern of America."

"I hope that you will join in this great national effort, this great national crusade through the United Way, and give. It will make your community a happier place; it will make you a happier person, and in the real sense that your community is your country—it will make our country a finer place in which to live. United, there is little we cannot do...."

"One of our enduring American traditions has been the voluntary contribution of time and money to strengthen our country's many communities. Nowhere else in the world do people give so generously toward this end. Millions of Americans perform both a public service and an act of human compassion by their participation in and generosity to their United Fund or Community Chest. In doing so, they express a common desire to help their community assist the young and old, the sick and distressed."

One gift works many wonders/the United Way

October 1966
SPARTAN BOOKS
Publishers of
AFIPS
Proceedings
Volume 29, 1966
FALL JOINT COMPUTER CONFERENCE ready for you in San Francisco November 8 in the registration area. After you pick up your copy, please come to our exhibit booth #631 and see our many other fine titles in the information sciences.

SPARTAN BOOKS
A Division of Books, Inc.

EDITORIAL OFFICES:
1250 Connecticut Avenue, N.W.
Washington, D. C. 20036

SALES OFFICES:
432 Park Avenue South
New York, N.Y. 10016

COMPUTER SCIENTISTS

The Research Center for PAN AMERICAN PETROLEUM CORPORATION needs scientists who can function in a creative professional atmosphere working on research problems in computing. The work will cover a wide range of tasks of analyses and programming in such things as:

- Applications for petroleum exploration and production
- Special hardware and associated software evaluation and implementation
- Data display
- Mathematical analysis
- Simulation and optimization studies

Advanced degrees are preferred; however experience in the above areas will also be recognized. Fringe benefits are excellent and exceptional working conditions prevail in our research complex which is located in the center of beautiful residential areas of Tulsa, Oklahoma.

For immediate consideration, please send a detailed resume to:

Recruiting Coordinator
PAN AMERICAN PETROLEUM CORPORATION
Post Office Box 591
Tulsa, Oklahoma 74102
An Equal Opportunity Employer

TRW DIVERSIFICATION AND GROWTH MEAN UNLIMITED CAREER OPPORTUNITIES EXIST FOR ENGINEERS DESiring COMPUTER-ORIENTED PROFESSIONAL POSITIONS.

AT TRW SYSTEMS SPECIALISTS IN PROGRAMMING ARE ACTIVELY ADVANCING THE APPLICATION OF COMPUTER TECHNOLOGY TO UNDERWATER DEFENSE SYSTEMS, GEMINI AND APOLLO MISSION PLANNING AND ANALYSIS, ADVANCED BALLISTIC MISSILE STUDIES, ADVANCED SPACE PROBES, MARS STUDIES AND SPACE COMMUNICATIONS SYSTEMS.

PROGRAMMERS GO WITH THE ACTION

SCIENTIFIC PROGRAMMERS—To assist in solution of problems arising in missile and space vehicle engineering and underwater defense systems. Will be responsible for analysis, programming and debugging of computer solutions. Positions require technical degree and experience in programming high speed digital computers.

DATA SYSTEMS ENGINEERS—To perform requirements analysis, system design, comparative evaluations and selection of elements for computer-based systems used in acquisition, recording and processing telemetry and instrumentation data. Software familiarity desirable. Technical degree and experience with on-line computers and system components required.

SYSTEMS PROGRAMMERS—To develop and/or modify control programs, i.e., supervisors, monitors, loaders, etc., for large-scale computing systems. Background in multiprocessors and multiprogramming desirable. Degree and related experience required.

PROGRAMMER ANALYSTS—To design and implement system and user oriented time-sharing programs in such areas as higher level language syntax checking, text editing and specialized compiling. Technical degree and related experience required.

REMOTE DATA SYSTEMS PROGRAMMERS—To develop software for remote operating systems and data management systems to allow time-shared remote information retrieval. Degree and experience in data management studies, information retrieval, time sharing or graphics.

SUBMIT RESUME IN CONFIDENCE TO J. R. ADAMOLI, DEPT. R-10

TRW SYSTEMS
AN OPERATING GROUP OF TRW INC.
ONE SPACE PARK • REDONDO BEACH, CALIF.
TRW is an equal opportunity employer
COMPUTER SPECIALISTS

You recognize this, of course,

but have you ever thought
how computers can be used to
get there and beyond?

Bellcomm, the systems engineering contractor
for the National Aeronautics and Space Adminis-
tration, has openings for imaginative computer
specialists interested in contributing to manned
spaceflight.

We need people who can:

- analyze data processing requirements of advanced missions
- determine functional requirements for the next generation of spaceborne computers
- study optimal computer organization for reliability (hardware and software)
- define computer systems for supporting launch and flight operations of multiple missions
- develop management procedures for controlling computer resources
- define ground network for distribution of data transmitted from space
- evaluate data management systems
- determine impact of new programming tech-
niques for all of the above

If you believe you are such a person, Bellcomm
will welcome your inquiry. Send your résumé to
Mr. N. W. Smusyn, Personnel Director, Bellcomm,
Inc., Room 1413-E, 1100 17th St., N.W., Wash-
ington, D. C. 20036.

Bellcomm is an equal opportunity employer.
WHAT IS YOUR TRUE WORTH?

FREE Data Processing Opportunities Bulletin

Every month, in the privacy of your own home, you can evaluate the nation's finest openings in the data processing field. Cadillac, the nation's largest executive and professional placement service, represents the majority of the nation's top companies. Their best jobs at salaries from $6,000 to $75,000 appear in our monthly Data Processing Opportunities Bulletin.

Our placements show that the average data processing man is worth 10% to 20% more than his present income. The Bulletin helps you evaluate yourself in today's market. Both the Bulletin and our confidential placement service are free. Client companies pay all costs.

For your free Bulletin, without any obligation circle Subscriber Service Card No. 352. Please use home address only.

LON D. BARTON, President
Cadillac Associates, Inc.*
29 E. Madison Bldg. Chicago, Ill. 60602
Financial 6-9400

* "Where More Executives Find Their Positions Than Anywhere Else in the World."

SALESマン

DATA PROCESSING SERVICES

International Engineering Service Organization desires to expand its data processing services. We require a salesman with full knowledge of data processing equipment applications, uses and markets.

Excellent Starting Salary in an exceptional growth situation.

Your inquiry is invited and will be treated in strictest confidence. Send full resume to:

DATAMATION
Dept. E-10-1
35 Mason Street
Greenwich, Connecticut 06830

Our Employees Know Of This Ad
An Equal Opportunity Employer

CIRCLE 350 ON READER CARD
We know that the most advanced systems today are only a beginning. So we’re looking for systems programmers who can take software into the 4th, 5th and 6th generations.

Programmers who won’t be content to work on a single project for years on end.

Programmers who want a say in hardware design.

Adventurous men, with a penchant for the esoteric.

The rewards are greater than you think.

Write to us if you’ve had experience in language processors, operating systems, utility systems or communications systems.

We also have openings in Sales, Field Systems Support, Product Planning and Engineering.

SEE US AT THE FJCC IN SAN FRANCISCO.

Contact Mr. E. B. Schultz, Dept. SW-13, RCA Electronic Data Processing, Bldg. 202-1, Cherry Hill, Camden, New Jersey 08101.

An Equal Opportunity Employer M & F

The Most Trusted Name in Electronics

October 1966
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
computer careers

Should you base your career on just one interview? Make your choice from among several career positions!

EUROPEAN and NATIONWIDE CHOICE

N.Y., N.J., NEW ENGLAND, WASHINGTON, D.C., PHILA., MINNESOTA, TEXAS, HUNTSVILLE, FLORIDA, ARIZONA, CALIFORNIA AND OTHERS

Contact us if you have some experience or interest in any of the following:

☐ Scientific Computation — Data Reduction or Numerical Analysis—Unusual Outer-space/Lunar and Advanced Programs
☐ Software Development — Languages, Compilers, Assemblers, Monitors or Sub-Routines
☐ Real Time Systems — Message, On Line, Process Control
☐ Technical Representatives—Programming and Systems support to Sales
☐ Digital or Logical Design
☐ Management Sciences
☐ Sales and Marketing

Unique opportunities exist in the $9000-25,000 class for Managers & Seniors and Men who can accept management responsibility and professional growth.

MGT. INFO SYSTEMS

and/or

REAL TIME COMMUN

NOW — NOW

Exceptional Jr. Posts available

All expenses are assumed by our client companies.

Write in confidence, including present salary, acceptable locations or call (collect) Mr. Nellissen (Area Code 212) PLaza 9-1720

now available

free computer career salary analysis for 1965

Albert, Nellissen, the leading consultants to management in the Computer field, has recently finished its survey of successful national staffing assignments and wage levels for 1965. This survey analysis is now available without charge or obligation. It covers the following technology areas:

☐ Scientific or Real Time or Message Switching
☐ Systems Programming
☐ Commercial Applications and Data Processing
☐ Circuit, Logic & Hardware Design
☐ Sales/Marketing

Albert, Nellissen, inc.

510 Madison Avenue
New York, N.Y. 10022

Please send me your free 1965 Computer Career Analysis.

Name _______________________
Address _____________________
City __________________ State ________

CIRCLE 356 ON READER CARD
Interested in a high-paying career in New York?

This free booklet is your first step.

Write today for the most comprehensive study ever done on computer career opportunities in New York. For the EDP professional, no city offers more. And no city needs you more: to develop and design the complex systems demanded by America's most challenging business and scientific community. But will you and your family enjoy living in Metropolitan New York? Will the change advance your career? We've prepared this booklet to help you decide.

It contains facts about the types of New York companies and industries using EDP equipment...the machines they use...the opportunities for you in systems development and design...salary ranges...professional courses available.

You'll also find facts on living expenses: housing; transportation; school and religious facilities; opportunities for recreation, culture, entertainment. Even tips about moving.

So send for your free booklet today. No charge. It could be the best move you'll ever make.

DREW Personnel Placement Center
160 Broadway, N.Y.C. 10038
(212) 964-8150

I Yes, send me a free copy of your guide to furthering my career in New York.

Name__________________________
Address________________________
City_____________________________
State______ Zip_____

Field of interest: Cmt. ☐ Sci. & Engrg. ☐

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 resume 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/REALTIME)—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 RESUME TO: R. W. Schroeder, Dir. of Scientific & Professional Employment, Dept. #573-DM, AC Electronics Div., Milwaukee, Wis. 53201. Your resume for one of the above positions will be reviewed immediately, and a reply made within a matter of days.

Drew Personnel Placement Center
160 Broadway, N.Y.C. 10038
(212) 964-8150

AC ELECTRONICS DIVISION OF GENERAL MOTORS

CIRCLE 358 ON READER CARD

194
THE UNIVAC 1108 JOINS OUR GROUP NEXT JANUARY

WHY DON’T YOU JOIN US NOW?

Scientific Computing equipment currently in use includes:
IBM 360/50 - IBM 7094 - UNIVAC 418 - CDC 3300 - IBM 360/30

The UNIVAC 1108 will be incorporated in our system in January, 1967

OPENINGS AT ALL LEVELS for

SCIENTIFIC PROGRAMMERS

Engineering applications on C-130, C-141, and C-5 cargo aircraft, VTOL/STOL development, and the JetStar airplane. Problems to be solved are in the areas of: Structural Analysis, Aerodynamics, Loads, Dynamics & Flutter, Flight Simulation, Statistical Design of Experience, and Numerical Control.

SYSTEMS PROGRAMMERS

Work is in progress on system design and development of:
1. Computer Graphics Project
2. Real-time Data Acquisition and Monitoring Systems
3. Remote Access Computing Facility

BS degree in mathematics or engineering and minimum one year’s experience with one or more large-scale digital computers for entry-level openings. We are also seeking personnel with several years programming experience and/or advanced degree to fill higher-level technical and supervisory positions.

Send complete resume, including current salary, to: Charles E. Storm, Professional Employment Manager, Lockheed-Georgia Company, 834 West Peachtree Street, Atlanta, Georgia 30308, Dept. 10-D.

LOCKHEED-GEORGIA COMPANY

A Division of Lockheed Aircraft Corporation
An equal opportunity employer
MANAGEMENT INFORMATION SYSTEMS SPECIALISTS

The rapid growth of engineering and manufacturing activities at Sanders Associates has placed additional requirements on our EDP facility—more factual information faster! To supply these needs we have installed 3rd generation hardware and are applying new and sophisticated systems to business, manufacturing, engineering, finance and control, and procurement problems. This has created new positions for experienced EDP personnel who are looking for that added challenge and responsibility.

SYSTEMS ANALYSTS
College degree (MBA preferred) with a minimum of 3 years experience designing and directing the installation of complex systems for computers and allied hardware. Prior experience in computer programming (COBOL, FORTRAN), software development or systems operation (tape and disc) is essential.

PROGRAMMER/ANALYSTS
College degree preferred with 2 or more years experience programming medium or large scale computers using tape and disc. Versatility in COBOL and FORTRAN is highly desirable.

Sanders is a major creator/producer of advanced electronic systems and one of the top fifty NASA contractors. Sanders growth record is remarkable—in the last 4 years alone corporate sales have nearly tripled and are expected to nearly double again for fiscal 1967. Our location, in the beautiful hill country of New Hampshire is particularly attractive to the outdoor sportsman, yet the conveniences of suburban Boston are only 30 minutes away.

Interested applicants are invited to send their resumes, in strict confidence, stating salary requirements, to Mr. W. D. Hobden.

sanders associates, inc.
NEW DIRECTIONS IN ELECTRONICS SYSTEMS
Nashua, New Hampshire
An Equal Opportunity Employer
WANTED:

PROGRAMMERS WITH WAY-OUT IDEAS.

IBM's Federal Systems Division needs individuals whose thinking is literally out of this world.

Programmers and analysts capable of spearheading the probe for faster, more efficient, advanced orbiting and ground support systems for space and defense.

Individuals who can solve problems involving trajectory telemetry orbit determination. Develop large-scale centralized computer control facilities. Facilitate re-entry data reduction. And other far-out problems.

If you have a B.S. or advanced degree and a minimum of two years' experience, you may qualify in one of these challenging career areas with IBM:

• Systems Programmer
• Scientific Programmer
• Applications Programmer
• Programmer Analyst

To get your career off the ground, send a resume today to:
Mr. John V. Croker, Dept, 701-X
IBM Corporation
9045 Lincoln Boulevard
Los Angeles, California 90045
An Equal Opportunity Employer

October 1966
They’re fluent in various aspects of total system development—operational sensors, display devices, communications, programming and operations research for example. Without the talent, they’d hem and haw when it comes to getting across their total systems development concepts and functional specifications for computing systems, peripheral equipment and software of the future.

Like everyone else, there’s always one “language” that’s their specialty. Some think most comfortably in systems, integrated software systems, applications, or range systems. Others in compiler and machine language, radar systems, command and control, or library systems.

Where does all their knowledge go? Into a complete range of data processing equipment, scientific and commercial. It keeps track of Gemini and Apollo. It flew by Mars. It’s in the software and hardware systems for aircraft and missile tracking, target discrimination, intercept programming, missile guidance, and computer simulation for design evaluation and into systems for business and industry. Among many other things.

The working atmosphere is just as savvy. Systems programmers work on their own machines (development engineers have their own). Software men can correct hardware design limitations. And since you’re working with the number one real-time leader in the field, the computer technology is more than big time.

If you see the advantage of programming at UNIVAC, send a resume at once to Mr. R. K. Patterson, Employment Manager, Dept. K-12, UNIVAC Division of Sperry Rand Corp., Univac Park, St. Paul, Minnesota 55116. An Equal Opportunity Employer.
Have you ever programmed a computer?

- **YES**
  - Give yourself one point.
  - **NO**
    - Watch for our trainee ad in the future.

Have you ever worked on Operating Systems?

- **NO**
  - COBOL or FORTRAN?
  - **YES**
    - Add 1 point for each.
    - **NO**
      - Time Sharing or Real Time?
      - **YES**
        - Add 1 point for each.
        - **NO**
          - Random Access?
          - **YES**
            - Add 1 point.
            - **NO**
              - State-of-the-Art Activities?
              - **YES**
                - Add 1 point.
                - **NO**
                  - Do you have 6 thru 8 points?
                  - **YES**
                    - Call (617) 891-8400 collect and ask for Mr. Edwin Barr or forward your resume.
                  - **NO**
                    - 1 thru 5 points?
                    - **YES**
                      - Call (332-6960 X - 395 and leave your phone number. The Director of PSD will call you.
                    - **NO**
                      - If you have experience in any area of computer technology, we would be interested in hearing from you. Please forward resume to Mr. Edwin Barr.

**Honeywell**

**Electronic Data Processing**

200 Smith Street

Dept. D-10

Waltham, Massachusetts

Opportunities exist in other Honeywell Divisions. Send resumes to F. E. Laing, Honeywell, Minneapolis, Minnesota 55408

An Equal Opportunity Employer.
Freight to France?

Orly Bird it.

Send it by "Orly Bird," Air France's all-cargo jet service to Paris, hub of the world's largest cargo network and the major break bulk point in continental Europe. From Orly Airport, Air France speeds your shipment to its destination. For all the facts on the ultimate in air cargo, connections, convenience and economy, call your agent, Air France, or clip and mail this coupon today.

AIR FRANCE
The World's Largest Air Cargo Network
P.O. Box 707, New York, N.Y. 10011

Please send your free book: Markets in Progress—France.

Name ____________________________________________
Address ___________________________________________
City ___________________ State ____________ Zip ________

---

advertisers' index

Raytheon Computer ........................................ 5, 132
RCA Electronic Data Processing ......................... 191
RCA Service Company ...................................... 179
Recognition Equipment Incorporated ..................... 1
Remex Electronics, A Unit of Ex-Cell-O Corporation .. 134
Revere—Minicom Division, 3M Company .................... 138
Rixon Electronics, Inc. ..................................... 74
Ro-Mac & Associates ....................................... 161
Robert Saxon Associates, Inc. .............................. 167

S
Sanders Associates, Inc. ..................................... 42, 196
Scientific Data Systems ..................................... 20
Sealed Corporation ........................................... 122
The Service Bureau Corporation, A Subsidiary of IBM .. 176
Siemens America Incorporated ............................. 47
Source EDP ...................................................... 158
Spartan Books, A Division of Books, Inc. ............... 188
Stanford Linear Accelerator Center ....................... 192
Stromberg Carlson ........................................... 40
Sweda International, A Division of Litton Industries .. 167
Systemat ....................................................... 172

T
Tabulating Search & Development Agency ................. 161
Tasker Instruments Corp. .................................... 136
Teletype Corporation ......................................... 12, 13
Thompson Book Company ..................................... 140
3M Company .................................................... 88, 89
Transistor Electronics Corporation ....................... 95
TRW Electronics .............................................. 158
TRW Systems ................................................... 188

U
Ultronics Systems Corp. ..................................... 75
The United Way ................................................ 187
Univac Division of Sperry Rand Corporation ............. 198
University of Illinois ........................................ 178
URS Corporation ............................................. 153
U. S. Magnetic Tape Company, A Subsidiary of Wabash Magnetics, Inc. .. 68

V
Vermont Research Corporation ............................. 55
Virginia Panel Corporation .................................. 81
Vitro Electronics, A Division of Vitro Corporation of America ......................... 98

W
Wanlass Electric Co. .......................................... 87
Wright Line .................................................... 107, 108, 109, 110, 122

CARE U.S.A.
Your help goes where hunger is — Give to CARE, New York 10016
Control Data Team Will Describe Job Openings During FJCC Nov. 8-10

Thirty more programmers are to be hired at Control Data’s Development Division in Arden Hills, a suburb of St. Paul. Arden Hills develops software for 3000 Series computers.

Jobs are available at all levels, according to David M. Noer, Arden Hills Personnel Administrator. There are excellent openings in systems development, in continuing development of existing systems, and in quality assurance programming.

A degree in Math, Physics, Engineering or business is preferred, along with 2-5 years experience in assembly language programming.

A San Francisco interview can be arranged by forwarding a résumé or letter to D. M. Noer, Arden Hills Facility, 4201 North Lexington Ave., St. Paul, Minn. 55112.

For more information on job openings, write J. D. Cassidy, Control Data Corporation, Dept. D1, 8100 34th Ave. South, Minneapolis, Minn. 55440.

St. Paul Facility Has Openings at All Programmer Levels

The Data Centers Division of Control Data has announced the release of ALLEGRO, the fastest linear programming system yet developed. The success of this system is creating exceptionally good jobs for programmer analysts in the Data Centers.

ALLEGRO is capable of solving up to 4000 constraints on the Control Data 3600 computer.

Data Centers are developing computer applications in practically every business field. The eight centers are located in Minneapolis, New York, Washington, D. C., Boston, Houston, Cincinnati, Los Angeles, and Palo Alto, Calif.

For more information on job openings, write J. D. Cassidy, Control Data Corporation, 8100 34th Ave. S., Minneapolis, Minn. 55440.

Palo Alto Needs 10 Systems Programmers For 6000 Series

The Palo Alto facility of Control Data’s Development Division has 10 openings for systems programmers.

Programming systems used with Control Data’s 6000 Series computers, the world’s largest systems, are developed here.

“We are doing advanced state-of-the-art development work in time sharing, real time and remote access systems and other areas,” said a staff member.

At least a BS in Math or Science and 2-5 years of experience is preferred. Experience in compiler development or operating systems development is of special interest.

“We’d like to talk to anyone who’s interested and coming to San Francisco for the FJCC. Drop down and see what we’re doing,” said Dan Moran of the Personnel department.

For more information or to arrange an interview, write or call Dan Moran, Control Data Corporation, 3260 Hillview Ave., Palo Alto, Calif. 94304, phone (415) 321-8920.

If you’re attending the FJCC, you can get all the facts on jobs open at Control Data.

All divisions will be represented Nov. 7-10 for the big meeting in San Francisco. Purpose: to describe openings for professionals in every one of the Corporation’s facilities.

“Regardless of the area or the type of job you’d consider, we’ll be prepared to talk with you in San Francisco. Our people will be armed with as many facts on specific openings as possible,” according to A. L. Tschida, Manager, Corporate Staffing Administration.

To arrange for a confidential interview during FJCC, write Control Data as soon as possible. Address your letter to Charles Hart, Control Data Corporation, Dept. D1, 8100 34th Ave. South, Minneapolis, Minn.

Systems Engineers and Analysts Urgently Needed At Howard Research Div.

Special systems projects require additional staffing immediately at Howard Research Division.

More qualified personnel are specially needed in projects covering the design of a Field Deployed Tactical Computer for the Army.

“Howard Research is growing fast, to keep pace with our backlog of special systems, according to Employment Manager J. C. Kinkead.

“We must fill 75 important junior and senior positions immediately.”

Systems engineers and analysts can get full information by sending a résumé to J. C. Kinkead, Employment Manager, 7735 Old Georgetown Road, Bethesda, Md. 20014.

What’s so funny?
The burly fullback was called into the dean’s office, and the coach went with him.

“I’ll give you one last chance,” said the dean. “How much is six plus seven?”

The grid star thought hard, then answered “Twelve.”

“Now don’t be too hard on him, Dean,” put in the coach, “he only missed it by two.”
The Forum is offered for readers who want to express their opinion on any aspect of information processing. Your contributions are invited.

**PROGRAMMERS:**

**THE INDUSTRY'S COSA NOSTRA**

Home again is the author of Grosch's Law. A computer pioneer, noted industry gadfly and bearded prophet with honor, Dr. H. R. J. Grosch was an early and frequent contributor to Datamation until he departed for Europe, where he spent several years consulting. He returned to this country about a year ago, and has since been spending most of his time thinking positively about Deacon, an online, natural-language, data base system. Last June the real Herb Grosch stood up at an ACM-sponsored conference in Stony Brook and took the industry to task (see July '66, p. 81). We are pleased to print here some extensions to his talk . . . and to welcome the industry's original polemicist back to the pages of Datamation.

I guess I really am thinking positively a good deal of the time these days. My new farm is fun, and I run it as I did the old 701 plantation back in the '50's—clear out brush all day and spread lots of fertilizer! But every once in a while the pretty Deacon vistas blur, and I hear the old familiar drumming. Dr. Jekyll would recognize the symptoms.

At Stony Brook, I tried in just a few minutes to get at the heart of our troubles: the almost unbelievable reluctance of Cosa Nostra to accept the realities of management. That reluctance makes terms like "professor" or "discipline" ridiculous: at most we might claim to be a trade; more likely, a huge confidence game. There's this scene with three walnut shells called Dartmouth, MAC and Bell and a little rubber pea labelled T/S—and you have ever noticed the similarities between The Magic Language Con and The Spanish Prisoner Con?

We are at once the most unmanageable and the most poorly managed specialization in our society. Actors and artists pale by comparison. Only pure mathematicians are as cantankerous, and it's a calamity that so many of them get recruited by simplistic personnel men. The turbine designers and astronomers and nuclear physicists and aircraft engineers who were the pioneer users were accustomed to reality, and struggled with it face to face. Their bosses measured them by the problems solved, not by the elegance or eruditeness of the techniques. But today's problem solvers are submerged in a wash of software artists: dialect bootleggers, SHARE committee-men, operating systems cosmetologists. And the horrible sight of three thousand gooney birds swarming over IBM's 360 programs shows how little management learns: remember the thousands of sage grouse at SDC? Or, closer home, remember the SCAT/SOS fiasco when the 709 slithered on stage in 1958?

One especially sad drama revolves around remarkably successful attempts to disguise the costs of computation. In the old closed shop, programming and machine charges were right out in the open. Then the bad managers got sore at all the fun the good managers were having, so they invented the open shop. The programming costs increased, of course, because amateurs were involved—but nobody could prove it! The engineering and accounting budgets absorbed the inefficiencies of third-rate FORTRAN coding and running, and the computing center budget shimmered like a mackerel in the moonlight. By Gresham's Law, closed shops were driven out.

But machine costs were still revealing, and embarrassing. So consoles were installed all around town, and RATS took over (remote access time-sharing, that is). Worthwhile work is to be relegated to a not-yet-functioning limbo called "background," and pipsqueak computing is to dominate. The real cost of A times B is perhaps three times what a non-conversational open shop or five times what a well-managed closed shop using the same quality central processor would have charged, but the poor novice customer is happy. The systems programmers are all committee away redefining MULTICS, usually at expensive resorts hotels on the other side of the continent. And their managers, deluded by growing empires and elaborate mechanized PERT reporting, take pride in the struggle—but keep a few resumes out just in case.

I used to end with a peroration: straighten up, fly right, use your hydraulic toothpick after meals. No more; it's a topsy-turvy world, where IBM profits increase not only along with but because of its 360 troubles, UNIVAC moves its international operations inland, and CDC plays foosie with MIT and ignores Illinois. Nowadays all I have to say is, it would be even more fun if our racket were both more manageable and better managed.

I'd like to see SHARE and GUIDE disband, except for 360 pressure groups. I'd like to see BEMA fight back openly at the BOB and GSA bullies. I'd like to see AFIPS be the outfit to tell Congress why we're where we are, and where we could go, instead of John Diebold. Above all, I'd like programmers to go back to work; quit trying to remodel the hardware, quit trying to persuade human beings to speak algebraic Volapük, quit trying to put a console in every kitchen. I'd like 'em to accept reality, not rebel against it. And I'd like to see their managers refuse to embark on grandiose or unworthy schemes, and refuse to let their recalcitrant charges waste skill, time and money on the fashionable idiocies of our racket.

Yep, I'd like all that—but I don't expect to see it! Meanwhile, I enjoy the scene, one of the rippest microcosms of LBJ America.

H. R. J. Grosch
Manager, DEACON Project
General Electric Company
Surprising? Not at all. Tape collects microscopic ferrous oxide and polyester dust during the slitting process. This damaging contamination cannot be seen. But your equipment will show it's there—in read-write signal loss, error skips, equipment cleaning downtime, and accelerated tape and head wear. Scraping or wiping off not only neglects the edges of the tape but can harm the surface. That's why MAC—and only MAC—goes one step beyond. We give our tape a bath—face, back and edges. We bathe it because water's the only way to completely rid tape of contamination without damaging it. Our unique process sends every "bit" of tape through specially built washers, gently and thoroughly flooding away all loose contamination in a jet stream of warm water. This extra treatment takes a little longer and costs us a little more. But cleanliness is just one of the reasons why MAC is your best value in tape. That's why we make "every day Saturday night at 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