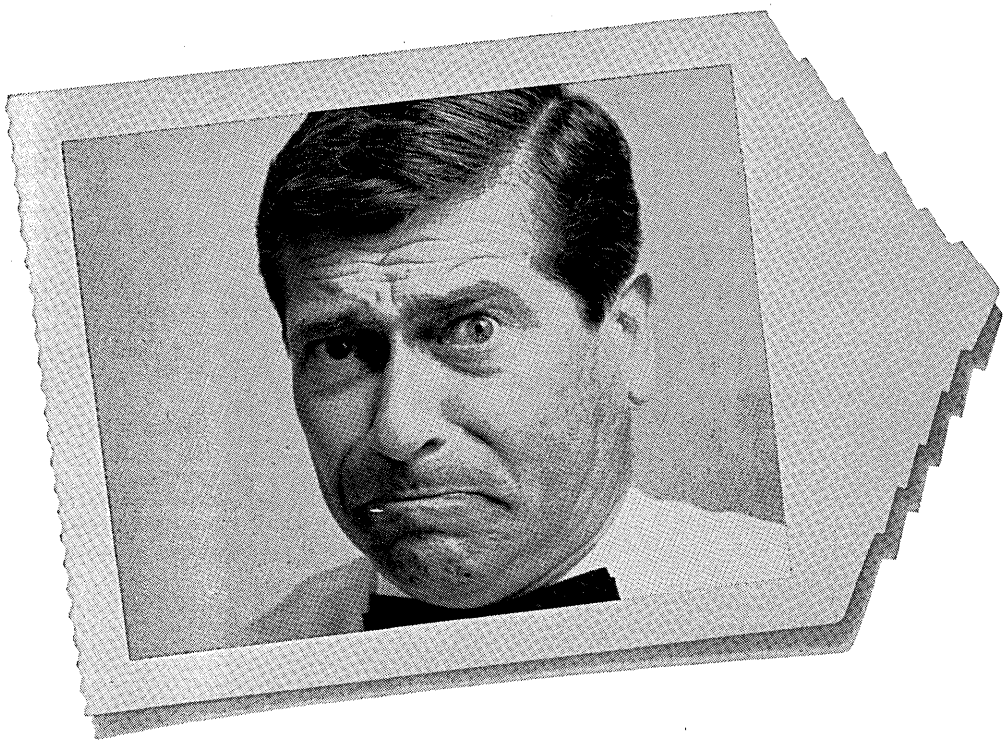
DATAMATION 65®

May

IFIP CONGRESS 65 interdata CONGRÉS IFIP 65

The following
is an unretouched
photograph of a systems
designer who had just
found out that he could
have gotten
Ampex core stacks—
Lithium*,
Aztec pads,
encapsulation,
environmental aging,
the works—
for the same price
he paid for
ordinary cores:

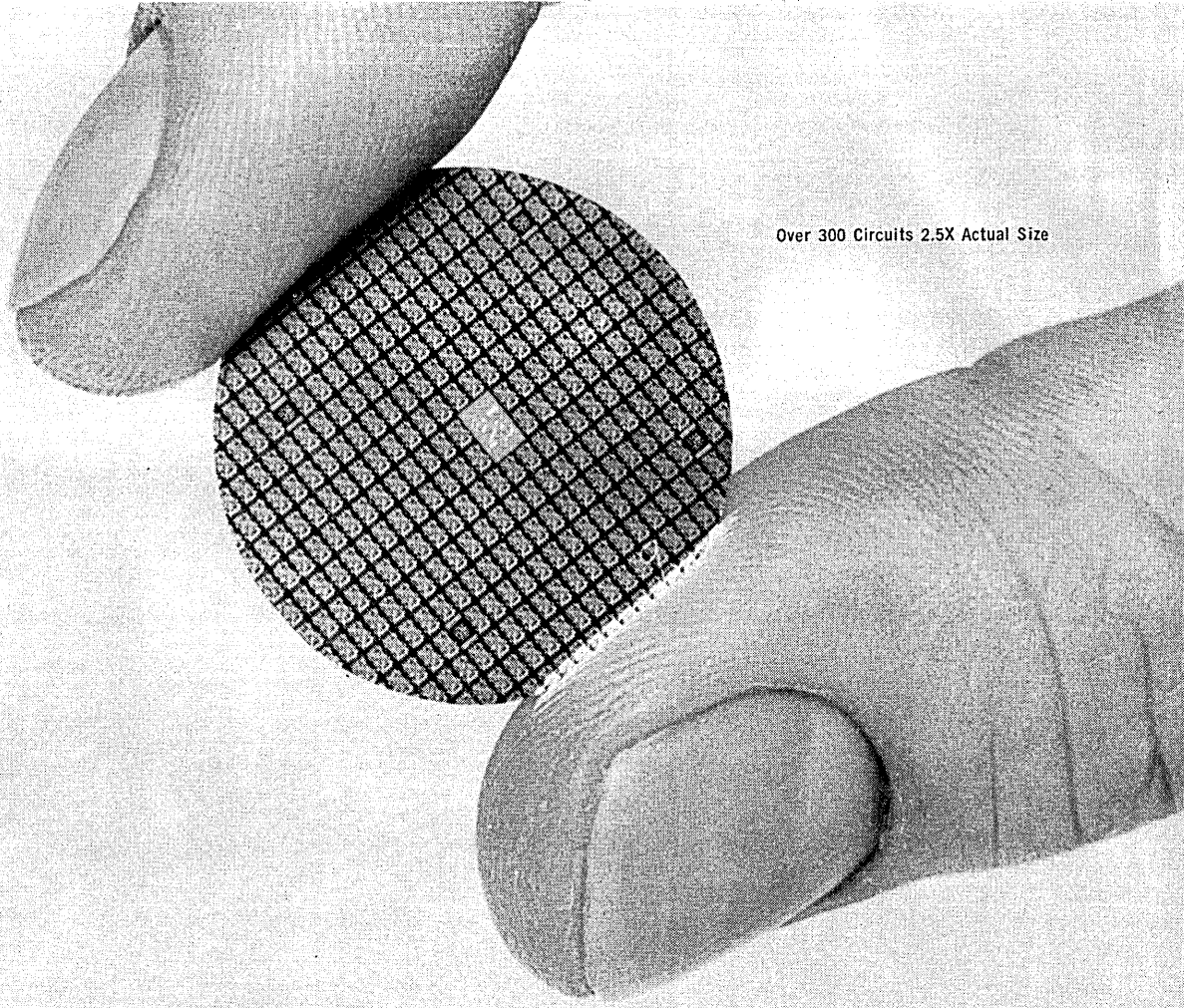


You can't really blame him. For the same money he could have gotten: 1.) Lithium core stacks—stacks with a temperature range of 75°C. (Without current compensation.); 2.) stacks with Aztec array pads—the pads that increase soldering area 100%, reliability by a handsome margin; 3.) all the extra benefits of the encapsulation, environmental aging and precision wiring that help give Ampex core stacks the lowest current requirements and shortest drive times of anything else going; 4.) the backup services of our factory-trained sales-engineers. All this for the same price he paid for ordinary stacks. Moral? Next time, remember: Ampex core stacks and ordinary core stacks really only have one thing in common: the price. To arrange for a first-hand look at specs, components, etc., write Ampex Corporation, Redwood City, California.

AMPEX

*AMPEX PATENTED FORMULATIONS

CIRCLE 1 ON READER CARD



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CIRCLE 4 ON READER CARD

There are a number of ways to solve every computer systems problem...Here are three new ways from ASI

Advanced Scientific Instruments presents three new performance-rated digital computer systems totally covering the scientific computer market in the $2,150 to $12,500 per month range. These high performance systems in ASI's *ADVANCE* Series are completely upward program compatible and entirely modular in concept thereby allowing upgrading of each of the machines to a higher classification when your requirements demand still greater performance.

Select the system that exactly fits your requirements—then contact ASI!

6050

The *ADVANCE* 6050 has been designed primarily for the general purpose market. It offers capabilities such as; double precision floating point hardware (38 bits mantissa, 9 bits exponent)—floating point multiply 17.1 microseconds—floating point divide 28.5 microseconds.
Typical fixed point times include multiply 7.6 microseconds—divide 9.5 microseconds. Direct input/output access to the accumulator register and to memory is also featured.

6070

Designed for use in the fast growing systems market, the 6070 provides a high performance unit with floating point hardware plus multi-processing capabilities. Simultaneous computation is available through an Accelerated-Processing Unit used with the standard processor unit.
Sample operating times are; floating point add 9.5 microseconds—floating point subtract 9.5 microseconds—Sine 42 microseconds—Square Root 48 microseconds—Arctan 70 microseconds. Capabilities of the 6070 may be expanded by the addition of multi-processing units.

6080

Fulfilling the requirements of the high performance general purpose user, the *ADVANCE* 6080 offers such features as; memory protect and hardware relocation. These features allow time-shared operations, multi-programming capabilities, and the use of remote stations.

In addition to all the above features, these systems also have the general features of all *ADVANCE* Series computers. They are completely upward program compatible and include a highly flexible high speed instruction repertoire, word size is 24 bits plus parity, memory cycle time is 1.9 microseconds, up to 32,000 words of memory are directly addressable. Three hardware index registers and indirect addressing further expand the large machine capabilities of all these *ADVANCE* Series systems. The latest advancements in microelectronic circuitry have been incorporated in the higher performance members of the *ADVANCE* Series. The 6050, 6070 and 6080 now extend the capabilities of the *ADVANCE* Series equipments already introduced, that is, the *ADVANCE* 6020 and *ADVANCE* 6040 systems.

Contact ASI to see how each of these systems can fit your particular computer system requirements. We stand ready to compare these systems point for point, dollar for dollar with *any* machines in the same market. Write to Advanced Scientific Instruments, 8001 Bloomington Freeway, Minneapolis, Minnesota 55420.

ASI

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DIVISION OF ELECTRO-MECHANICAL RESEARCH, INC.

8001 Bloomington Freeway, Minneapolis, Minnesota 55420

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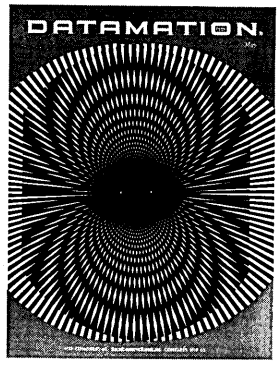

may
1965

volume 11 number 5

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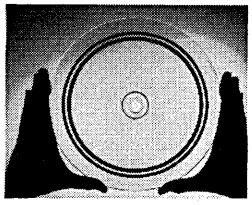

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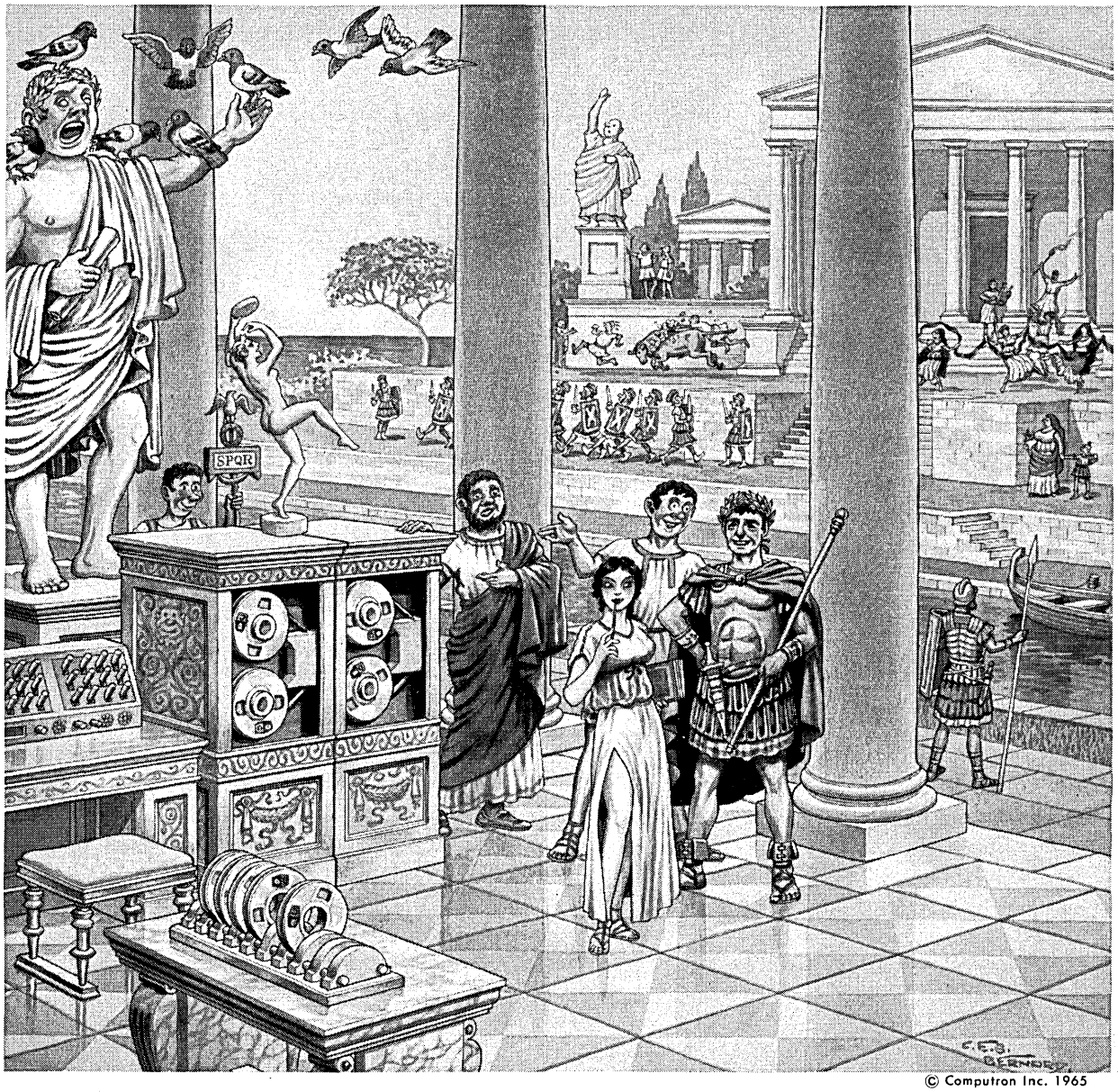
People with tapes only get in the way of Itek's new data processing system — the Memory Centered Processor. It offers 100 times more mass random storage capacity than ordinary memory systems. Unique photo-discs store so much data that your entire storehouse of magnetic tapes can be placed ON-LINE in one MCP Digital Library Unit. Each disc holds information equivalent to two reels of tape (25 million characters), and once in reading position offers 15 millisecond average random access. The serial readout rate is four million bits per second. The MCP System delivers any record in a trillion-bit file in 2.5 seconds maximum, and any queued ("look-ahead") record in 250 milliseconds. You will soon be able to see units of the MCP System store, search, compare, translate, extract, and edit information at Itek's New York Information Processing Center. To visit the Center or to obtain information about our lease/purchase plan for auxiliary mass memories or the MCP System, write

Itek

Itek Corp., Digital Data Systems Division, 10 Maguire Road, Lexington, Massachusetts 02173, Tel. 617-862-6200

CIRCLE 7 ON READER CARD

AN OFF-BIT HISTORY OF MAGNETIC TAPE...#6 of a series by Computape*



Pompey the Great, who considered himself a great innovator in the art of warfare, often boasted that he had introduced the use of pigeons as airborne messengers.

(Actually, he had borrowed the idea from a cashiered Chinese general named Ho Ming — which explains why they are known by that name and not as Pompey Pigeons.)

"You can have your new-fangled computers," he would scoff at Caesar. "Pigeons are the last word in modern communications!"

"Want to bet?" Caesar asked him one day.

"Name the stakes!" said Pompey.

Answered Caesar: "How about the Roman Empire?"

"You're on!" Pompey shouted.

And so the great struggle between the two took place, with Rome itself as the prize.

If you remember your Gibbon, you know what happened. Caesar's legions and his data processing equipment triumphed, and Pompey's boast came home to roost. After the crushing victory of the pro-processing forces over the pro-pigeon wing, Caesar dramatically celebrated his triumph by installing his computers directly at the base of Pompey's statue — as if to demonstrate to all the world which of the two had been right, and which had been for the birds.

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

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

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

*Reg. T.M. Computron Inc

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

CIRCLE 8 ON READER CARD

DATAMATION 65®

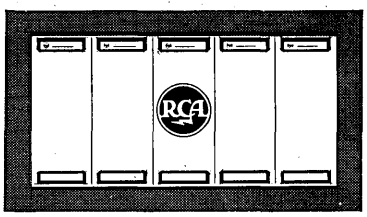
may
1965

volume 11 number 5

automatic
information
processing
for business
industry & science

This view through a multi-image lens only suggests the scores of companies who have already bought the RCA Spectra 70. A few of their fields: banking, chemicals, insurance, soap, airlines, publications, rubber, electronics, utilities, food, accounting, investments.

The multiplying customers for the RCA Spectra 70 computer series say "success."



Seen from any view, they're blue-chip customers. One of America's largest banks, for example. A leading soap company. A key rubber company. Companies that cover the broad range of American industry.

Scores of them have come into the RCA Spectra 70 circle in the three short months since this remarkable computer series was announced.

A blue-ribbon panel of computer judges they are, too. Companies that know computers. That, by and large, use systems from more than one manufacturer and can *compare* computers. That demand the 1970 kind of performance the RCA Spectra 70 offers now.

Consider some of the reasons why these companies are finding in favor of the RCA Spectra 70.

Consider that the RCA Spectra 70 is the first true third-generation computer series. The two larger computers in the series have up to 8,000 tiny *monolithic integrated circuits* that raise computing speed, lower cost, assure you greater reliability.

...Or that the RCA Spectra 70 talks to other computers without costly reprogramming. Protects your program investment. Extends computer flexibility.

...Or that, dollar for dollar, the RCA Spectra 70 gives you superior computer performance.

...Or that the RCA Spectra 70 has the hardware, the software, the languages, the communications—the *total* capability—to meet your needs now and as you grow. To let you build a total management information system at the lowest possible cost.

...Or that the RCA Spectra 70 is an *RCA* computer series with RCA space-age skills to build on—and RCA service to back you up.

Consider, finally, that so many other companies have *already* considered—and bought. Are, in fact, beating our own best estimates of sales.

What else says "success" so clearly?

All *we* can say is what we've said all along: *the RCA Spectra 70 gives you the best management control for your computer dollar—without costly reprogramming.*

Let your RCA Spectra 70 representative show you how profitably this years-ahead system can work for you. Or write RCA Electronic Data Processing, Camden 8, N.J.

RCA The Most Trusted Name in Electronics

Tmk(s)®

NEW RCA SPECTRA 70

CIRCLE 9 ON READER CARD

DATAMATION calendar

● ACM Reprogramming Conference to be held June 1-3, Nassau Inn, Princeton, N.J. is limited to 225, advanced registration is required, early registration advised.

● Meeting on "Advances in Biomedical Computer Applications" will be held at the Waldorf-Astoria, New York, June 3-5. Meeting is sponsored by Biological Information Processing Organization and New York Academy of Sciences.

● Course dates for Simulation Modeling and Programming by means of the SIMSCRIPT Simulation Programming Language are being offered by The California Analysis Center, Inc., Los Angeles, June 7-11, August 23-27 and December 6-10.

● Purdue U., Lafayette, Ind., will conduct a course, Computer Models and Simulation Techniques for Power System Engineering, June 7-18.

● "International Seminar on ADP for Top Management in Public Administration" will be held June 8-16 in Amsterdam, Holland. Organized by the International Computation Centre Rome and the Netherlands Automatic Information Processing Research Centre Amsterdam, seminar registration fee is $100.

● Southeastern regional conference of ACM will be held June 10-12, Palm Beach Towers, Palm Beach, Fla.

● Seminar of military computer educators and computer center directors will be held at the U.S. Military Academy, West Point, N.Y., June 14-17.

● Course on "Hybrid Computation" will be held June 14-25, University of California Extension, Los Angeles, Dept. K. Fee: $250.

● Moore School of Electrical Engineering, U. of Penna., is offering

courses in "Advanced Digital Computer Programming" and "Automatic Checkout Techniques" June 14-25. Registration two weeks in advance. Fee: $250; $125 for staff members of colleges and universities.

● MIT, Cambridge, Mass. will sponsor a two-week sumer course on Concepts of Management Planning and Control Systems: Theory and Technology, June 15-25.

● The 1620 Users Group will hold meetings June 17-18, Portland-Hilton, Portland, Ore. and October 5-8, Americana Hotel, New York City.

● Conference of the Computer Personnel Research Group will be held June 17-18, Washington U., St. Louis, Mo. Conference will focus on selection, training, and appraisal of computer programmers.

● Third Congress of the International Federation of Automatic Control will be held in London, England, June 20-25.

● Information Sciences Institute, U. of Maryland, College Park, is offering two tutorial programs. Seminar I: "Image Processing," June 21-25; Seminar II: "Pattern Recognition—Models, Learning, Decision Theory," June 28-July 1. Fee: $250.

● A short course, "The Use of the Computer as a Tool," is being offered by UCLA, June 21-July 2. Fee: $250.

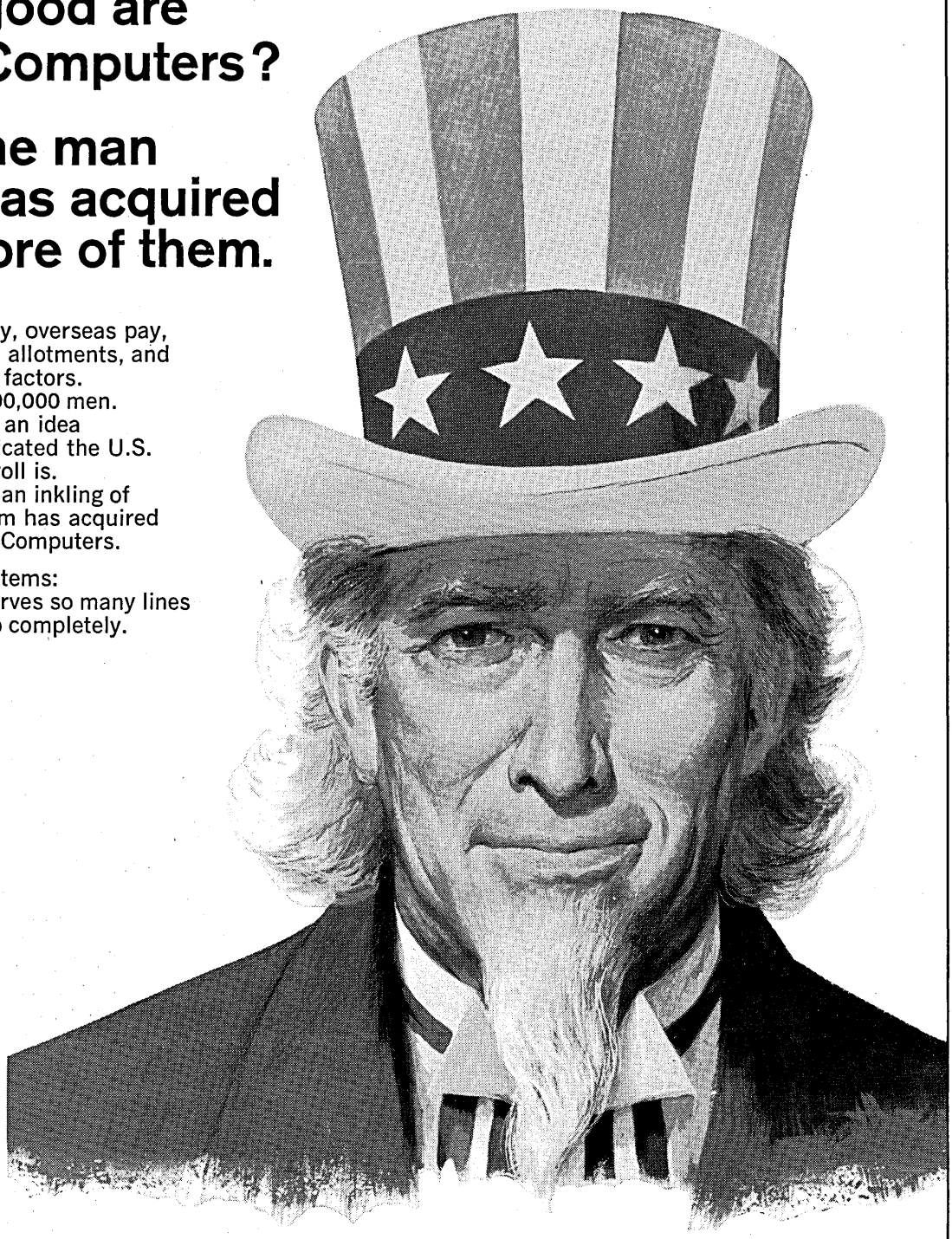
● Joint Automatic Control Conference will be held at Rennselaer Polytechnic Institute, Troy, N.Y., June 22-25.

● Second Annual SHARE Design Automation Committee Workshop will be held, June 22-25, Chalfonte Haddon Hall, Atlantic City, N.J.

● DPMA's 1965 International data processing conference and business exposition will be held June 29-July 2 at Convention Hall, Philadelphia, Pa.

How good are NCR Computers?

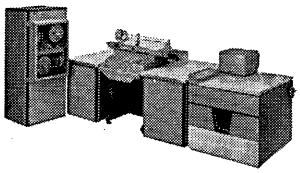
Ask the man who has acquired 174 more of them.



Take flight pay, overseas pay, time-in-grade, allotments, and some 50 other factors. Multiply by 800,000 men. You now have an idea of how complicated the U.S. Air Force payroll is. You also have an inkling of why Uncle Sam has acquired 174 NCR 390 Computers.

NCR Total Systems: no one else serves so many lines of business so completely.

NCR



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

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CIRCLE 12 ON READER CARD

Here's the only advice you need to design your own on-line system: don't

Designing on-line systems is tricky. Nevertheless, do-it-yourselfers often try it, taking twice the time to do it wrong at triple the cost of doing it right. Nobody has that sort of money. Or time. That's why you need an expert to put your system on line. Which expert? We have some advice on that subject, too.

by Richard H. Hill

Would you pilot a commercial jet from Los Angeles to Bangkok? Would you take your wristwatch apart and repair it? If the answer is "Yes" and you aren't a pilot or a watchmaker, read on at your own risk. We're about to shoot do-it-yourselfers right out of the on-line systems design business.

SAYS WHO?

First off, our credentials: At Informatics Inc., we think we have every right to speak on the subject of on-line computer systems. Our justification is simple: we've probably done more work in on-line software than any other group in the field. Fact is, we seem to be the only major programming firm anywhere *specializing* in on-line computer systems implementation. And much of our work has been conducted at the furthest extension of the art (National Military Command System, the RADC on-line computing system and the Mobile Wing Reconnaissance Technical Squadron are a few examples). Do we know what we're talking about? We'd better.

THE MISSING LINK: SOFTWARE

At Informatics, we believe that the computing system exists for the user, not *vice versa*. Consequently we are convinced that the directions of the future point inevitably to direct, on-line user/computer communication. But, if you accept this fact, you also have to accept the problems of putting the user and the computer in direct dialog. How do you do this? It's not easy. Nevertheless, a lot of well-meaning users have tried. And a lot of amoebic monsters have been spawned—so divided and subdivided that any semblance of direct access to the system is lost. That's why the job has to be done by an expert—someone who's had the course in the complexities of on-line programming. Right now, today, all of the equipment and technology exists to put even the most sophisticated system on line. The only missing ingredient is on-line software.

THE WAITING GAME

The essential key to on-line implementation is *time-sharing*. Modern computers—and even those not so modern—are too fast to serve only one person. To make economic sense, the computer must be shared. Segments of the total computing time must be made available to many users. And not all of the users need be humans: regularly scheduled programs can also have their share in on-line systems. For instance, a computer in a medium-sized manufacturing company might service ten or twelve on-line engineering design consoles, concurrently record sales orders and other messages received by teletype from other company offices, and also compute payroll—all on a time-sharing basis. Difficult? Yes. Impossible? No. It can be done by someone who knows how. And knowing how means mastery of a few knowledge areas: Dynamic storage allocation. Interrupt management. Task queuing. Priority level control. Program rollout and rollback. Random access storage management. Time-slicing. Memory protection. And several other odds and ends of programming technology. Knowing how also means experience. Real, practical, working experience. The I've-done-it-before-and-I-know-exactly-how-to-put-the-whole-thing-together-and-make-it-work-type experience. And, on top of this, knowing how means knowing what *not* to do in on-line implementation. Knowing what not to do is every bit as important as knowing what to do if the system is to work, work right and work under all conditions.

WE'RE READY, ARE YOU?

If you've read this far, chances are you need an on-line system. And at this point you should realize that we think we can design one for you. If you'd like to talk over your own on-line systems design requirements or if you think you're qualified to help us solve other people's problems, our number is (213) 783-7500. Ask for me, Frank Wagner, Walter Bauer or any other members of our staff. We also have literature on our people and capabilities which we will be happy to send you. Address Department E, Informatics Inc., 15300 Ventura Boulevard, Sherman Oaks, California 91403.

letters

manufacturers & software

Sir:

Although I am usually in sympathy with your editorial policies (± a grimace or two), this time I must protest! Your editorial of March, 1965, strongly suggests that the manufacturers be handed the language development business "without the confusing influence of users who want every software system to include their pet esoteric options which tend to reduce compiler speed and efficiency." I must remind you of some historical facts.

(1) If a group consisting largely of users hadn't come up with ALGOL in the face of a practically standard FORTRAN, there would be very little that is new in NPL.

(2) Some of us users were involved in showing the manufacturers that it is possible to have both a decent language (not pet options) *and* compiler speed.

(3) If users hadn't objected *violently* to early versions of NPL, you would have found procedure-oriented languages set back some years. (You have only to compare the final version of NPL with versions 1 and 2 to see what I mean).

(4) The success of SHARE has been and will continue to be due in large part to the common cause of the members. If IBM had been so wise as to do all things as well as your recommendations require, SHARE should have withered away long ago.

Your suggestion of a national institute has been made many times, and it has merit. But if it is staffed only with manufacturers' experts, it could stifle progress for years.

As an example of the kind of thinking we find these days, I note that ASA is now following the progress of NPL. How in the world could anyone seriously consider NPL as a standard now when not a single program has gone through a computer? There may be many pitfalls in the language which will be discarded—not because they wouldn't be useful, but because of implementation problems. (There were several in ALGOL 58). NPL wasn't even announced until it had gone through six versions. It must surely be expected to go through at least another six before it settles down and is accepted as useful and productive. What harm is there in watching it as a potential standard, I will be asked. Has anyone ever tried to make changes in something which is "almost a standard"? And there will be those who are pleased if no changes can be made. But let us be forever grateful that FORTRAN I is *not* a standard now.

BERNARD A. GALLER
University of Michigan
Ann Arbor, Michigan

Perhaps manufacturers could have the first whack at language development, allow *intelligent* users to suggest modifications. But in our view one coordinated, full-time group should make the final decisions.

dp in australia

Sir:

The March issue, containing a series of articles on computing in Australia, is being read with considerable interest in this part of the world. However, reading Mr. Forest's random impressions (p. 49), I can only conclude that during his visit he was confined to the university and government areas of data processing and did not have the opportunity of talking to people in commerce and industry.

Not all the bright and brave EDP pioneers are in the universities and government departments. There are some very challenging commercial applications either working or in an advanced stage of development. To cite only one example, in my own company we are planning a three-computer complex for worldwide message switching, passenger reservations and commercial/industrial needs.

E. S. BURLEY
Sydney, Australia

atlas software

Sir:

As a fair dinkum Aussie (grandfather a convict, grandmother an Aborigine), I must congratulate you on your March issue. However, your news bulletin on Atlas software (p. 71) is just plain crazy. As writer of the Atlas scheduling routines, I can say their whole basis is one of simplicity. A one-instruction modification can alter the look of the whole system.

At $1 million, this must surely be the most valuable instruction ever written.

Atlas is one of the few computers designed by a team including both programmers and engineers. It contains many hardware features specifically designed for efficient implementation of a sophisticated operating system. Following the tradition of Turin and Williams, the Manchester team pioneered many new features—one-level store concept, pre-addressed fixed blocks on magnetic tape, read-only store, sophisticated interrupt system and extracodes.

Since 1962, when the Manchester University Atlas was officially opened, well over 150,000 jobs, long and short, have gone through the system. The average is now around 500 jobs per day. Having looked at programming systems in Europe, Scandinavia, Russia, Australia and the U.S., I have yet to see one which approaches the elegance, power and flexibility of the Atlas system.

Clearly, your English correspondent is drinking in the wrong pub. I suggest he try the beer up north.

P. D. JONES
St. Paul, Minnesota

mag tape standard

Sir:

You state that omnibus mag tape standard is being published over the strenuous objections of IBM (March, p. 19). You further state that no current computer, or the IBM 360, can write the ASCII code without a black box. It may be that IBM is raising a howl because for the first time they must conform to an omnibus mag tape standard that they have not generated or cannot change at a whim.

While I was a member of X3.2.1 and X3.2 several changes were made to the standards to allow IBM 360 to write the standard code. The 360 and a number of present-day computers will write the code without a "black box." It is true that program conversion may be needed between ASCII code and the machine code.

An 800-bpi, ASCII tape standard is being prepared which includes IBM's CRC!

J. E. TAUNT
Phoenix, Arizona

IBM
HONEYWELL
RCA
UNIVAC
SDS
CDC
GE

Which of the companies above...

1. Has shipped the greatest number of real time scientific/engineering computer controlled systems direct to using customers?

2. Has been specified into the greatest number of digital real time scientific/engineering systems by major control systems manufacturers?

3. Has the greatest total number of digital computers now operating in real time scientific/engineering systems?

4. Has the widest experience in designing digital systems for use in hybrid analog/digital applications?

The answer to all questions, 1 through 4: SDS. Until recently we only had a thin lead. That was before our acquisition of Consolidated Systems Corporation from Allis Chalmers and Bell and Howell. Now the full line of SDS digital equipment (including the computers that made real time really real) plus CSC's ten years'-worth of computer systems experience come in a single package. Does that put SDS way out front in real time systems? Just look at the record. It's all there. In black and white. And no challengers.

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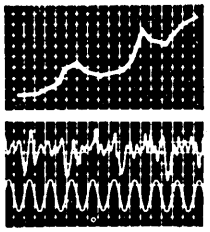
SEE US AT INTERDATA '65, NEW YORK HILTON, BOOTHS, 86-91

CIRCLE 16 ON READER CARD



BUSINESS & SCIENCE

FIRST T-S SERVICE BUREAU
OFF AND RUNNING

The first attempt to make time-sharing pay gets underway this month at Keydata, a Chas. Adams subsidiary in Cambridge, Mass. Built around a big PDP-6 (48K core, 6.3-megacharacter drum, 33-million-character discs), the system is being offered initially to commercial users in New England. Engineering users will be added by July.

Customers pay for a Keydata station (Teletype plus auxiliary printer) plus $50; other charges are based on amount of disc storage reserved, and per-transaction charges (e.g., 7½¢ per invoice and 2½¢ per line on an invoice). Typical charges are expected to be from $1K-1500/month, with 20% of that for the remote station, 20% for storage, the rest for transaction charges. The system can accommodate between 200-250 remote stations for commercial users.

One measure of the implications of the new system: one Keydata customer is replacing a 1440. Another: no more in-house keypunching, or programming.

INDUSTRY LETHARGY SLOWS
NEW TAPE DEVELOPMENT

A 10-man L.A. outfit which is probably the country's biggest manufacturer of plated recorded media says that 3000-bpi mag tape is just around the corner. Produced by a chemical process, the tape offers better uniformity, wear, and signal-to-noise ratios than oxide tapes. And it doesn't attract dust.

Thin Film, Inc. has produced thousands of feet of the plated tape, which offers hopes of densities up to 24,000 bpi eventually, 8000 bpi within a few years. Some technical hurdles, industry "compatibility" lethargy are slowing development of the tape, which could be offered at 3000 bpi for perhaps $50 a reel.

Meanwhile TFI's George Wilhelm is experimentally applying the plating technique to related products for random access memories, which he feels may one day replace more expensive discs. Meanwhile the company continues to produce high quality, high-density discs.

BULLISH NCR AIMS
AT BIG ON-LINE MARKET

That Dayton outfit that makes cash registers is bullish about its edp prospects, and with some reason: computer sales for the first quarter of '65 were reportedly a healthy $25-million. NCR is setting its sights on the on-line business, which already represents 20% of its dp income. Encouraging is the reaction ("beyond our wildest expectations") of on-line services at NCR data centers. With a strong base in retailing, NCR is confident it can make a big dent in a market which they feel has 1000 potential users. So far cable and terminal costs have slowed progress. Aiming at selling 1000 computers a year, NCR is bolstering its technical support staff 50%.

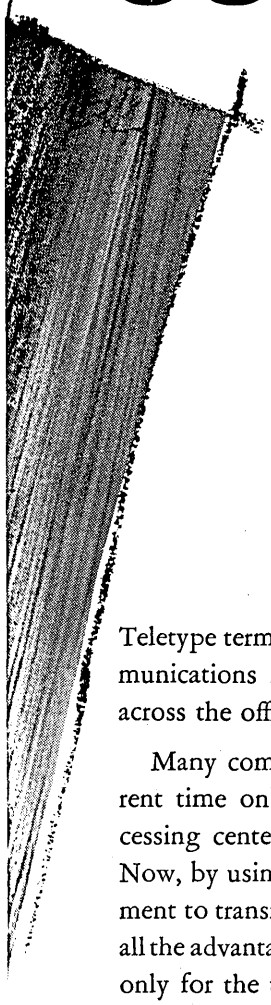
BIG D BUREAU GETS BIGGER

University Computing Co., which began on a shoe-string with a used 1604 at SMU, is going great guns. The Dallas service bureau opened a shop in Tulsa last year, has now acquired a couple of tab shops in Oklahoma City, and the Information Processing division of The Western Co., in Ft. Worth, where it will use 1401 time. The company, now some 70 strong, will probably go public in June.

RUMORS AND RAW RANDOM DATA

Look for Honeywell to announce soon the top end of its 200 line: the 8200. It will be compatible with the 800 (no emulators), which means a 48-bit word, and is supposed to be able to handle six- and eight-bit characters with equal dispatch. ... Carnegie Tech's Al Perlis and Michigan U.'s Bernie Galler are off in August for a year's leave of absence to the Amsterdam Mathematical Center, where they will collaborate on a book on programming. ... Data Corp., LA programming house, will install both Philco and Recognition Equipment, Inc. scanners, which will be matched against keypunching during a big microfilm conversion project. It should test the validity of one man's claim that a scanner can equal the output of 170 (U.S.) keypunchers in an 8-hr. day. ... One user found that the average life of all of its computers (other than those still installed) was 33.8 months. ... One large firm estimates that the economics of using big, big computers (6600 class) in a centralized operation may offer 30% cost reductions. They feel 10 of these big machines could handle all computing now being done in this country. (Ignoring I/O?). ... As predicted in these pages last month, Sperry Rand has sued Mohawk Data Sciences and some former employees to enjoin the misuse of its trade secrets, although no equipment is named. ... Latest shuffle at Univac sends two regional vp's to NY staff positions. Maybe it means a stronger voice for marketing at Univac. Also Univac's defense activity has been spun off, put under wonder-worker Lee Johnson, who vacates his NY marketing post. ... Turner & Moni, NYC consultants, are conducting a feasibility study on an interline reservation system for Reuben H. Donnelley Corp., publishers of the Official Airline Guide. ... Contrary to our report in Feb., Elliott Automation has not ordered any CDC printers from Scientific Furnishings, is continuing to order Anelex units. ... The Burroughs B263 has passed the first stage of its tests for the Air Force's punched card mechanization program with flying colors. ...CDC has reportedly sold three 6600's to Brookhaven and to Bettis and Knowles Atomic Labs. ... The '66 DPMA certificate exam will be completely revised; a new study guide will include questions from the '65 exam. ... First MPPL software (44K level) was scheduled for delivery last month; the 200K MPPL version of the 360 operating system is due out in Sept. ... Japan's Electronic Industry Council has recommended closer cooperation of the nation's six computer makers, continued import restrictions, strengthening of the leasing company for the six. Report assumes that domestic machines will represent more than 50% of those installed, 60% of local production, in three years or so. ... The British Board of Trade may seek tighter Australian gov't. control of U.S. computer imports.

HOW TO FEED DATA DIRECTLY TO A REMOTE COMPUTER



Teletype terminal equipment is your most effective communications link to a remote computer—whether it's across the office or across the country.

Many companies are finding it more economical to rent time on a large computer located at a data processing center than to have a computer of their own. Now, by using Teletype high-speed tape-to-tape equipment to transmit to a remote computer center, they gain all the advantages of having a large computer while paying only for the time they actually use it.

Solves Complex Problems Because this Teletype equipment can be used with most computers, many businesses and industries are solving more quickly engineering problems, payroll, and complex accounting problems, and even developing the most economical methods of production control and product distribution —all by remote control.

These Teletype units operate on the American Standard Code for Information Interchange or any other 5, 6, 7, or 8-level code. Thus, you can program and activate computer functions at remote locations and transmit to a centralized computer quickly.

Timesaver This new tape-to-tape equipment transmits and receives data at 1,050 wpm using existing communications channels. To save time and communications costs, you can accumulate data on punched paper tape throughout the regular working day and transmit the data during non-working hours or at intervals when the line is not in use.

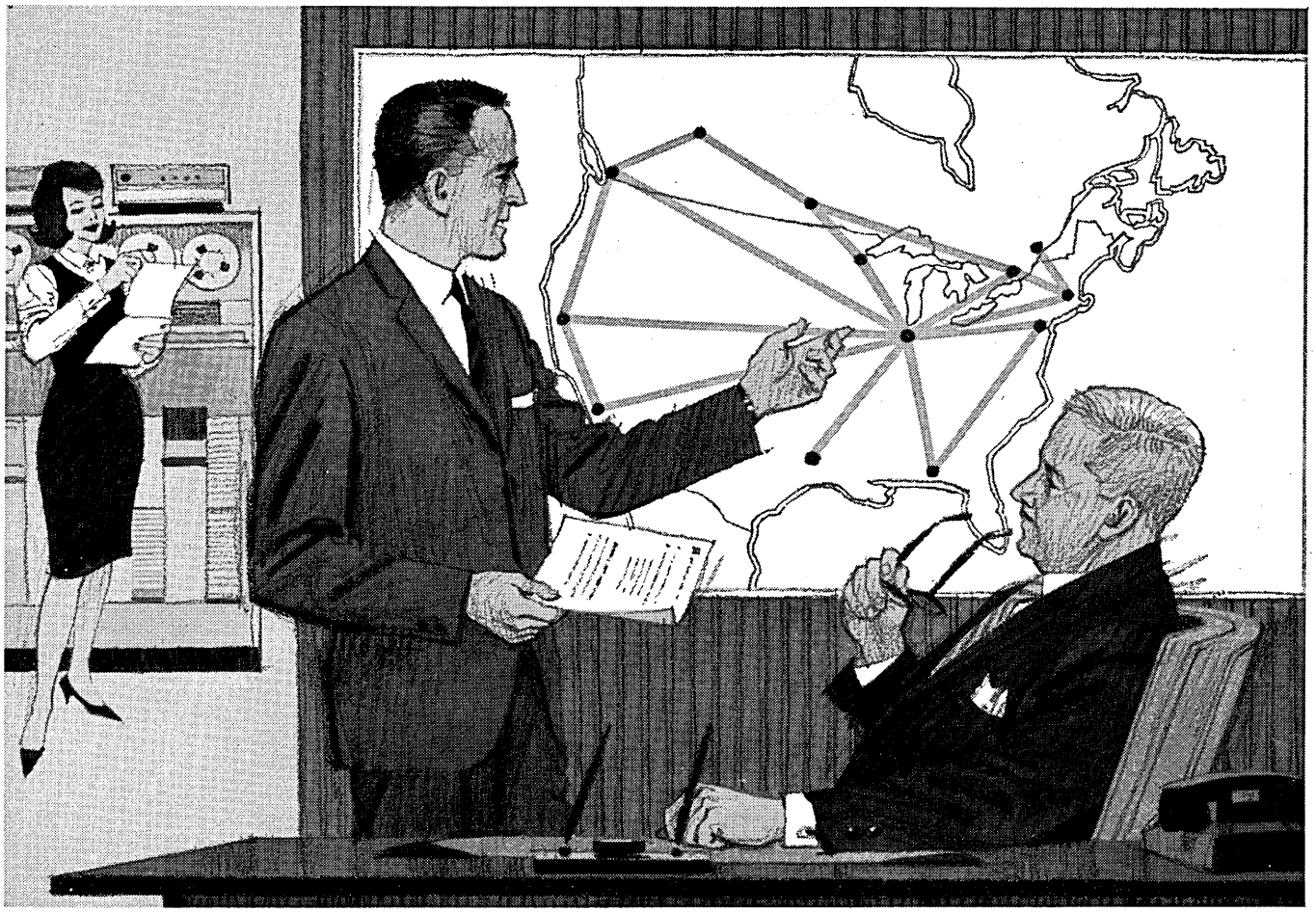
Increases Your Communication Capabilities Whatever your data processing needs, you can rely on the versatility of Teletype high-speed tape-to-tape equipment to add speed, flexibility, and economy to your communication capabilities. That's why it is made for the Bell System and others who insist on reliable communications at the lowest possible cost. Information on the additional uses of Teletype sets with a centralized computer can be obtained by writing: Teletype Corporation, Dept. 81E, 5555 Touhy Avenue, Skokie, Illinois 60078.

machines that make data move

TELETYPE®

CIRCLE 18 ON READER CARD

Looking for a **LOW COST** Data hook-up between head and branch offices?



Here's the unique cae Telepath* CODE TRANSLATOR

This low-cost unit that breaks the data transmission barrier between head and divisional offices is now in use with major telephone companies.

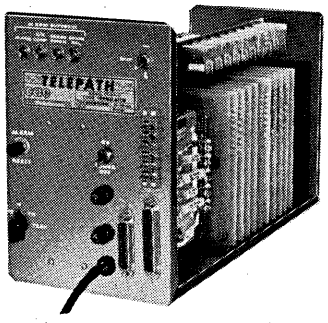
With a computer in head office and a Telepath Code Translator at each branch or divisional office, electronic data flows as freely as if each branch were computer equipped.

The Telepath Code Translator takes punch card data and turns it into teletype code for transmission. Or takes teletype code and feeds it as punch card data for the computer.

Integrating distant offices into EDP systems, CAE translators quickly repay their costs through increased utilization of expensive computers and more economical use of wire.

CAE Telepath data processing peripheral equipment is in wide use over the world: translators; selectors; supervisory, control and telemetry systems. **Fast delivery.** CAE translators are available *now* for adaptation to any data processing system, old or new. Our field experts in system analysis and design will recommend equipment that's exactly tailored to your needs.

* *CAE Registered trade name*



TELEPATH CT-512-X TRANSLATOR is an on-line device that receives 5-level serial data and transmits 12-level punch card data. Five-level serial code is taken directly from the line, translated to 12-level parallel code and fed to a business machine card punch. Or 12-level parallel code is taken directly from card punch, translated to 5-level (8 unit) serial code for direct transmission. Built-in power supply. Available for any transmission speed.

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CIRCLE 19 ON READER CARD

Raytheon Computer's 520 System is the new price/performance leader in the industry.

It starts at $94,000 and outruns competition.

These figures prove it.

OPERATION	DERIVED TIMES IN MICROSECONDS INCLUDING MEMORY CYCLE			
	RAYTHEON 520	SDS 930	CDC 3100	IBM 360/40
SCIENTIFIC/ENGINEERING FUNCTIONS				
FLOATING POINT ADD (24-BIT MANTISSA)	21-36*	81	NA	43**
FLOATING POINT ADD (39-BIT MANTISSA)	34-35*	NA	210	NA
FLOATING POINT MULTIPLY (24-BIT MANTISSA)	25-28*	59	NA	105**
FLOATING POINT MULTIPLY (39-BIT MANTISSA)	74-76*	NA	340	NA
REAL-TIME DATA SYSTEMS FUNCTIONS				
ADD REGISTER-TO-REGISTER	1	NA	1.8	7.5
CONVERT TO ENG. UNITS (12-BIT DATA) (ax+b)	15.5	19.25	21.5	81.26
NORMALIZATION $\left(\frac{X-Z}{F}\right) \longrightarrow Y$	20.5	31.5	22	216.26
CONVERT ANY 6-BIT CODE TO ANY OTHER CODE	2	8.75	5.25	17.5+6.25/CH.
BINARY TO BCD CONVERSION (4 SIX-BIT CHAR.)	36.5	112	77.5	<50
BCD TO BINARY CONVERSION	28	80.5	72	<45
DATA QUALITY CHECK (MATCH 24-BIT WORD AGAINST REFERENCE WORD AND COUNT UNMATCHED BITS)	23	69	108	108

**Times for subroutines in fast memory and calling sequence in main memory.*
***Short format (24-bit mantissa and 7-bit hexadecimal exponent) with floating point option.*

The Raytheon 520 System has a substantial speed advantage in scientific and data systems computing. It's equipped with a 200 nanosecond access, NDRO memory for table, sub-routine and executive program storage. Memory accesses are reduced by 1-microsecond register-to-register instructions using seven programmable registers. A variable length multiply can provide 8-bit execution in 2.5 μ secs, 12-bit in 3.5 μ secs and 24-bit in 6.5 μ secs. Input-output features include direct memory access and a standard controller for low-cost interface to A/D-D/A converters and other real-time data sources.

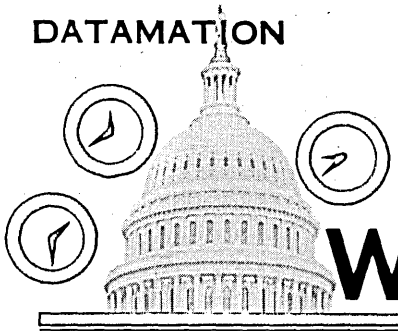
Automatic programming aids for the 520 System include the BOSS operating system; an advanced assembler with macro instructions oriented toward real-time systems; a simulator that will allow users of IBM 1620 computers to switch to the Raytheon 520 and process their machine language programs up to three times faster; and 520 FORTRAN, a fast and powerful compiler (benchmark comparisons invited).

Write or call today for the whole story. It's in Data File C-108J. Raytheon Computer, 2700 S. Fairview Street, Santa Ana, California 92704

RAYTHEON

SEE THE 520 AT IFIP, NEW YORK HILTON, MAY 24-27

CIRCLE 20 ON READER CARD



WASHINGTON REPORT

HR 4845 HEARINGS END, STILL FACES SENATE

Spokesmen for the Budget Bureau and the Defense Dept. voiced a multitude of qualms and quibbles concerning H.R. 4845 at hearings conducted recently before the House Government Activities subcommittee, chaired by Rep. Jack Brooks, the bill's sponsor. Both Elmer Staats, deputy to Budget Director Kermit Gordon, and Paul Ignatius, DOD Undersecretary for Installation & Logistics, refrained from expressing outright opposition to the measure, which would lodge within the General Services Admin. sweeping procurement powers for dp equipment used by all federal agencies. Word was out that President Johnson, enamored both with government economy and "Government by Consensus," had given a benison to the goals of 4845 and would not take kindly to any agency stating public opposition.

This placed BOB in an especially ticklish position since their recently-issued report on government dp operations (also bearing the President's imprimatur) explicitly rejected the central tenets of the Brooks bill. Hence, the bureau's position statements at the hearings were exquisite in their murkiness. Testimony by Ignatius and his chief assistant, Paul Riley, was in the same vein. Kinder words were spoken for 4845 by spokesmen for GSA and the Dept. of Commerce (Bureau of Standards), and by Joseph Campbell, head of the General Accounting Office, who in fact plumped for stronger language in the bill.

With hearings concluded, informed prognosis is that 4845 will be favorably reported out of committee, as it was in '63, and come to a quick vote on the House floor. It's a different story on the Senate side, however, where no sense of urgency concerning dp legislation is discerned in the Government Operations Committee. "Frankly," said a committee aide, "we're not convinced of the need for any legislation in this area." Sen. McClellan's committee already has a crowded docket of hearings, and it may be some time before it gets around to government dp unless some Olympian bolt is forthcoming from the White House.

LINKED COMPUTER NETWORK LIKE THE MILITARY HAS

Implementation of the Advanced Record Service on GSA's Federal Telecommunication System this summer will give a big boost to the plans of many non-military federal agencies to establish far-flung computer nets. Some of the agencies reportedly planning to tap into FTS soonest for this service are Agriculture, Internal Revenue, Social Security, Bureau of Reclamation. The nets would consist of a large-scale computer complex in central HQ linked to I/O terminals in district offices, with bulk data transfer back and forth over FTS facilities. Lower communications costs via FTS will make netting practical, whereas before it was only possible. Also looming large on the FTS horizon: time-sharing.

HONEYWELL SERIES 200

takes the sting out of changing computers

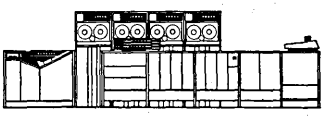
Switching to a new computer can cost you plenty in reprogramming and retraining. Ouch.

You might delay those costs by "simulating" your old computer. But then, all you'd be doing is running your old programs on an expensive new computer — at the same old speeds. That smarts.

In SERIES 200, Honeywell has a better approach: an exclusive concept called "Liberator". Liberator lets you convert your old 1401 programs, for example, and run them at high new speeds on a new Honeywell SERIES 200 computer. Automatically, permanently, painlessly. No reprogramming. No retraining.

SERIES 200 is a full line of compatible computers, including software and peripheral equipment that has been refined down to the smallest increments of capability ever achieved. The result: your system fits the dimensions of your business exactly. You save because you buy only what you need now. As you grow, you add on — in sensible, economical increments. We call this new approach Dimensional Data Processing.

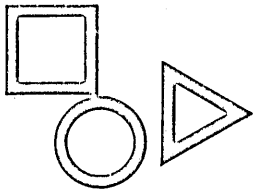
Want to know more? Write the nearest Honeywell EDP office. Or give us a buzz.



Honeywell

ELECTRONIC DATA PROCESSING

CIRCLE 22 ON READER CARD



EDITOR'S READOUT

AS I SEE IT:

A GUEST EDITORIAL

(Editor's note: This guest editorial is a portion of a letter which attempts to place in perspective some of the developmental work now in progress in the computing industry—specifically, such programming aids as languages, compilers, and on-line facilities. Earlier in the letter, the author outlined the involved total process of preparing problems for handling by machine, which he called the "programming process." And he pointed out the series of "loops" or related interactions between the man with the problem, the programmer, and the machine which make the programming process a complex one. Dr. Ware is head of the Computer Sciences Dept. at the RAND *Corp., and is a Fellow of the IEEE).*

. . . Altogether too often, casual discussion speaks of "programming a problem" and the reference is to the overall process. Yet it is clear that only a part—perhaps a small part, at that—of the programming process is involved with actually using a language for writing routines. Much of the programming process involves intellectual activity, mathematical investigation, discussions between people, etc. Very often, individuals who are trained as programmers actually do the early stages of the programming process but they may very well write no routines—although trained and capable of doing so. One man who participated in the SAGE initial programming has estimated for me that roughly half of the total programming man-hours invested in the original SAGE programming was for analysis and definition of the problem; the other half of the total man-hours produced machine routines.

I think you can perceive the point I'm getting at. We lament the cost of programming; we regret the time that it takes. What we really are unhappy with is the total programming process, not programming (i.e., writing routines) per se. Nonetheless, people generally smear the details into one big blur; and the consequence is, we tend to conclude erroneously that all our problems will vanish if only we can improve the language which stands between the machine and the programmers. T'ain't necessarily so! All the programming language improvement in the world will not shorten the intellectual activity, the thinking, the analysis, that is inherent in the programming process. Another name for the programming process is "problem-solving by machine;" perhaps it suggests more pointedly the inherent intellectual content of preparing large problems for machine handling.

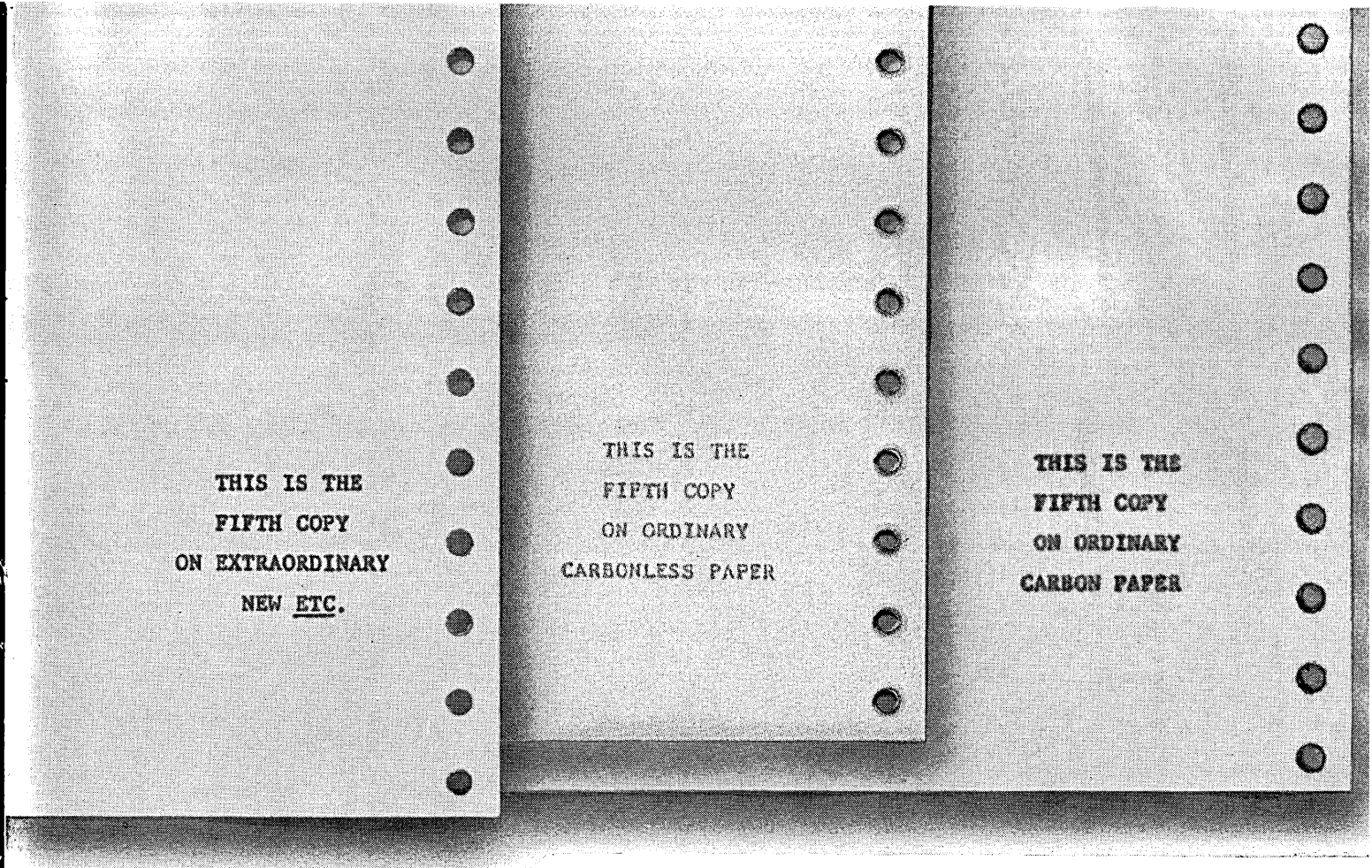
My recitation, above [of the details of the programming process], has another use; we can identify where the likely payoffs are from the kinds of computer research that we know about. Let's go through the process backwards. Certainly better programming languages will facilitate the interface between the professional programmer and the machine, at all stages of his use of it. Certainly on-line schemes which provide the programmer conversational intereaction with the machine will help him. He can run tests more

quickly; he can try out ideas more expeditiously; he can complete debugged routines more rapidly. The next stage back is the flowchart. Programming languages, if we understand that phrase to include ALGOL, JOVIAL, ADAM, COBOL, FORTRAN, and their associated operating systems, will not substantially improve flowcharting; the flowcharting business is essentially one of graphics, mixed with problem statements. There is research directed to providing a programmer with a graphical language and a graphical input/output to a computer. When this research is completed, hopefully a programmer can sketch his flowcharts directly into the machine, and conversion to a routine will be accomplished within the machine. So a graphical language will be a big asset; it reaches from the machine further toward the beginning of the programming process than anything else we have going in research.

The next step nearer the beginning of the programming process is formulation and definition—problem analysis. This is largely intellectual in nature, and I don't see much hope for significant improvement here. As we do more and more large problems on machines we'll accumulate additional experience and insight. We may, in the future, be able to pass through the analysis stage more easily as our experience deepens; on the other hand, if the level of problem difficulty increases too rapidly we may not get through analysis any more easily. There is a potential payoff from graphical languages and possibly other kinds of languages, but I can't estimate the payoff very accurately. Conceivably, the on-line conversational or dialogue mode of handling a machine may be useful to the analyst. If he is either trained to some extent in machine use, or if we are clever enough with our languages, it may be that an analyst can *expedite*—but never eliminate—the intellectual activity that he must pursue.

There is some hope—dim at the moment to my eyes—that really sophisticated languages and computer input devices when used by properly trained analysts can compress the conventional programming process into a one-step handling by one individual, directly with the machine. Be cautious of my phrase "properly trained analyst." For the foreseeable future—perhaps for as long as 10 years—he who uses a computer will be obliged to organize in some degree the work he wants it to do . . .

—Willis H. Ware



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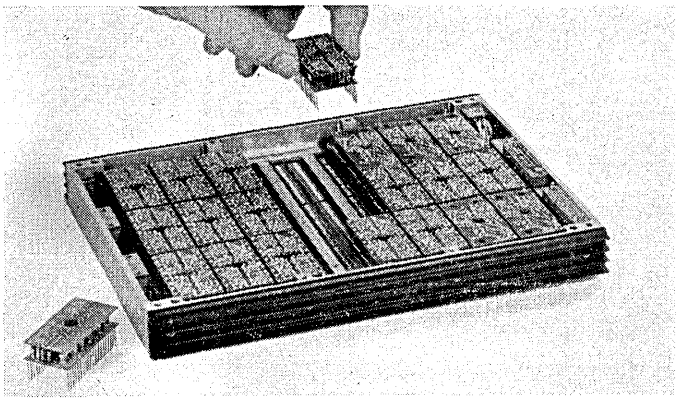
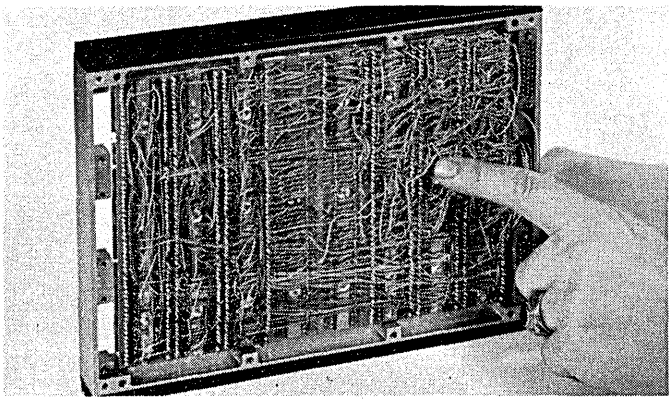
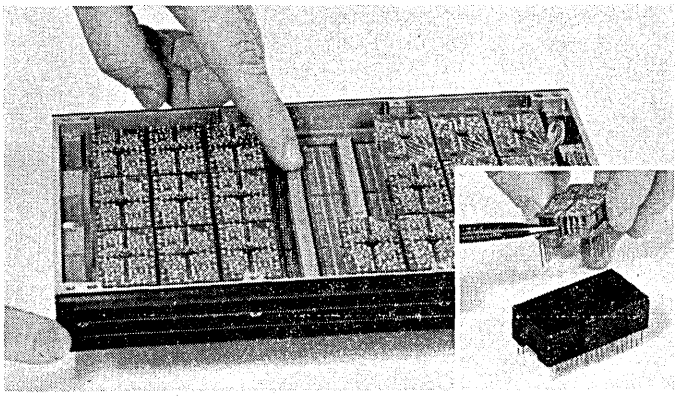
CIRCLE 13 ON READER CARD



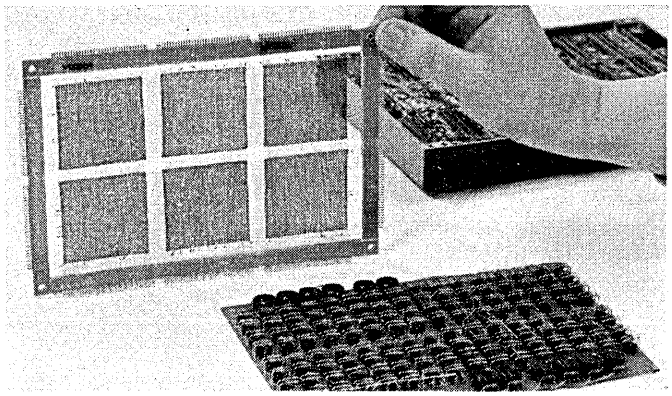
Economical circuit modules, mated directly through a parent-board assembly can be potted with light-closed cell foam if desired.



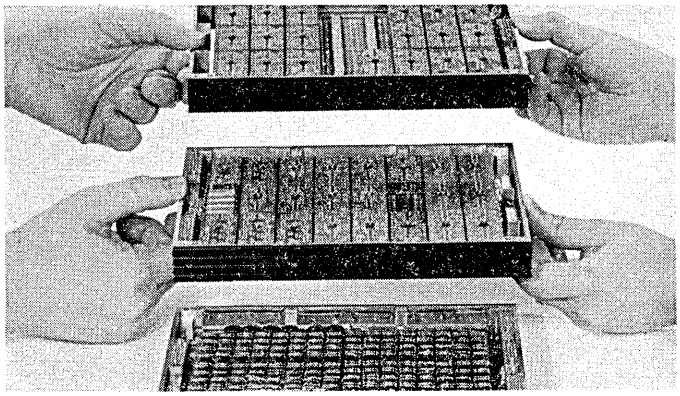
Wrapped wiring of circuit module terminations eliminates connectors, increases reliability, and yet retains easy replacement features.



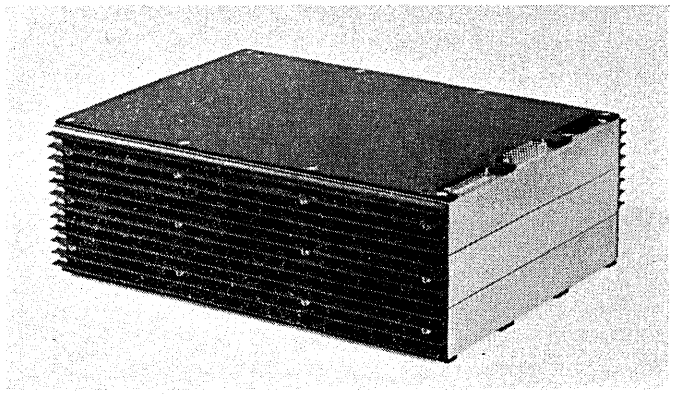
All heat-producing components mount directly to heat sinks. Inset shows how circuit modules each contain individual heat conductors.



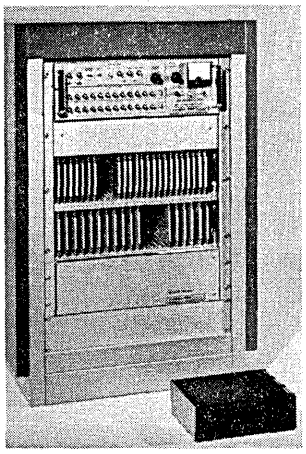
Memory stack consists of 64 x 64 core arrays mounted on rugged, laminated frames. Wide temperature cores are used. Planes can be potted.



System is composed of stacked modules. Number of modules depends upon memory capacity. This typical system has 3 modules and a capacity of 4,096 x 12.



This typical Series MC memory is 7.25″ x 9.375″ and weighs approximately 8 pounds. Max. power dissipation is less than 48 watts. Operating temperature range is —55° to 71°C.



A COMPACT, RUGGEDIZED MEMORY FOR SPECIAL-PURPOSE APPLICATIONS

Two Fabri-Tek 4,096 x 12 memories. The larger one is the 1 usec. Series MF. Dwarfed is the 4 usec. Series MC compact memory. Of course, the big one has integral power supply, self-test, and many other features.

This Fabri-Tek memory incorporates high-reliability packaging techniques intended to extend the MTBF to from 7,000 to 10,000 hours. Typical applications for this memory are: use in industrial atmospheres, geophysical van-mounted systems, special-purpose aircraft, and military applications. Fabri-Tek has used MIL-E-16400 and MIL-E-5400 as development criteria. Ask for information about the Series MC memory system. Write: Fabri-Tek Incorporated, Amery, Wisconsin. Call: 715-268-7155. TWX: 510-376-1710.

FABRI-TEK INCORPORATED

CIRCLE 24 ON READER CARD

SOFTWARE IN EUROPE

by A. d'AGAPEYEFF

The story of software in Europe is rather like a series of races in which the natives on bicycles are competing with Yanks in Cadillacs. Against all the odds on the plains of mathematics the natives are keeping level, more or less, but on the mountain passes of the business world they are finding the going rugged, and there are some routes they simply have not charted.

Yet the problem is basically bicycles versus Cadillacs, which stems in part from a disbelief that anything as new as programming can be terribly vital. Thus neither governments nor the military have provided the necessary lubrication to match developments from across the Atlantic. They have bought hardware, but very little software. And much of their hardware purchases have been for expensive and unnecessary special purpose machines due to a lack of appreciation of the scope and import of general purpose computers.

The present situation is something of a vicious circle. Computers have recently become fashionable and all kinds of advanced projects are in the air. De Gaullism and the current political climate have forced a belated policy of supporting local manufacturers. But there is a dawning realisation that these projects could be launched more quickly, and safely, with IBM-type software.

The British Government has now tried to keep the home team going by providing some $12 million a year for development—of which half may go towards software. The danger is that much of this may be used to put last year's American software on our machines, to produce a FORTRAN IV in 1966 or a pale imitation of MIT in 1967.

It is true that there are a few small voices who would have us accept that we have lost the present race, that we had better buy the Cadillacs and learn to use them and put all available support into making sure we at least compete in the next race. But when did reason prevail against politics and patriotism?

European manufacturers have of course contributed to their present difficulties, chiefly by chasing every new gimmick offered by their American counterparts. They have toyed with elegant source languages, but omitted really good assemblers; they rushed in with theoretical schemes for time-sharing, but often failed to make the basic supervisor work on time.

scientific languages

The absence in Europe of a large vested interest in FORTRAN has led to a ready acceptance of the advantages of ALGOL as a language. It is the main vehicle for university teaching and is in widespread use particularly in Holland, Germany and Scandinavia. In Germany ALGOL or ALGOL-like compilers have been available for some six years, allowing an extensive body of experience to be built up.

In Britain the progress of ALGOL has been more hesitant. Both FORTRAN and Mercury Autocode, a simple but valid language developed at Manchester University, have long been in use. Cambridge and London Universities have combined to produce a new language, CPL, for the Atlas computer. Furthermore, with one striking exception, it is only recently that really useful ALGOL compilers have been released. However, it is now the policy of two of the three main British manufacturers to support ALGOL, and it is backed by the majority of the universities. It would seem, therefore, that subject to the future impact of NPL, Britain will go along with the rest of Europe in favouring ALGOL.

Other aspects of note are the many matrix schemes and, more recently, some simulation languages. Examples of the latter are CSL from IBM and Esso U.K., ESP from Elliotts, and Simula from the Norwegian Defence Ministry.

In general, one might say that this is an area in which the natives are doing pretty well especially on small machines where FORTRAN compilers (DEC and some others apart) tend to be more of a gesture than anything else.

business languages

Under this heading come many local brews and daydreams. Almost all of the local manufacturers have offered a COBOL compiler at one time or another but, except for a restricted version called RAPIDWRITE from I.C.T., not one of these has actually been issued. Nor are any in prospect except from I. C. T.

European "experts" tend to regard COBOL as something nasty wished upon an unwilling industry by the old sugar daddy. Manufacturers envying the sugar have been more

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Mr. d'Agapeyeff is managing director of Computer Analysts and Programmers Ltd., England's first software contract research firm. He has been in the computer field for some nine years and is a member of the executive council of the British Computer Society. His firm has produced ALGOL compilers for manufacturers in Europe and commercial compilers for U.K. machine makers. Among the latter is TALK, for small to medium systems.

discreet but, although their salesmen may have talked COBOL, their compiler writers have been brewing a different mixture.

Bull and Olivetti have dabbled, but the main alternatives to COBOL have come from Britain. These are CLEO and TALK from English Electric-Leo-Marconi, NEBULA from I.C.T./Ferranti, and Language H from NCR U.K. All these languages have some advantage over COBOL for European machines in the European market, and their compilers frequently work on smaller configurations than do efficient COBOL compilers.

In general the success of these languages has been mixed. CLEO, which is not as yet terribly ambitious, is in widespread use and on the whole keeping the customers happy. NEBULA, which is very ambitious, has been slow to get on the air and is not really keeping anyone very happy. They could all do with more effort in extending them and making them more efficient, and although they can rival COBOL they may well find NPL is too supercharged for comfort.

operating systems and utility routines

Operating systems on large time-shared and real-time computers for business purposes can be considered the uncharted territory. The facilities claimed on the G.E. machines, and which now seem to be emerging for the System 360, are more flexible and of greater scope than those being planned in Europe. Project MAC is regarded with awe and is unlikely to be imitated in Europe unless universities such as Cambridge are provided with a great deal more money than hitherto.

There is evidence that this weakness is now becoming sufficiently apparent to lead to a concentrated effort to provide a remedy. Some rather bitter experience on running large scientific machines such as Atlas has been accumulated. Unfortunately there is little evidence that the size of the problem is understood; this has always been an area of greatest weakness in European machines.

Macro assemblers have only recently appeared and are not comparable, say, to Univac's SLEUTH. I/O packages have tended to be cumbersome and loaded on an all or nothing basis. The worst fault has been that this kind of software has not been knitted together in a planned manner. On the contrary, different packages (not always compatible) have been allowed to grow in an ad hoc manner mostly under pressure from the more vocal customers.

This heading more than any other in software provides the reason why European manufacturers find it so difficult to be fully competitive. ■

HARDWARE IN EUROPE

by DR. JOHN PINKERTON

Users in Europe expect very good value for money spent on computers, and high productivity from the jobs done. This stress on economy is perhaps stronger than in the U.S. There are many computers on the market to choose from, both European and American, and no shortage of ingenuity in applying them—though as everywhere programmers are scarce.

The difficulty of making the smallest computer in a fully compatible range economically, has led some manufacturers, content with one section of the market, to concentrate on individual unrelated models. More generally, however, the trend is certainly towards introducing a range of models. ICT have the 1900 range, for example, and English Electric-LEO-Marconi offer, besides several other models, a data processing range based on their LEO III. The association of GE with Olivetti in Italy and Bull in France has recently resulted in new designs but full details are not yet known. The trend towards integrating all models into one range, however, seems strongly established and is likely to continue indefinitely. A range implies standard instruction and data codes, a standard peripheral interface, and independent peripheral control units, so that a comprehensive selection of peripheral devices is

Dr. Pinkerton is manager of the Product Research Div. of English Electro-LEO-Marconi Computers Ltd., London, England. After wartime work on radar and reading for a PhD in ultrasonics at Cambridge U., he joined J. Lyons & Co. in '49 to engineer their Leo computers. After completion of LEO I in '54, he led the team that designed both LEO II and III. He holds MA and PhD degrees from Cambridge.

usable with any model in the range.

The trend towards on-line processing and data transmission has strengthened the urge to adopt standard data codes. It is to be hoped that the efforts of ISO and ECMA to agree on standard 6- and 7-bit codes will not be frustrated. The advantage of having the same data code for both computers and telecommunications is obvious.

8-bit characters

The use in the IBM 360 of 8-bit characters subdivided into two decimal digits of 4 bits was earlier a feature of LEO III. This too seems likely to continue, with corresponding 6- and 7-bit codes as subsets. The corresponding future adoption of 9-track IBM-compatible tape would seem likely to follow in due course, but has not been generally announced yet in Europe.

Time-sharing of major and minor unrelated, data processing programmes appeals particularly to the larger data processing users, like government departments, as a way of getting more done by keeping both peripherals and central processor busy for a higher proportion of the time. Interrupt features are therefore widely introduced and efforts made to reduce programming overheads in master routines and the like by suitable specialised hardware—e.g., the multiple nesting stores for several programmes in KDF9, which is primarily a mathematical machine.

The internal organisation of computers has been influenced by this desire to allow as many things to go on at once as possible and, in particular, to provide autonomy and concurrency on several peripheral channels. This is of course coupled with the introduction of the standard peripheral interface. The position for this interface has now settled down at a point between the specifically peripheral control electronics on the outside, and the general-purpose block assembly logic on the inside. It is usually character organised.

A wide range of the usual types of peripheral equipments is in use with European computers though of course some of the more specialised items used in smaller quantities tend to be obtained from American sources. Use of paper tape for input and, to a lesser extent, for output is very much commoner than in the U.S., not only for scientific machines where it is more useful than cards, but in many data processing installations as well. Part of the reason may be the comparatively high European price of the cards themselves.

the european market

The methods of linking these peripherals resembles that familiar in U.S. designs. A variety of magnetic tape formats is in use, though some standardisation is coming and when it arrives is likely to be IBM-compatible. Installations tend to have fewer peripherals per computer than in the U.S.; from two to six tape decks, for example, in small or medium installations and up to 10 or 12 in larger ones. On-line data transmission is planned for by the more modern systems but few installations yet possess it.

The largest slice of the market is still that for data processing machines, with mathematical and scientific second, and industrial on- and off-line third, a fair way behind but expected to catch up rapidly. This has naturally oriented system design rather towards the data processing user. Nevertheless mathematical users' needs have been well catered for by specialised large machines like Atlas and KDF9. In the former a multi-console approach was adopted, which differs from the MAC approach in the fact that the consoles are all attached firmly to the computer; the operator at each is not in the same kind of intimate contact with his programme. KDF9 offers very fast arithmetic and the ability to "nest" items in one or more "push down" stacks, thus simplifying the structure of a programme and enabling very high speed calculations to be carried out. KDF9 may one day be seen as the forerunner of a new kind of computer organisation which allows really efficient automatic compiling. ALGOL users in particular have developed a segmented concept of programme structure which may influence the design of future computers, though it has hardly done so yet.

Single address instruction codes seem to be the most popular, with a trend towards variable length in increments of eight bits, as in KDF9, for example, to overcome limitations of address length to deal with large stores without being wasteful of bits. Code sets are tending to become all the time more comprehensive with microprogramming introduced to cheapen the engineering. Floating point and double precision instructions in the repertoire are now *de rigueur* for all well-dressed systems even for data processing. The boundary between data processing and scientific and technical calculations is anyway becoming more and more hazy.

larger memories

Large-scale use of time-sharing with quite unrelated jobs being now quite common in larger data processing installations, at least in England, there are demands for larger and larger core stores to accommodate the several programmes. These usually include a master routine or executive programme of maybe 4-6,000 instructions administering amongst other tasks, peripheral transfers, the allocation of peripheral devices and storage, and logging the progress of work on a typewriter. To cope with time-sharing of many programmes, data processing systems also offer priority interrupt features and various forms of store reservation to protect one individual programme against inadvertent corruption by another.

Microprogramming, first devised at Cambridge, England, by Wilkes and Stringer, has been a feature of many European computers of which LEO III was amongst the earliest. It seems likely to stay with us in one form or another for medium and large systems, especially with the more elaborate instruction repertoires now being offered. Ways are being found of economising on the amount of hardware in the microprogramme store.

Silicon semiconductor devices are rapidly ousting germanium in current designs, and at least one computer, Myriad, designed by the Marconi Company for military and industrial use, is completely microminiaturised. This example is expected to be followed rapidly for at least the central processor. The greater diversity of circuits required for the peripheral equipments will slow down the rate of introduction of fully integrated micro-miniature logic here.

conclusion

To sum up, the marked concentration of the industry into a small number of firms that has occurred in all European countries in the last few years has given a considerable impetus towards standardisation of data codes and formats and of programming languages. It has not so far resulted in much standardisation of basic instruction codes. Microprogramming is allowing a wider range of instructions, and the standard peripheral interface a range of different sized computers, all using a common set of peripheral mechanisms and control electronics. As in the U.S., there are increasingly many types of peripheral equipment to choose from. Microminiaturisation is just beginning to come on the scene. There is a very strong emphasis on operating efficiency, and though this is mainly a software question it has also greatly influenced hardware design. ■

FROM MINSK TO PINSK WITHOUT INTOURIST

by DR. EDWARD A. FEIGENBAUM

One day, while I was in Siberia. . . .

Isn't that a wonderful opening line? It echoes of an opening chapter of a latter-day Soviet novel about the Stalin era. I deserve to use it. I have just been to Siberia, and had a marvelous time there. I cannot say the same for Moscow (though my friends, the Napalkovs, of Moscow State Univ., hosted me royally) nor for Minsk or Pinsk (especially since I have never been to Minsk or Pinsk). Which reminds me of an old Russian story that certainly predates the Soviet regime.

Two old Russian men are sitting silently in a train compartment. Finally one says to the other: "So where are you going?" "I am going from Minsk to Pinsk. And you?" "I am going from Pinsk to Minsk." The long silence that follows is broken by the first reflecting aloud, "Aren't Russian trains wonderful!"

One day, while I was in Siberia, I was sitting in the office of Dr. A. P. Yershov, talking with him and his programming staff, when the mail arrived. One of the envelopes bore a Westernized Cyrillic scrawl and a domestic postmark.

Yershov opened the letter and read it aloud to the assembled group. It was from Michael Arbib, late of MIT, and it detailed his frustrations in attempting to get out to Novosibirsk. Michael was on a *Wanderjahre* journey that took him to the Soviet Union to commune with Soviet coreligionists of the cybernetics cult (the USSR, incidentally, is by now the Mother Church for Cybernetics and all its Mysteries). By chance, Michael and I overlapped in Kiev and Moscow (he was there to paint the town Red, he said). He came to the USSR with an invitation in hand, from Academician Sobolev, head of The Institute of Mathematics at the Novosibirsk Scientific Center, to deliver a few lectures out there. Officially, however, Michael was in the USSR as a tourist, under an Intourist visa. I knew Michael was trying hard to realize his visit to Siberia. His letter to Dr. Yershov detailed the sad story. It went something like this.

He first went to Intourist and showed them Sobolev's invitation. They responded that Novosibirsk was a closed city for Westerners on Intourist itineraries, hence they could not sell him a ticket to go there. If the Academy of Sciences wants you there, Intourist told him, then *they* will have to get the ticket for you.

Off to the Academy went Arbib. Who are you, asked the academy in Moscow, and under whose auspices are you in the USSR? I am Arbib, and I am here under an Intourist visa. Ah! In that case, since you are not a guest of the Academy, *Intourist* must sell you the ticket to Novosibirsk.

Cycled back to the Intourist Bureau. Then back to the Academy. No go. Eventually Michael gave up. His letter to Dr. Yershov recounted these events.

As Dr. Yershov read through the letter aloud, laughter among the programmers broke out *pianissimo*, and became *fortissimo* as the letter ended and a programmer rose to declare: "Poor Arbib! He got caught in a program loop!"

I will remember this punch line the next time I spend a week trying to change my hotel room in Moscow.

datamation back east

DATAMATION is received each month in Novosibirsk—two copies—and is read from cover to cover. Nowhere farther east of the Urals is DATAMATION wrung so dry. There are no known copies going to Irkutsk, Khabarovsk, Vladivostok, or even Ulaan Baatar in Mongolia.*

Associate professor in the Computer Science Div. at Stanford Univ., Dr. Feigenbaum recently completed a series of lectures before the USSR Academy of Science and a tour of computer centers there. This followed a 1960 visit as a delegate to the first International Congress of Automatic Control, which formed the basis for an article on Soviet cybernetics in the ACM Communications. He is also co-author of "Computers and Thought."

*Since the voice of DATAMATION is heard loud and clear in Novosibirsk, like Pravda and the Voice of America (when the Chinese exploded their nuclear bomb in the second week of our visit, our Russian friends showed that this was no surprise to them, explaining that Dean Rusk had said it was about to happen, over the Voice of America), I do not want to let pass this opportunity to thank publicly, through these pages, my many hosts in the academic town for the warm and splendid treatment that my wife and I received there—to Academician Lavrentyev, head of the Siberian Div. of the Academy of Sciences, whose vision and energy made this "science city," and his remarkable Barnard-trained wife; to Academician Vekua, rector of the university, and his wife, whose feasts of Georgian dishes and Georgian wine we will not forget; to Computer Center director Marchuk, a brilliant 35-year-old Lenin Prize winner, and his wife, for their warmth and hospitality; to the programmers of the Computer Center, for their unparalleled dinner party, full of youth and enthusiasm and good feeling; and, of course, to Dr. Yershov, my friend and host in Novosibirsk.

DATAMATION travels a long way to get to Novosibirsk—2,000 miles along the Trans-Siberian Railway. The city of Novosibirsk is a large industrial city of 1.1 million people, vaguely reminiscent in general outlook of Pittsburgh, Pa., 20 years ago (pre-Renaissance). Outside the city, however, the aspect quickly changes to one of real natural beauty. Eighteen miles south of the city, along the Ob' River, there is a hydroelectric power dam. A lake backs up from there, and along its shores are birch and pine forests. In one of these forests, the Soviet government has built the home of the Siberian Division of the Academy of Sciences, the Novosibirsk Scientific Center.

Six years ago nothing was there. Today there sits a city of 25,000 whose residents affectionately refer to it as "the academic town." There are 15 fully staffed and operating Research Institutes, and a "Science" University of 3,000 students. The town contains 14 full members of the Academy of Sciences, 35 Corresponding Members (second-level Academicians), and hundreds of senior research scientists with training at least equivalent to an American PhD. The town is self-contained, including shops, apartments for all (no shortage as in Moscow) and schools (even an English school, at which the general instruction is given in the English language). The first real supermarket in the USSR is being built here, as well as a restaurant of quite modern design.

Another unique feature of the academic town is the presence of private homes (private occupancy but state-owned, of course). The full Academicians with families rate these. The Corresponding Members of the Academy live in two-family duplexes. The other scientists live in apartments, scaled (it is my impression) to rank and size of family.

This brings to mind a thought about the classless society. You know, the Soviets have a theory about this, and they appear to be remarkably diligent in putting this theory into practice. One reads much to the contrary about this, but here are some impressions.

One of the residential "microregions" of the academic town houses the families of the construction workers who have been building the town. The standard of living in this microregion appears to be identical with that enjoyed by most scientists in the other two microregions. Though science is a high-prestige occupation, the salary spread compared with other, more mundane, occupations is not too great (remember that theory?). A construction worker in the academic town earns about 110-130 rubles per month (1 ruble = $1.10 at the official rate). A faculty member at Moscow Univ., working in the sciences and occupying a "middle-level" rank, makes about 250 rubles. A small spread. Indeed, classless! That was my first thought. My second thought was that my local plumber undoubtedly makes more than I do, a phenomenon called Exploitation of the Proletariat.

yes, virginia, there is a dr. yershov

Virginia, do not believe those IFIP skeptics who tell you that YERSHOV is an acronym for a Soviet compiler-writing program. He exists! And he knows all about you, Virginia—your hardware, your software, your NPL, your time-shared toys, and the tattered undergarments you show in the pages of DATAMATION each month.

My hat is off to this splendid and generous person. In the context of Yershov, it is hard to understand what the Cold War is all about. The Soviets should send him abroad, under the Cultural Exchange Program, as their answer to Satchmo.

And they are about to do something like this. Dr. Yershov is scheduled to attend IFIP-65 in New York. I hope that you congress-goers have a chance to meet him.

Dr. Yershov is director of Theoretical Programming at the Novosibirsk Computing Center, and Mr. Automatic Programming in the Soviet Union. He is known in the West for his pioneer work in compilers (Programming Program for the BESM Computer) and for his work in ALGOL. His group has recently finished an extended ALGOL translator, called ALPHA, for the M-20 computer. This is a 45,000 instruction, twenty pass, ultra-optimizing compiler for a slow machine with a 4K memory. Since I don't want to upstage Dr. Yershov, I won't describe it. Go to his talk in New York, or read it in the IFIP Proceedings.

what was your greatest surprise?

I gave many talks that week in Novosibirsk. These were technical talks (heuristic programming, time-sharing, etc.) that I was already tired of hearing myself deliver. One was different. Dr. Yershov asked me to address a hastily-called meeting of students at the university on the subject, "Cybernetics in the USA." I did this from quickly-sketched notes. (If there is anything a university environment trains one to do well, it is this).

Students are great, the world over. These students, who crammed the big lecture hall to overflowing, were warm and enthusiastic. I talked of many things: our biggest computers (oohs and aahs), our smallest computers, our numerous languages (why do you need so many? How would *you* answer that one?!), the effect of computerization on everyday life in America (how do you explain a Diners Club card to a Russian audience? Easy? Then try this one. How do you explain to them Clarkson's heuristic program for simulating trust-investment decision-making in the selection of common stock portfolios? Now, for the PhD, how would *you* explain Goldwater to a Russian audience?). The question period was vigorous.

The last question was this: "During your trip to the USSR, what was your greatest surprise?" I thought for a moment, and answered honestly: "The news from Moscow two weeks ago" (Khrushchev's removal). There followed a translation of my answer, then a second of stunned silence (when does a second seem like an hour?), followed by a tremendous roar of laughter and applause that broke up the meeting. As I said, students are great, the world over.

If the Soviets can launch a three-man space ship, why can't they *X*? Here are some candidates for *X*: build fast transistorized CPU's, build reliable fast tape units; build alphanumeric printers for their computers. To answer the question would require another lengthy article. The theory behind the answer would involve the terms *organization, red tape, incentive,* and *technological base.*

In rational science planning, you put your money where your brains are. In Soviet computer circles, where are the brains? My answer is Novosibirsk and Kiev (at Glushkov's Institute of Cybernetics). At both these places the "workhorse" computer is the M-20. The M-20 has been described in DATAMATION. It was new in 1959, when it was shown to the official exchange delegation. It is a v-t computer of approximately 704-709 CPU speed, with inferior I-O facilities and a 4K core memory. There are perhaps as many as 100 M-20's in the USSR, no more.

I heard about better machines coming along, but did not see any at the major research centers I visited.

The most imminent new machines are two transistorized upgradings based on the M-20 design: the M-220 and the BESM 3. The M-220, it is understood, will operate at about 50 to 60,000 three-address operations per second.

Another relatively widespread machine is the Minsk 2, a transistorized computer with an 8K (max.) core store operating at about 10,000 operations per second. According to reports, these are produced at the rate of seven per month (another candidate for *X*?). The Novosibirsk

Computing Center has three M-20's and a Minsk-2. They hope to acquire four or five more Minsk-2's in the next couple of years.

The center has the brains. Nowhere in the USSR, in two trips, did I encounter a more sophisticated group of computer scientists. Yershov and his group, in particular, are completely tuned in to modern computer science and technology as it is developing in the USA (the Novosibirsk Chapter of the ACM, I call them). Yet they lack a modern computer. The ALPHA translater accepts input characters from a 170-character set (approximately), but they have no alphanumeric printer. And the problem is not money. It's technology.

Undoubtedly the Soviet scientists make better use of their limited computer resources than we do of our surfeit. Academician Glushkov said to me, "If we had computers as big and as fast as yours, we would think just as sloppily as you do."

is that all you have to say about soviet computers?

No, I have a lot more to report, but Bob Forest had only so much space to fill. The full story will be forthcoming. Watch your Journal (*c.f.* Ladies Home, under "Son of Soviet Cybernetics and Computer Science").

There remains only this to set down: that the trip was made at the invitation of the USSR Academy of Sciences (the *only* way to go; tell that to your travel agent) for the purpose of delivering a series of lectures on heuristic programming and computer simulation of human cognition in Moscow, Leningrad, Kiev, and (as it turned out, due to the much-appreciated efforts of Dr. Yershov, Dr. Marchuk, and Academician Lavrentyev) Novosibirsk. The dates were October 5 through November 2, 1964. (I carefully picked a quiet time, before the American election. In the second week, the Soviets launched a three-man spaceship on Monday, canned Khrushchev on Wednesday, and the Chinese exploded their A-Bomb on Friday).

I visited many research institutes, in computer sciences, psychology, and biocybernetics, in some cases revisiting places I had visited in 1960. I talked with numerous other computer scientists whose institutes and schools I was not invited to visit. Exceptionally pleasurable and rewarding was the week I spent at the Institute of Cybernetics in Kiev as the guest of Academician Glushkov (who in 1964 achieved both full Academician status *and* a Lenin Prize for his work in the theory of digital automata). I distributed numerous Johnson buttons, Bobby Kennedy pins and a bumper sticker to a friend with a car (LBJ for the USA). I made more friends in four weeks with Polaroid color pictures and Kennedy memorial half-dollars than Lend-Lease made in four years. And, as an encore, I would have wowed 'em by time-sharing the Project MAC machine from Moscow—except for two things. I couldn't get a MAC Problem Number, and anyway the Russians wouldn't let me use the Hot Line. ■

COMPUTING IN LATIN AMERICA

se habla fortran

by SERGIO F. BELTRAN

For Latin America it all began when the National Univ. of Mexico decided to establish its Electronic Computation Center. Since then, in 1958, an ambitious but enthusiastically pursued training and research program has been serving all Latin American countries from Mexico to Argentina.

Today, the Electronic Computation Center (ECC) of the National University of Mexico leads the way for several dozen computing facilities in Latin America and is a good example of how the Computing Sciences are developing in this part of the Continent. The ECC is organized into the following departments:

- –Computing Services
- –Programming
- –Mathematical Theory of Programming
- –Biocybernetics and Automatic Control Theory
- –Educational Programs
- –International Center for Research in Management Sciences (TIMS/ECC)

In its Dept. of Computation Services, the ECC currently has installed a CDC G-20, a Bull Gamma 30 Scientific, a CDC G-15 (all of them magnetic tape systems with punched paper tape and card I/O facilities), and an Applied Dynamics AD-2-24PB analog computer. This department has also an IBM 101 statistical machine, paper tape and card punching facilities and three teletypes for data transmission. Through it, the ECC offers computing services not only to the schools and departments devoted to scientific, technological and humanistic research in the

Mr. Beltran is professor of math at the National University of Mexico and founder of its Electronic Computation Center. He is a member of the Consultive Council of the Mexican government in Education, Scientific and Cultural Organizations, is a member of the IFIP Executive Council, and president of the Mexican Assn. of Computing and Information Processing. He holds a BS in civil engineering, a BS and MS in math.

National Univ. and in more than 25 provincial universities, but also to a large number of governmental agencies and private industrial, commercial and banking enterprises. Computing services are also provided by the ECC to organizations in several other Latin American countries.

The department of Programming does the programming not only for those users who do not have their own programmers but also for research projects undertaken by the ECC itself. The department of Mathematical Theory of Programming performs research on formal languages (for example, ALGOL, IPL-V and LISP have been studied intensively, and translators written for the machines installed at the ECC); on linguistics and mechano-linguistics, efforts are concentrated on four major projects: the deciphering of the ancient Mayan glyphes, the comparison of some 1,800 indigenous languages of the American and other continents (in order to structure the World Linguistic Network and test the current theories about how our continent began to be populated), the lexicographical analysis of these languages and, finally, the machine-aided translation of natural languages. In two additional sections of this department, research in automatic documentation and applications to aesthetics are undertaken, mainly in computer-teaching of musical composition and in computer exploration of the "golden rules" utilized by the ancient cultures in architecture, sculpture and painting.

With the cooperation of The Institute of Management Sciences (TIMS), the ECC has established an International Center for Research in Management Sciences where advanced courses and research in the methodology for application of science and technology to economic and social development for our countries is currently proceeding. Simulation models are also studied, mainly for research in "intercultural" problems and for complex demographic and growth problems. A simulated model of Mexico City is currently under development, with 148 people involved in the field work.

But the most important activities are those related to educational programs. With UNESCO's support, regional graduate courses in Computation Sciences and in Economic Planning and Operations Research have been established, receiving attendance from almost every one of the Latin American countries. In addition to these and to the numerous classical courses on programming, logical design and applications, a mobile computing center has been assembled with both digital and analog computers. This mobile computer center (CEMOCE) travels throughout Mexico each year, visiting many of the more than 30 provincial universities on each trip. This facility has been particularly valuable in providing initial familiarization and training for professors, students and professionals as well as introducing local business and government executives to the benefits of computers.

As a means of providing instruction in depth throughout the year, correspondence courses are offered to the groups which the mobile computing center has visited. The response to date has been enthusiastic, and this has been a major ingredient in building an increasing interest in computers and regional computing centers.

The development and implementation of the programs described above, oriented towards the whole of Latin America, have begun to render results after a relatively short period. They have opened the ground quite effectively for sales activities of equipment manufacturers: several additional electronic computers have been installed in Venezuela and Puerto Rico since 1958, in Colombia and Brazil since 1959, in Argentina, Cuba and Chile since 1961. In the following years they have appeared in almost every country of this continent.

Today, Mexico has more than 100 electronic computers installed or on order. In the six republics that comprise Central America the total number will reach more than 20 during 1965. South America (that is, from Colombia to Argentina) has at least 80 more on order or installed. And in the Caribbean (Puerto Rico, the Dominican Republic, Cuba, Jamaica, Trinidad, etc.), 12 others are already operating.

It is worthwhile mentioning that these installations cover a wide range of computing capacity, from the CDC G-20 magnetic tape system installed at the Electronic Computation Center of the National University of Mexico, through several 7070's and the British Ferranti computer installed in Argentina, down to a great number of CDC G-15's, IBM 1620's and 1401's. As far as the relative representation of equipment manufacturers is concerned, even if Ferranti, Bull and Lorenz (in Chile) are present, the true status of the market is that IBM has the most active sales organization, followed by Univac. NCR has also established EDP divisions in several Latin American countries and has already received commitments for several installations in Mexico, Colombia and Venezuela.

Control Data Corp. and Bull-General Electric seem to be the main contenders with IBM in these countries. Both are offering excellent lines of equipment, and as soon as they extend their operations south of Mexico the availability of a wider spectrum of equipment and the healthy competition to be expected will bring important benefits to potential users in Latin America. In less than two years CDC has already delivered in Mexico alone a G-20 tape system, two 3100's, one 160-A, two 8090's and three G-15's. Bull-GE has installations or commitments for four Gamma 30's and four GE 415's in Mexico. Both companies have several more in negotiation; and this is possibly why IBM has been slowed down in orders for its new 360 series. As far as is known, IBM has managed to sell four of the new systems as a result of their tremendous (and costly) sales barrage.

Newcomers to the Latin American scene are expected to include Digital Equipment Corp. (with its first PDP-8 installed also at the Electronic Computation Center of the National Univ. of Mexico), and probably Honeywell and Computer Control Corp. Whoever the final owner of General Precision's Commercial Computer Div. turns out to be will probably find three or four installations dropped in its lap, furnishing firm support for future expansion.

used vs. new equipment

One of the main obstacles to the development of the computing sciences and application of computers in Latin America is the insufficiently trained local staffs of the manufacturers. This has had the effect of imposing on users a burden several times heavier than that usually experienced in the U.S. This is one of the reasons the educational and training programs of the ECC have become so crucial.

But this being the case, it has been all the more worthwhile for potential users in Latin America to take a serious and thoughtful look at the used computer market. Costly-to-maintain vacuum tube equipment is not desirable for these users, but proven solid-state machines which can be purchased at small fractions of their original price have generated wide interest. Installed with almost no extra effort compared with the "manufacturer supported" brand new or used equipment, a number of new centers will soon be operating their first computers. International Computers Inc. has been active in this field in Latin America and has already made good headway in Mexico.

future trends and problems

It is logical to expect that the basic philosophy of the ECC of the National Univ. of Mexico will continue to

spread throughout Latin America. With this the case, the universities will become the most important foci for training and development in these countries.

Open-shop installations offering computing services not only within the universities but also to private enterprises and governmental agencies are springing up all over Latin America. IBM is experiencing increasing difficulty at several of the universities where their equipment is installed, because of attempts to enforce their extra-shift rental policy for those systems. Recognizing this, they have found a way to circumvent it through friendly relations with some of the foundations and agencies that grant financial support in Latin America. The mechanism has been to convince them to buy IBM computers that are afterwards donated to local institutions.

It should be realized by manufacturers that the "social cost" of a computer installation in countries like ours is very high, not only because of the exchange factor of local currency vs U.S. dollars but also because if a $10,000 installation is "equivalent" to 10 or 12 human salaries in the U.S., it is equivalent to 60 or 70 human salaries in our countries.

In Latin America, computers are becoming truly public-utilities, and service bureau activity will have to be undertaken on an increasing basis by pooling equipment resources of the manufacturers and human resources of the universities.

An explanatory comment is necessary here: more than 90% of the Latin American universities are public ones in which the total annual tuition fees range from $10 to $20. In all of them, professors usually hold high positions in business or government concurrent with their university duties. This makes our universities small reflections of the respective regions and even of countries. It is then easy to predict that manufacturers with the most audacious and liberal policies in regard to installation of computers in universities will be the most solidly established in the long run among the 230 million inhabitants of Latin America.

The importance of computers for our countries cannot be over emphasized. But it is of the utmost importance for Latin-American experts to realize that we have to utilize them in a much more "sociological" and economical way than in other highly industrialized countries. In the U.S., computers can be justified on the basis of reducing high labor costs. This is not always true for us. In our case, it is indispensable to vigorously pursue their utilization in the automation of industrial, transport and even agricultural production processes as a major aid to economic development. It is urgent to focus our efforts on the development of automated public and private management systems.

Due to low standards of living and economic conditions, the portions of our populations that can devote themselves to highly creative endeavours (scientific and technological research and development, humanistic creative speculation, musical, poetic, literary and philosophical activities) are many times below the percentages in more developed countries. We then have to direct our computing installations and orient our computing development toward liberating large masses of individuals from the enslaving tasks of manual production, creating for them the possibility, and the opportunity, to become involved in the intellectual processes.

Finally, it will be desirable for more and more computer installations to follow the lines of action of the Electronic Computation Center of the National Univ. of Mexico and convert themselves into powerful and active centers for the assessment of scientific and technological needs, for natural resource analysis, and for the implementation of the methodology for the application of science and technology to the development of their respective countries. After all, countries not fully developed will have to learn how to utilize computers as the most powerful tool to ensure not a "similar" rate of development that industrialized countries already have, but a "higher" rate of development. To do otherwise will maintain in the world the pernicious spectrum that spans from affluent to starving societies. ■

COMPUTING IN CANADA

by G. S. GLINSKI

The history of computing in Canada goes back to 1948. In that year the first Canadian company specializing in computing was established (The Computing Devices of Canada, Limited) and the University of Toronto embarked on its computer project.

In 1949 a computer research department was established by Ferranti in Toronto, Ontario.

In 1950, the first scientific computer was installed in the University of Toronto (The Ferranti FERUT) and the first course offering in computer sciences was given (The University of Toronto).

In 1951, McGill University had begun computer science courses in their Extension Department.

In 1952, CDC acquired the Canadian franchise for the CRC102A computer manufactured by the Computer Research Corporation in California.

In 1953, the first industrial computer (CRC102A) was installed at the AVRO Aircraft Company in Malton, Ontario.

In 1954, another firm, Data Processing Associates, was formed, and distributed Datatron 205 (manufactured by the Consolidated Electrodynamics Corporation in Califor-

nia). The first Datatron was installed in 1956 at the Atomic Energy of Canada, Limited, Chalk River, and at CANADAIR, Montreal.

In 1956, IBM began to install the 650 computer in Canada. The first three 650 installations were in Canadian insurance companies.

In summary, the general computer development in Canada has been strongly influenced by the United States and, to a lesser degree, by Great Britain. There were a few attempts at the independent development of specialized equipment, one in the Defence Research Board, one at the National Research Council of Canada, one at the Post Office (mail distribution) and one at Ferranti-Packard (airline reservation).

Present Situation: From its humble beginnings the expansion of computing in Canada has been just as spectacular as in the United States. As of March 31, 1964 there were 538 computer installations. Some 388 are in industry, 53 in institutions (universities, etc.), 65 in government, and 32 are unspecified. Of these, 123 can be classified as "small" installations (less than $2500 per month rental), 387 as "medium" (rentals between $2500 and $20,000 per month) and 28 as "large" (rentals greater than $20,000 per month).

Of this total, 375 (70%) are IBM computers.

The details of computer growth in Canada may be found in two periodically updated publications.[1,2]

Manufacturing: With the exception of IBM's assembly of some computer types in Toronto, there has not been, as yet, even one attempt to manufacture the general purpose computer in Canada.

Consulting: Almost all "management consultants" these days offer their services in the information processing field. There are, however, a few well established consultants specializing in this field alone (KCS, in Toronto, for example).

Use: In the industrial and business fields the prime use of computers is in the so-called "office automation." There has not been, as yet, even a single attempt to "close the loop" in manufacturing. In the government, probably the most spectacular result of the use of computers is in the field of income tax.

Education: Twenty-three universities offer now courses in computer sciences. Most of the universities are integrating these courses with their established curricula. In a few cases (the University of Western Ontario, for example) a new department (of Computing Science) has been established. The engineering departments and the departments of business administration are generally particularly active in this field.

Societies: The Computing and Data Processing Society of Canada, CDPSC (with headquarters in Toronto) is the national society, and represents Canada on the international scene. It has local branches in the main centers of computing activity. Since this society purports to encompass all of the computing activities in Canada, it has problems with the heterogeneity of its membership. It is thus not surprising that splinter groups begin to appear. In particular, the Computer Science Association (CSA) has been established to cater more specifically to the university computing centers.

Meetings: Periodically, CDPSC organizes national conferences. The last (4th conference) was held at the University of Ottawa in May 1964.[3] National conferences are quite costly in time and money. Recently, CSA inaugurated "microwave network" conferences. For the purpose of this conference all major computing centers of the universities are connected, for the duration of the conference (usually a few hours), by CP-CN Telecommunication facilities. Even though only voice communication is involved, the results have been quite spectacular. Assuming that closed circuit TV could be added in the future, this appears to be an ideal "modern" way of conducting conferences without the necessity of travelling to remote places.

Social Impact: We will not attempt here to discuss the philosophical aspects of the problem.[4] Instead, we will concentrate on the problems of employment.

It is obviously easy to gather statistics on the growth of employment in the field of electronic data processing (positive employment). There have been 3500 people employed full-time at July 1, 1962. It appears that this number grows in proportion to the number of computers in use (thus it seems there would be some 7000 people employed in edp now).

It is interesting to note that contrary to the standard notion of computers creating more challenging jobs, the greatest increase in the number of edp personnel is in the "menial" category of input preparation (keypunching, etc.). These, of course, are not all "new" jobs, but represent a conversion impact of edp on the traditional structure of office occupations.

It is more difficult to assess the potential negative employment impact of edp. To gather some reliable data on this subject, the government is conducting a case study of the introduction of a computer into a large Canadian insurance company, and 10 field investigations at large-scale business data processing installations.

The information gathered to date seems to indicate that of some 6,000,000 employed (1962 figure) in organizations operating computers, approximately 20% were clerical personnel. It appears that only some 10% of the latter (or 2% of the total) were directly affected by the introduction of edp.

It appears thus that "office" automation has not yet created any major upheaval in the Canadian employment situation. As a matter of fact, we could say that office automation will probably never be a major negative factor in the employment situation. This is *not* to say that there will be *no* problems. But the real problems will arise in another sector of employment, that of plant workers. ■

Mr. Glinski is professor and chairman of the Electrical Engineering Dept. of the Univ. of Ottawa. A Fellow of the IEEE, he is co-founder of Computing Devices of Canada Ltd., computer manufacturing firm that is now a part of Bendix. He holds a Dip. Ing. (equivalent to a masters) in EE from the Warsaw Technical Univ., and has done graduate work at the Univ. of Grenoble in France.

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[1]"A Second Survey of Electronic Data Processing in Canada 1962," *Research Program on the Training of Skilled Manpower*, Report No. 9C, Oct. 1963, Department of Labour, Queen's Printer, Ottawa, 1964.

[2]"Census of Computers in Canada," Special Supplementary Issue, April 1964, of *Quarterly Bulletin*, The Computing and Data Processing Society of Canada, Vol. 4, No. 3.

[3]The Computing and Data Processing Society of Canada, Proceedings 4th Conference, Ottawa, May, 1964, University of Toronto Press, 1964.

[4]J. C. MacDonald, "Impact and Implications of Office Automation," Occasional Paper No. 1. Economics and Research Branch Department of Labour, Ottawa, May, 1964, Queen's Printer, Ottawa, 1964.

THE LEO I

there was a machine

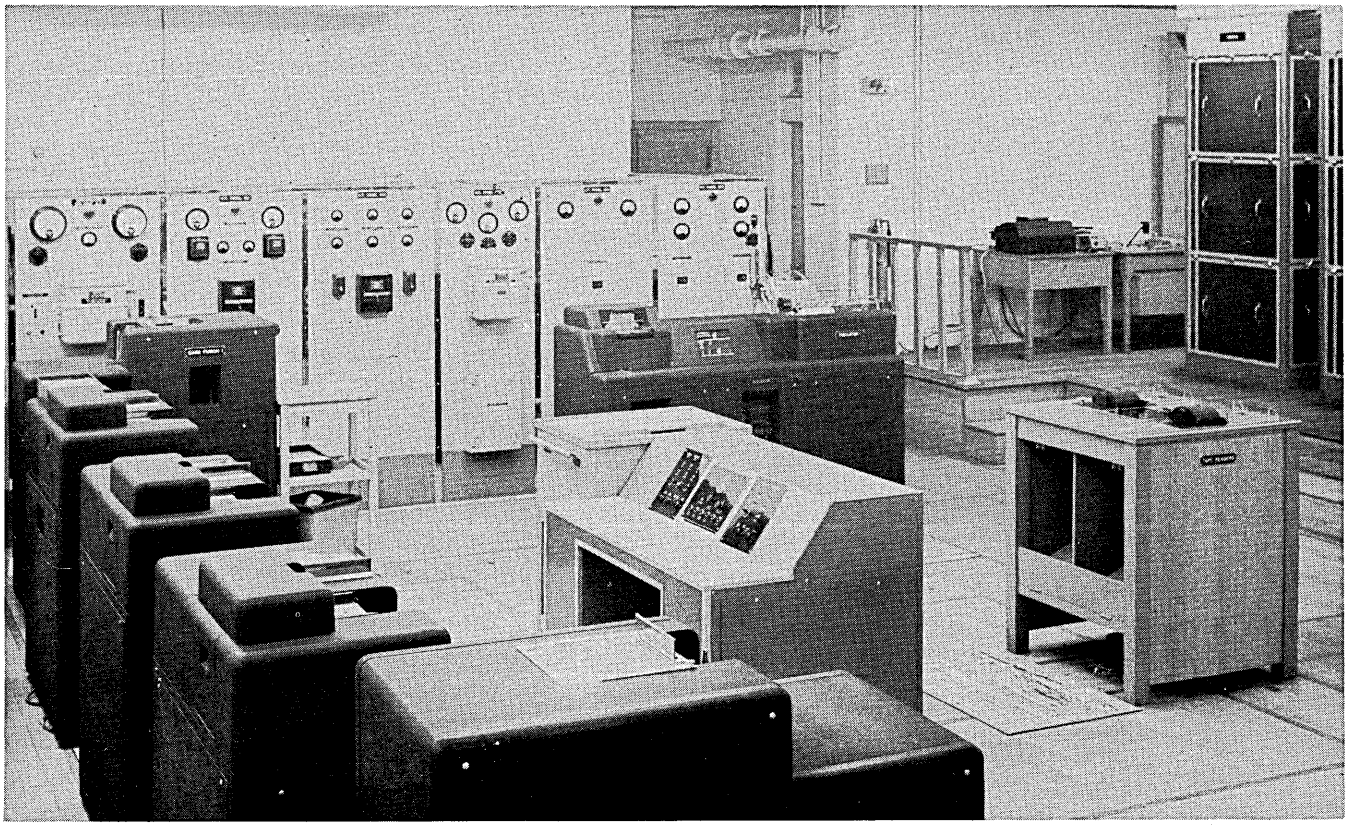
by GORDON R. GIBBS

LEO I (Lyons Electronic Office), one of the first British vacuum-tube computers, has been recently retired after 14 years of active service, and some "bits" are being moved to the Science Museum in London, England. I was fortunate to have been a member of the original team who began the development of this computer in 1949, under the direction of Messrs. T. R. Thompson and J. M. M. Pinkerton of J. Lyons & Co., Ltd.—a large catering and restaurant company.

The story of LEO I is generally considered to begin subsequent to the visit in 1947 by Mr. Thompson to the United States. T.R.T., as he is generally known, was then a senior member of the J. Lyons & Co. administration. He came to the U.S. to study the results of wartime developments in office management and organization. Whilst in this country, he became convinced that early calculators such as ENIAC demonstrated the feasibility of electronic office management. Following his enthusiastic report to the directors of the company, he was invited to proceed with a program of development. Surprisingly enough, he found out that the Mathematical Laboratory at Cambridge University in England was then developing a scientific electronic calculator (EDSAC) under the direction of Professor D. R. Hartree, Dr. M. V. Wilkes and Eric Much. In short, Lyons decided to enlist the cooperation of the EDSAC team and to re-engineer and modify the EDSAC design, with the plan that the resulting machine would be satisfactory for office management computations.

The basic units and flow of data were relatively conventional for that period; however, the input-output equipment was on-line and was isolated from the computer itself by a series of buffer registers—known as "annexes" which essentially allowed the computer to continue until input or output was available.

There was not much storage capacity by today's standards, and the average access time of the memory was 500 microseconds. However, later a semi-permanent store of data was held on 80-column punched cards for each job run on the machine. Jobs were generally broken into phases to circumvent the limitations of the small capacity store.



The mercury delay line storage system was initially relatively unstable and required demounting every few months; however, persistent efforts in this area resulted in a new method of "crystal wetting" and uptime became almost indefinite. A novel automatic frequency control system eliminated the need for critical temperature control.

LEO I was a single-address binary machine, and the actual time to add or subtract two numbers varied with the relative position of the data in the store. To obtain a relative idea of the machine's speed, the time to compute a man's wage allowing for all the exceptions of the British Income Tax and Social Security system was 1.5 seconds. This relates to the previous manual computation of eight minutes—a truly fantastic improvement for 1951.

The input/output for Leo I was a relatively sophisticated arrangement whereby programs were taken into the machine by means of high-speed paper-tape readers or from a punched-card pack; current detail data was generally fed in by means of the high-speed paper tape readers. There were two high-speed photo-electric tape readers and three 80-column punch-card readers. The output equipment consisted of two sets, each comprising an 80-column card punch and a line-at-a-time printer. The whole input/output system was switchable from the auxiliary operating console so that a considerable amount of equipment was available on a standby basis. Operational techniques called for a job to be set up on one set of equipment whilst the previous job was being run utilizing the other set.

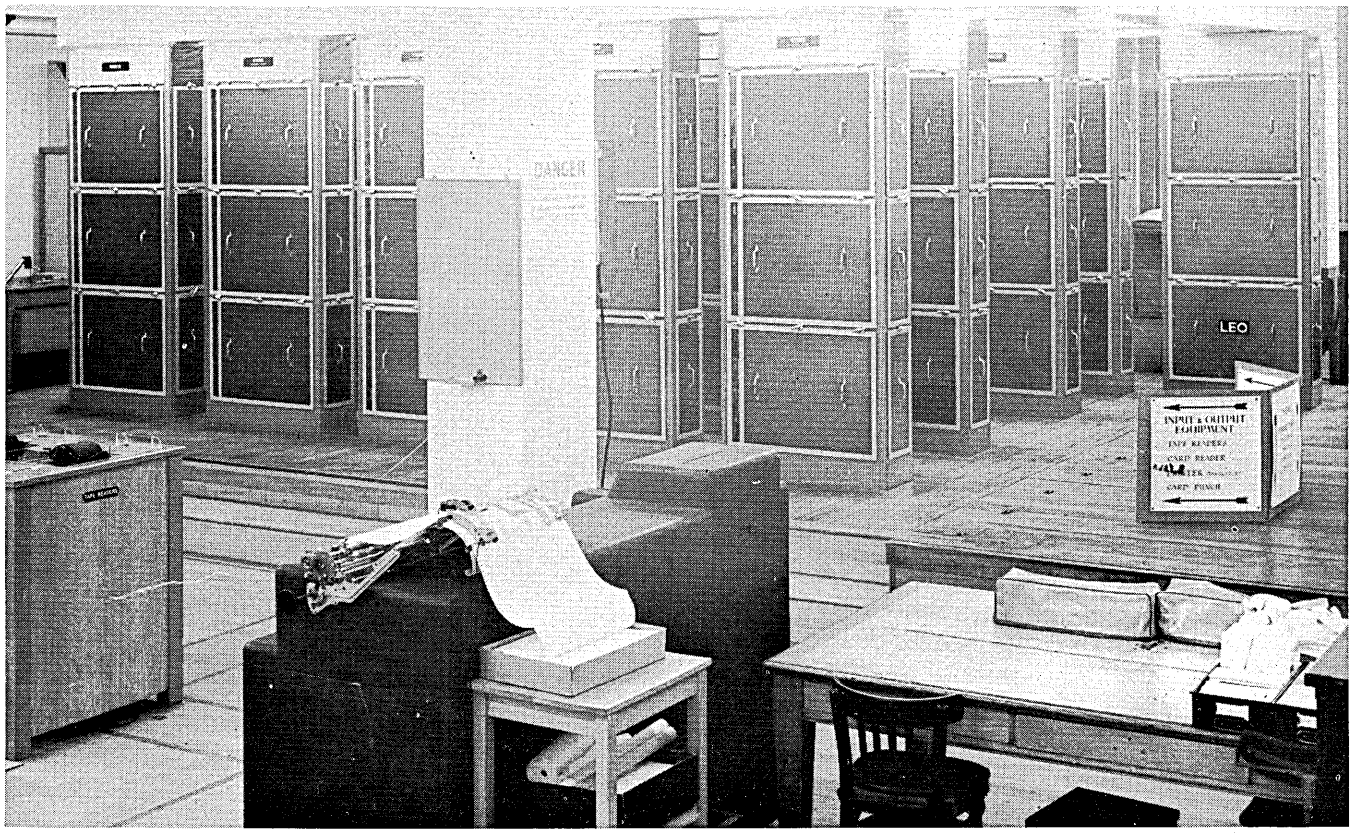
Current data to be entered into the computer often began life as hand-coded sheets and was translated into six-channel paper tape by a keyboard operator using modified Teletype equipment; the original data and the data tape were then passed on to a second operator for verification. This was carried out using a unique piece of checking equipment which compared the orginal tape, character by character as the operator re-keyed the data from the original sheets. The degree of data reliability was extremely high since only original errors were potentially able to reach the computer.

LEO I was equipped with a comprehensive marginal testing scheme which contributed to the extremely high uptime record; I well remember, in addition, that the junior technician was paid a bonus to go around the machine each morning and discover the vacuum tubes whose heaters had failed—truly a delightful task to look at 7,000 tubes. Subsequently, the computer itself was programmed to report those tubes most likely to fail, and these were removed before they became a source of difficulty.

LEO I began "earning its keep" in 1951 by carrying out computations associated with the Lyons bakery, the optimum mix for Lyons tea, recomputing new tax tables, fundamental crystollography work and the Lyons payroll. The total system was finally dedicated in 1953, by which time the original LEO team had grown to sizeable proportions. This event was celebrated by a magnificent dinner and entertainment in the Lyons tradition and it was, by this time, that LEO II had been conceived—a more comprehensive and faster machine. After LEO II, vacuum tubes were abandoned and LEO III, fully transistorized, became the staple product of LEO Computers Ltd.

The LEO group has now merged with other companies to become English Electric-LEO-Marconi Computers Ltd., and most members of the original team are still with this organization.

Team members who will always be remembered are John Pinkerton, the original source of my own personal motivation, Ernest Kaye, with whom I was forever playing relay games, Len Lenearts who actually put LEO I and LEO II together, Ray Shaw and Arthur Clements; Derek Hemy, Leo Fantl and John Gosden, the programmers who tamed the beast without the benefits of FORTRAN and COBOL, and Peter Mann, who kept the darned thing going; Wally Dutton who wired it up, Tony Barnes, who always seemed to be there, and T.R.T. who was a persistent inspiration to us all. ■



PROGRAMMING FOR AUTOMATED CHECKOUT

part 2

by Dr. VICTOR MAYPER, Jr.

Last month, Dr. Mayper discussed what a computer-controlled automatic tester is, what is involved in programming it, and some of the typical difficulties faced by an automatic-test programmer. The equipment consists of (1) a computer with peripherals, (2) specialized and often extensive controls and displays, (3) more or less standardizable input-output buffering, switching and conversion circuits, and (4) specialized signal generating and signal conditioning devices. The programming task is almost more like equipment and system engineering than it is like scientific or business programming. The largest single phase of the programming effort is system checkout with real dynamic prime equipment hooked up to the tester, and the second largest phase is defining the detailed program requirements on the basis of broad and generally-stated overall test requirements.

In this, the second and final installment, he discusses the special topic of automatic-test problem oriented languages (POL's), and a few additional summary conclusions of the recent Project SETE survey.

In scientific computation and data processing, problem-oriented languages (POL's) have proven useful in reducing programming costs and in simplifying training, so that engineers and scientists may often code their own problems without relying on a programming specialist. While the running efficiency and speed of the resulting program may not be as high as those of one prepared by an expert coder, this is usually a minor cost factor compared with the saving in labor, communication problems, and convenience of computer access. Favorable experience with scientific POL's has inspired their application to other fields, including automatic testing.

Even in scientific programming, however, there are some limitations on the usefulness of POL's. In any language which is heavily problem-oriented, there will be problems which a typical user might want to solve but which are awkward or even impossible to handle within the confines of the language. Often this happens when the user knows a language oriented to one type of problem, but wants to solve a different type of problem. Also, there may be areas in a particular program where speed or efficiency is particularly important. An escape hatch is usually provided, which allows portions of the program to be coded in machine language or assembly language by a trained programmer (e.g., FAP in FORTRAN).

In computer-controlled automatic testing, programming is in some respects more difficult than in scientific computation. The automatic-test programmer must be intimately familiar not only with the logical capability of the machine, but also with the detailed timing of its internal and input-output operations, with the input-output hardware, and with the instrumentation capabilities of the hardware.* He must also understand well the details of the prime equipment to be tested.

The training and talent required for such familiarity are considerable. Adding a moderate amount of coding training to the other training does not represent much of an increase. An engineer of the necessary ability for this task can be trained to produce useful machine-language codes, even on a very complicated computer, in a month to six weeks. Therefore, the programmer-training reduction due to a POL is less critically impor-

*The problems of timing, input-output, and instrumentation characteristics will, of course, vary from one system to the next more violently than does the basic computer code. Therefore, attempts to develop a "universal" automatic-test POL meet difficult obstacles.

tant in automatic testing than in scientific computing.

Further, unless the test problem is quite simple, it is unlikely that machine language or assembly language can be avoided entirely. There may be large portions of the test which are composed of simple steps, not very time-critical (at least on a scale of fractions of a millisecond), which can indeed be handled by a reasonably learnable POL. However, there will very likely also be significant portions where the test requires too many complex operations in too short a time to permit coding in the POL. (For example, certain dynamic tests of servos, or of telemetry apparatus, or of other digital equipment may require machine-language or assembly-language coding).

advantages in training

There nevertheless remain appreciable training advantages from use of a good POL. First, although most or all programmers might still have to understand machine language, the fraction of them who have to become expert machine-language coders will be reduced. Second, for simple tests where program and machine timing are not critical, test engineers may possibly code their tests themselves—as long as the process is monitored by an expert to ensure that the tests are indeed simple from the programming viewpoint, and that timing is indeed non-critical. Third, and perhaps most useful, a problem-oriented coding sheet is its own documentation, suitable for review by, and system training of, trainee engineers and programmers. Even if the trainees understand machine language, a good problem-oriented coding sheet is far easier to follow than a machine- or assembly-language coding sheet.

Three additional important advantages result from a POL which is well-matched to the problem: reduction in coding labor, improved communications, and improved assurance of good "operating system" basic software.

Coding labor may be reduced below that necessary for assembly-language coding by a factor of 2 to 4, or even more, for those portions of the total software to which the POL is applicable. This might reduce programming costs by 3 to 10%, or even more in special cases, neglecting the cost of the POL itself.

More important, the communication between programmers and other engineers is made more precise and rapid. A good POL can often permit a non-programming engineer to follow a program with relatively little training, and even possibly to write simple routines in the POL. The resulting high-quality engineering review, and cooperation on elimination of "bugs," can increase the final effectiveness and reduce checkout effort by a good factor.

Finally, the presence of a good POL almost always implies a good set of basic software (executive routines, GP subroutines, monitoring and emergency routines, etc.), and good basic software is critical to the success of a large automatic-test project. Good basic software has upon occasion also been provided in systems using solely machine-language programming, when the programmers and their management had the proper experience and knowledge. However, designing a good POL forces competent consideration of many of the basic software problems, and thus increases the probability that good basic software will exist.

The reduced coding training, reduced coding effort, and improved communication all tend cost, although the only effect for which quantitative estimates are available is the reduction in coding labor. The total reduction in programming cost due to a *good* POL may run from 3% or 4% to perhaps as high as 20% or 25%, depending on the importance of coding to the total task and on the detailed nature of the checkout communication problems. These figures ignore the cost of implementing the POL itself, which will tend to counterbalance them.

disadvantages of pol's

On the other hand, POL's also have disadvantages, also ultimately reducible to cost. To programmers, one of the most conspicuous disadvantages is the possibility that a particular language (or the compiler or interpreter which implements it) may not be "good." That is, programmers may be trained to use it, and actually try to use it, only to discover eventually that limitations of flexibility, timing, or convenience make it more practical to abandon the POL in favor of assembly or machine language. Worse, a language which is "good" for one testing problem, and which is therefore highly regarded by its users, may turn out not to be "good" for another testing problem. Considerable analysis and experience over a wide range of problems may be required to judge this issue.

A second disadvantage often encountered results from incomplete "debugging" of the compiler or interpreter. If a subtle error exists in the compiler or interpreter—and only the more subtle errors will be left after the initial "debugging"—a test programmer may spend inordinate amounts of checkout effort in the mistaken belief that a subtle error exists in his own test program. This danger is particularly acute with relatively new languages, and with test problems which "stretch" the language by their complexity.

A third disadvantage, applicable only to new POL's, is the universal problem of delivery schedules. If the POL is being developed at the same time as the test equipment, a programming supervisor subjected to difficult schedules may plan on training everyone in machine or assembly language, and might not code critical programs in POL until it has passed its acceptance test.*

The fourth and most obvious disadvantage of a problem-oriented language is the cost of implementing it—for automatic-test POL's probably five to 10 man-years. This, however, may be estimated reasonably well in advance, and merely forms part of the overall budgeting compromise.

It should be noted that these comments apply to computer-controlled automatic testing, which is the topic of this paper. For externally-programmed (tape-controlled) automatic testing, the situation is much more favorable for POL's.

interpreters and compilers

The distinction between a compiler and an interpreter can be important to the success of the POL implemented. Both compilers and interpreters are being worked on for automatic-test machines, and each has advantages in certain situations.

A compiler operates off-line. It translates problem-oriented statements into a machine-language program. The machine-language program is then placed on the tester to perform the test. Usually, a compiler generates only a few machine-language statements per line of code, which include the commands to be executed directly. If well-constructed, and used by a knowledgeable programmer, it may often produce a program almost as fast as one coded by an expert in machine language. Thus a com-

*Sometimes it is suggested that programmers code in POL from the start, and rely on manual "compiling" if the POL is not implemented in time. This, of course, is applicable only to compilers, not interpreters. It also has the disadvantage of possibly throwing a "manual compile" transient into the coding effort during the later and more panicky stages of development, instead of planning for the worst from the start.

piler tends to produce relatively time-efficient programs which take close to full advantage of the internal speed of the computer. In practice, compiler automatic-test languages also seem to be more flexible than interpreter languages. On the other hand, this very flexibility is associated with a higher complexity (and therefore longer training time and higher probable coding-error rate) in the language. Also, if the test program requires a small change, it must go through an off-line process of recompilation.

An interpreter operates on-line. The problem-oriented statements themselves (or perhaps condensed versions of them prepared off-line by a pre-processor) are stored in the test-program memory. As the computer runs the test it reads a statement from memory, translates it into a machine-language action, and then executes the machine-language action. Although this process can be made reasonably fast by means of well-constructed subroutines in the interpreter, it is inevitably considerably slower than the operation of a program which has been coded in machine language, or in a good compiler language. Available automatic-test interpreters seem somewhat less flexible than compilers—some even going so far as to require inputs in a limited, fixed format—but, probably for this reason, also seem easier to learn. Also, during "debugging" a programmer may make minor changes in an interpreter-coded program directly at the test-computer console, since the problem-oriented statements are still present in the on-line program, even on-line.

There are actually two classes of interpreters: one which reads problem-oriented statements and performs the complete translation process on-line, and one which takes pre-processed statements (perhaps even compiled machine-language calling sequences) and uses them directly to call on-line closed subroutines. Some automatic-test POL's use the latter "hybrid" approach, which eliminates much of the time required for on-line translation (although operating speed is still well below machine or compiler codes), and reduces the memory-size requirement significantly. The pre-processing is not so severe that it prevents an informed programmer from making rapid changes in the condensed statements at the test-computer console.

In summary, the compiler approach may be favored when the test operations are complex, when the test computer is "stretched" by the problem (e.g., when computer hardware cost has been minimized), or when the program is to be applied to a system whose testing will eventually become more or less routine and fixed. The interpreter approach may be favored when the test operations are relatively simple (although the overall test may be long and complex), when computer speed is not a serious problem, and when the program is to be applied to a system whose testing is in a state of continual flux.

So far, interpretive languages have had more use. Perhaps the largest present application is the Saturn project, for which considerable coding will be available in ATOLL. (The present version of Marshall Space Flight Center's ATOLL is a successor to previous Saturn languages, including MSFC Astrionics Division/RCA HYLA, Douglas Aircraft/Mesa Scientific STOL, and an earlier version of ATOLL from MSFC Quality Division). Compilers are also being worked on, such as Frankford Arsenal FATAL, and Battelle Institute is preparing PLACE, a framework and basic structure from which different machine-oriented compilers may more easily be derived.

some survey conclusions

A survey of programming in a number of automatic testing projects has recently been released by Project SETE.* The survey covered nine computer-controlled test systems in which the test system was external to the equipment tested, three systems which included built-in computers providing extensive system self-test, and two separate POL projects. In addition to much of the discussion above and in Part I, the following summary conclusions resulted.

obstacles to programming efficiency

All of the organizations surveyed were asked what was the most significant obstacle to programming efficiency that they had encountered. Of the nine answers from external-automatic-tester projects, six may be summarized as "difficulty of obtaining test requirements." Sometimes this was phrased as "difficulty of communication with prime-equipment designers," some times as "lack of priority or manpower for defining test requirements;" sometimes it even included "lack of sufficient prime-equipment information to let us understand and detail the test requirements ourselves."

An automatic-test programmer must understand the engineering involved in his test, and must be able to derive detailed tests from rather generally-stated requirements. Nevertheless, the only man who can efficiently state the basic test requirements is a specialist in the design of the prime equipment. Test programming will be slow, wasteful, and considerably less effective without his active cooperation. Furthermore, there must be sufficient documentation or oral communication to permit the programmer to fill in the details left unstated by the basic requirements, and to keep up-to-date on changes in the design. These facts are simple and obvious, but schedule pressures, manpower shortages, or administrative problems have often led to neglecting them.

Useful by-products of correcting this situation may well be (1) that test equipment (and programs) are available in time to help the prime-equipment designers solve some of their own checkout and integration problems; and (2) that early attention to test requirements may orient the thinking of prime-equipment designers more toward testable, producible, quantitatively-analyzed designs.

One other answer from external-tester projects—the Frankford Arsenal engine-tester project—was related to this, while being somewhat diffierent. Here, a detailed, precise definition of test criteria was also the biggest programming problem, but in this case the source of the problem was not insufficient attention from prime-equipment designers but a general lack of knowledge in the field. Test criteria for internal-combustion engines had never been investigated in a manner which would lead to automatable tests; and defining the test criteria was therefore a signficant engineering research project.

Other answers from external-tester projects included "checkout of new types of functions" (a more straightforward engineering problem), and "availability of prime equipment for dynamic program checkout" (to which the self-test discussion below is relevant).

From the self-test projects, two answers referred to

*V. Mayper, "A Survey of Programming Aspects of 'Computer-Controlled' Automatic Test Equipment," Report SETE 210/78, June 1964 (Project SETE, New York Univ., 401 W. 205 St. ,New York 34, N.Y.). The author wishes to express his appreciation to Project SETE for permission to publish this adaptation and summary of Report SETE 210/78, and to the many organizations and individuals who cooperated in the survey leading up to the report.

another major problem implied previously: "definition of test requirements." Two, however, referred to another major problem implied previously: the fact that when unproven programs are being checked out on unproven prime equipment via unproven test equipment, the checkout costs increase tremendously. Under these conditions, for a large fraction of the time, one of three things is true: (1) program checkout cannot proceed because of equipment checkout difficulties, (2) program checkout is difficult or invalid because the equipment is not in specification configuration, (3) there exists a subtle problem which has not been localized to either the program or the equipment.

The solution to this problem is not entirely a straightforward matter of priorities and manpower. Given the typical tight schedules of an important project, it may have no complete solution. However, there certainly are palliatives, such as avoidance of "tricky" programs, equipment scheduling which provides enough units to allow "muddling through" when the initial design is unreliable, and modularization of both equipment and programs, to permit checkout of separate pieces as equipment is available. Ease of recoding (to make program fixes or "kluges") is also important in this situation. Finally, it is important to assign high priority to early development of thorough self-test programs, and special integration-test and acceptance-test programs, for the automatic tester.

The remaining self-test answer referred to a rather special situation in which a large number of versions of the prime-equipment and test equipment existed, all of which needed somewhat different test programs. The resulting coordination problems were evidently serious.

Surprisingly, no one said that his biggest problem was lack of "design for testability" in the prime equipment, although there was some mention of it as a lesser problem. (However, this probably indicates that the test designers often accepted limitations on test quality when the prime equipment was not testable—not that the problem of "testability" was unimportant). Also, no one said that his biggest problem was obtaining definition and documentation of the test equipment I/O and interface equipment, although this was another strong contender for second place.

programming labor costs

There exists no good criterion for comparing programmer productivity among different automatic-test projects. Number of words is a measure of the size of the program, and therefore the number of words produced per man-year of programming is considered a measure of the net production rate. However, simply counting words per man-year does not take into account the relative difficulty of different tasks, so it is by no means a measure of efficiency or absolute productivity. "Words per man-year" may differ by a factor of 10 from one project to the next, even though both projects seem to have equally capable and well-organized programming staffs, simply because of differences in the character and difficulty of their tasks. For these reasons, "words per man-year" figures should be interpreted as measures of the difficulty of the task, not as comparisons of relative programming efficiency.

In general, programs making considerable use of the computer's ability to do complex things seem to run about 1500-3000 words per man-year, although some operations involving considerable sophistication or large amounts of coordination effort run lower, and under very good conditions the figure may run considerably higher. Programs in which the computer does relatively simple things (even though it may do them rapidly and in large

numbers), usually in an interpretive mode with coded data, may run up to 8,000 or even 10,000 words per man-year.

One observation which may be of interest is that the differences in "words per man-year" due to task differences are so large that they completely mask any statistics of efficiency improvement due to problem-oriented-language coding. While a good POL will almost certainly improve automatic-test computer-program production rate, the improvement is probably in the 3%-20% region. This is not easily distinguishable compared with factors of 1.5 to 10 among different projects.

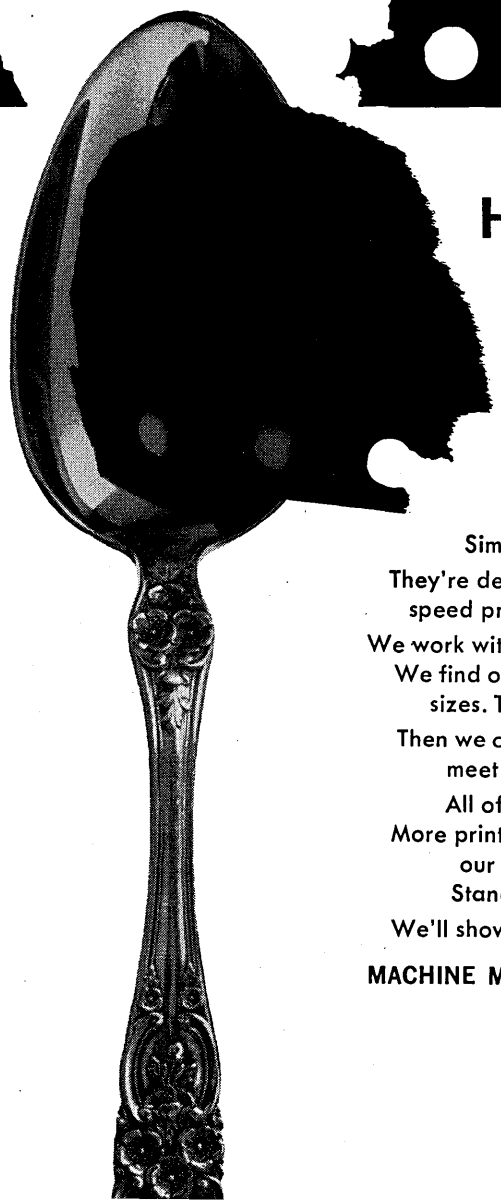
design and checkout aids

Since the design of an automatic-test system may involve a large wiring and system-integration problem, a number of projects have made use of various automatic aids to speed and make more error-free the design of the interconnecting wiring. These are usually programs on large data processors. In some cases, particularly in digital "adapter" equipment, modern design-automation aids permitted unit wiring layouts to be made almost directly from logical equations, with a minimum of human direction as to the placement and choice of plug-in modules. More frequently, the basic wiring design was manual, but automatic aids were used in the many clerical steps involved in developing (and updating) final wire lists. The automatic aids also made feasible various types of printouts to speed checkout (e.g., a list of all the pins on which a particular signal appears) and equipment production (e.g., separate lists of "buss" and "harness" wires). Finally and possibly most important, they proved extremely useful in catching errors in the initial design, such as wires improperly connecting two signal paths, gaps in signal paths, excessive capacitance, and others—and to prevent the introduction of new errors while updating the wire lists.

For the design and evaluation of test program for digital prime equipment, a bit-by-bit, diode-by-diode simulation of the prime equipment on a large data processor has been used effectively. To analyze the effect of each of the thousands of possible prime-equipment faults is excessively time-consuming and error-prone, and to prove the program by introducing each fault into a piece of real prime equipment is probably impractical. However, digital simulation of the digital prime equipment can do the entire job in relatively inexpensive fashion, with accuracy limited only by the "goodness" of the simulation. Less use has been made of this technique for analog prime equipment, probably because of the greater difficulty of making a fine-grained simulation which is "good" from the viewpoint of the test designer.

Digital simulation of the tester (rather than of the prime equipment) has also proved a useful tool for checkout of programs in general. Several organizations have simulated the logic of their automatic testers on large data processors, and can thereby perform much static checkout without tying up the real automatic test system. Here also, however, the difficulties of fine-grained simulation of the prime equipment have been important, and have restricted most use of the technique to static checkout.

"Hardware" models of the prime equipment have also been used, particularly for the earlier stages of program checkout. Again, the engineering effort and cost involved in making a "good," fine-grained simulation has limited use of the technique. ■



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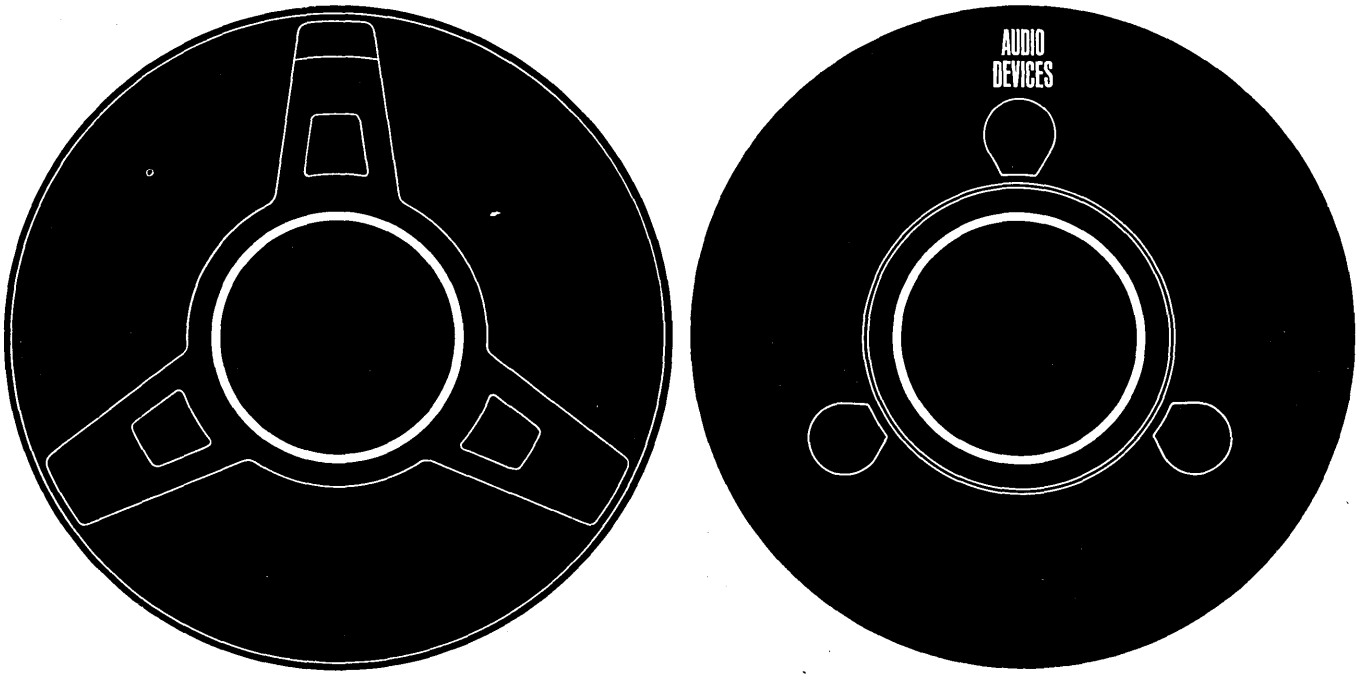

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THE T-FORMATION

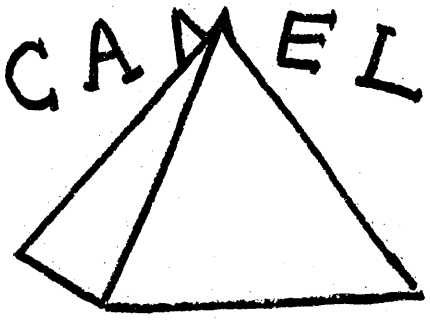
eliminating edp empire building

by T. D. C. KUCH*

Teamwork, as we all know, is the most important aspect of business management. No amount of know-how or common sense can make up for poor teamwork at the top level. Gibbons and Smith[2] have shown that it is not the personalities of the men in the team that contribute to good teamwork, but rather the Organization of the team. With proper Organization, and a properly-drawn Organizational Chart, *any* team can function to perfection.

The history of Organisational Theory to the present time has consisted of repeated attempts to update the classical Pyramid (see Fig. 1) for modern business use (see Fig. 2). The Pyramid, we all know, derives its stability from its broad base and triangular form. The first Pyramid was designed by an Egyptian management-consultant for the ruler, Rameses II. This Pyramid has lasted for thousands of years, furnishing an inspiring model for today's Top Management.

Fig. 1: A Pyramid



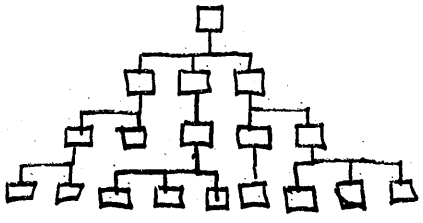
However, the Pyramid is clearly unsuited to this century. Its extreme stability entails lack of flexibility; its perfect symmetry fails to take account of the fact that some departments of a corporation, such as Data Processing, achieve a position on the chart out of all proportion to their real importance.

One of the variations on the Pyramid has been the Modified-P (Single Wing), which is shown in Fig. 3.

The DP Department shows the result of several years of intensive growth, which has made its size eclipse that of the parent organisation. At this point one of two things can happen. Either the leftmost Pyramid will fall, lacking a Broad Base, or the DP Department will swallow it up, turning the whole company into a Service Bureau. At the stage shown in Fig. 3, one of these alternatives is about to happen. This is symbolised by the daggers, which indicate a Reciprocal Relationship. All this would have been avoided had the corporation used the T-FORMATION.[3]

In Fig. 3 we see that the only de-

Fig. 2: Another Pyramid



*President of Kuch Konsultants Inkorporated.

THE T-FORMATION

terrent to the DP Department's growth is the limitation imposed by the Chief Executive. If he can be cowed, the DP Chief is given free-rein for empire building. This tends to happen far more often than one might expect, given a chance distribution of computers, empire builders, and Chief Executives.

In the T-FORMATION, however, there is no danger of this. In the T-FORMATION, by the time a manager has acquired a position of power, he is bereft of all subordinates but one (see Fig. 4).

We see in this diagram that the DP Chief must cow *five* executives before attaining his goals, which invariably are (1) a larger staff, (2) a bigger, more expensive, faster computer with more buttons, lights, bells and whistles, and (3) a private secretary, preferably a divorcee with her own apartment. It will readily be seen that (2) leads inevitably to (1), which in turn leads to (2) again, and so on. Goal (3) has little relation to (1) and/or (2). In fact, realization of this has led some Chief Executives to bestow (3) upon their DP Chiefs, so that they will have little time to ponder the best ways of attaining (1) and/or (2).

Fig. 3: Modified-P (Single Wing) showing DP Department on the right.

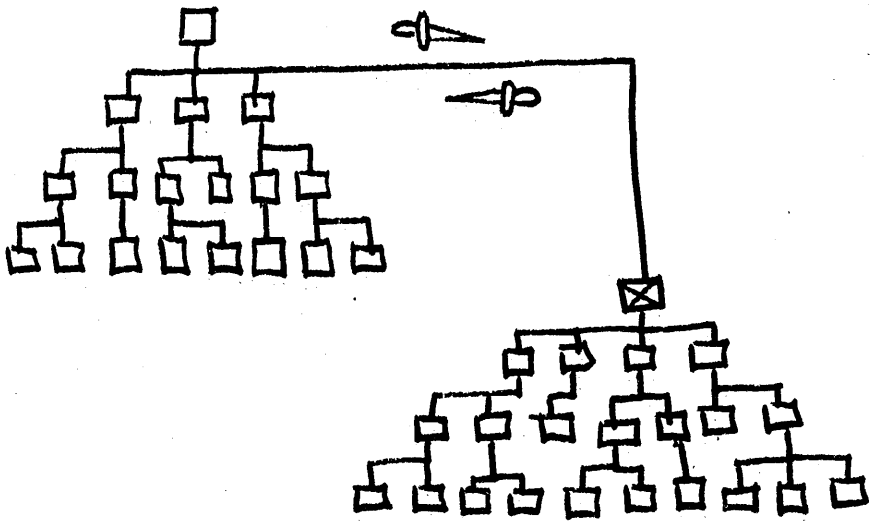
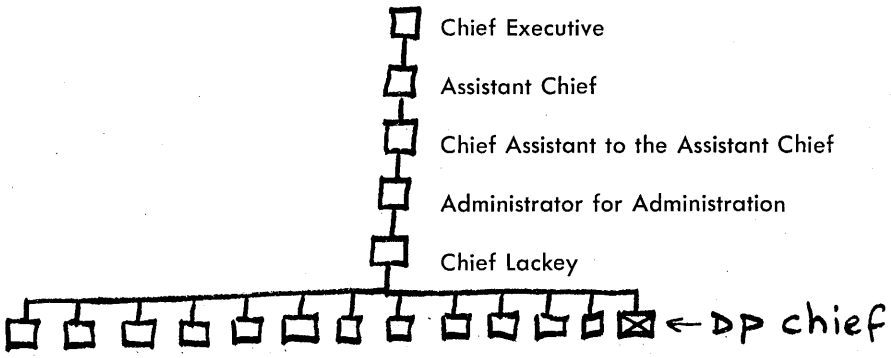
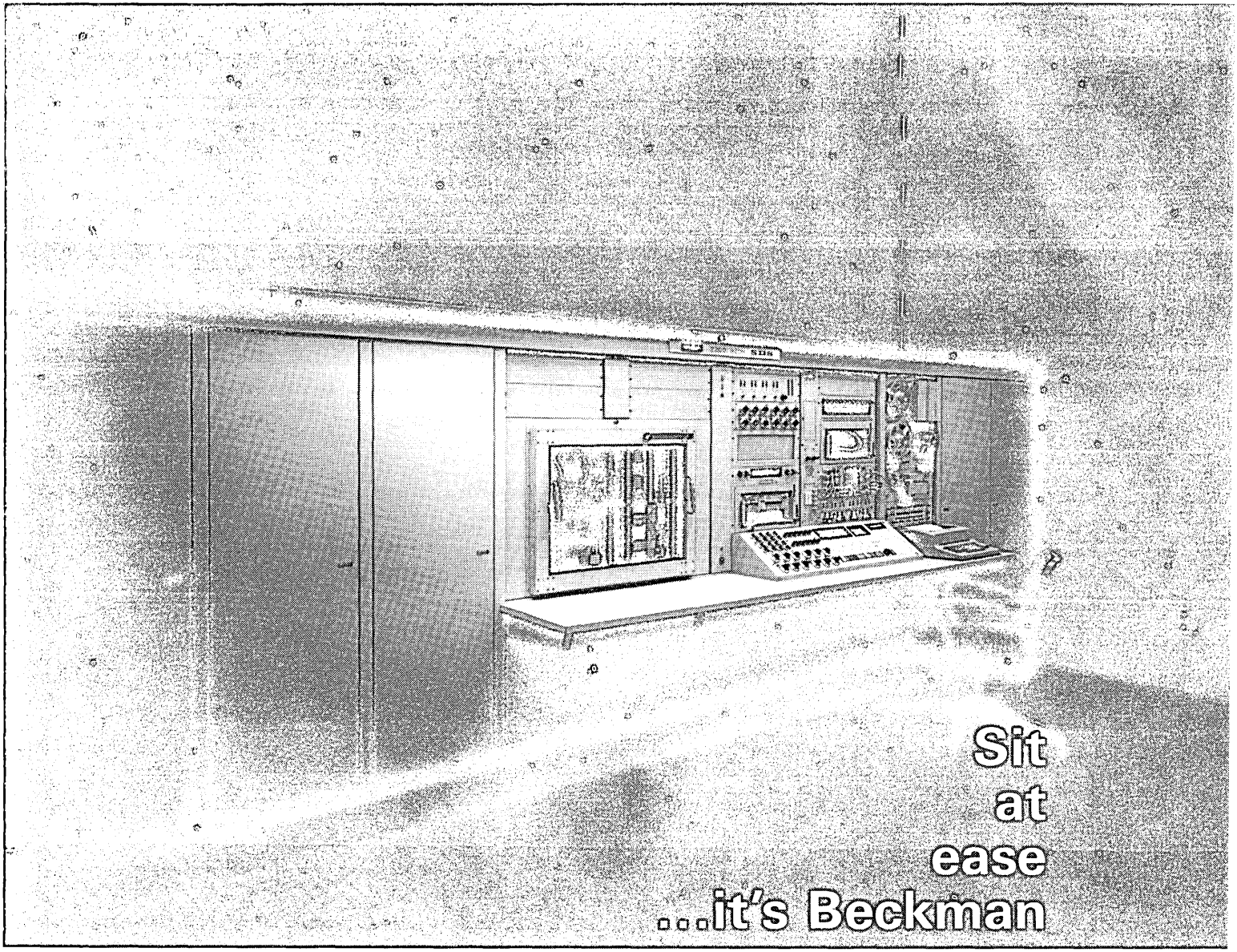


Fig. 4: T-FORMATION, showing DP Department in its proper place (for private industry only; for Government agencies, turn the diagram upside-down).



In the T-FORMATION, the DP Chief can advance only by becoming Chief Lackey, then Administrator for Administration. Once he becomes Chief Assistant to the Assistant Chief, his influence is limited to an occasional browbeating of the Adm/Adm, who invariably doesn't listen to him anyway. He will attempt first to sway,



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then to replace the Assistant Chief. This, in spite of by now long odds, he may do. In the position of Assistant Chief, he will attempt to sway the Chief Executive. It is assumed that by this time *all* lower positions will have been usurped by DP personnel.

In time (*per impossible*!) he may even become Chief Executive, a result which the T-FORMATION is designed to prevent, but which, in a few cases, may happen. His broad background of DP experience, and his far-reaching and powerful mind, will soon go to work.

He will expand the corporation as fast as possible, hiring employees in anticipation of possible future needs, buying more and bigger computers,[4] extra bells and whistles, etc., until the whole operation becomes as solid and immobile as the pyramids at Gizeh, and just as relevant. ■

REFERENCES

[1]This paper is the substance of a talk recently delivered at a meeting of the Tab-Planners' Management Association (TPMA).

[2]L. Gibbons and J. W. Smith, "Organisation of Businesses; a Summary of Progress in the COMATOSE (COmputerised MAnagement TOols and SErvices) Program," J. DataQ.Rev., 3:3 (1964).

[3]This New Concept was developed by KKI as an unanticipated byproduct of our management science software package PRATFALL (PRogrammed Administrative Techniques For ALleviating Logjams). *This* catchy term was generated by our program ACRONIM (Automatic Computer ROutine for Names In Miniature).

[4]Kuch's Extension of Parkinson's Law states that, in a Healthy Business, a larger and faster computer will be purchased when ½ the capacity of the present computer is used at peak-load time. The new computer will invariably have 3/2 the throughput capacity of the old one. To avoid much of the ensuing embarrassing idle time, tab-shop jobs will be written in COBOL, ALGOL, or HADACOL (Half-Adequate Data-ACquisition Oriented Language) and put on the computer. For this purpose, we here at KKI have developed and copyrighted DOPE (De-OPtimised Edit), a COBOL program which reads punched cards and checks for a group-mark in column 80. It requires 45 minutes to compile and two seconds per card to execute. We guarantee issuance of source-language changes at least once a week. It is ideally suited to Healthy Businesses.

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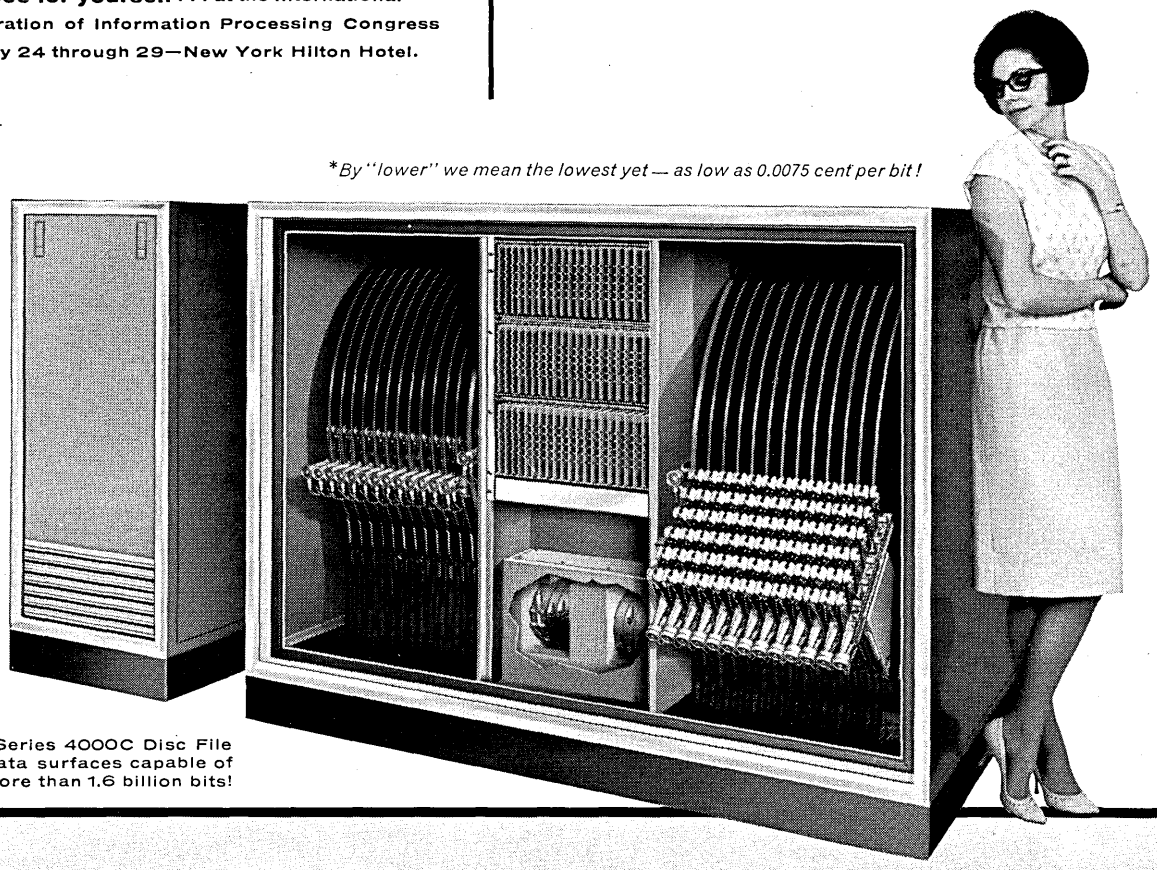

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IBM vs REMRAND

part I
the early struggle

by GEORGE SCHUSSEL

Until the end of the 1950's, two American firms, IBM and Remington Rand Inc. (now Sperry Rand Corp.) dominated the world market in the field of digital electronic computers. Their struggle for pre-eminence in selling, leasing, and installing computers is the focus of this article.

In the spring of 1951, the division of Remington Rand that had formerly been the Eckert-Mauchly Computer Corp. delivered and placed into operation the first large-scale, commercially-available computer. That computer, a Univac I, was delivered to the U.S. Bureau of the Census. Indeed, the first large-scale computers sold to private enterprise for non-scientific uses were Univac I's. Starting in 1952, systems were sold to Sylvania, General Electric, Prudential Insurance, Home Life Insurance, A. C. Nielson Inc., and others. By the end of that year, RemRand had acquired Engineering Research Associates (ERA) which, with the Eckert-Mauchly group, was one of the two foremost companies in the field of electronic computing.

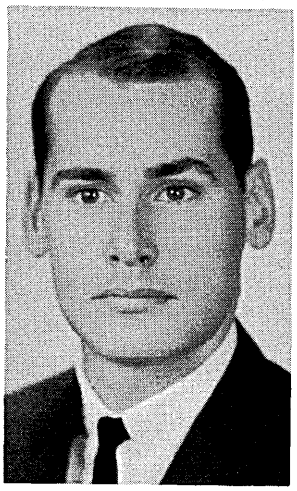
Meanwhile, IBM was the leading office machinery company in the world, and RemRand was considered merely a "tag along in the punched card field."[1] Until 1956, when IBM brought out the model 704 computer, there were no machines on the market that were technically superior to the Univac I.[2] Although IBM had built the world's first computer (Mark I), RemRand, with the Univac, was clearly the outstanding company in the world for computer-based data processing and large-scale computing from 1951 to 1956. By 1957, however, RemRand had lost its position of dominance to IBM; by 1960, the Remington Rand Univac Div. of Sperry Rand was a secondary force in the computer market.

> It (IBM) has installed more than three-fourths of the computers in the world—an estimated 13,000 to 14,000—or more than 10 times the tally of its nearest competitor, Univac . . . It has over 19,000 data processing customers . . . [3]

IBM is the business image of one man, Thomas J. Watson, Sr. For 42 years, until his retirement in 1956, T. J. Watson was the head of the International Business Machines Corporation. The company, which he molded, is a reflection of his beliefs from research to sales. Although there is a general consensus, among those who work and have worked for IBM, that it was Watson, Sr., who initially prevented the company from entering the electronic computer business before it did, it is still a reflection of the man and the company that once IBM realized its mistake, it took them only five years to become the outstanding company in the field.

In 1950, IBM was the dominant company in the data processing and office machinery industry. Computers were not yet a factor and at that time its dominance was based on electromechanical systems which depended on Hollerith punched cards. IBM's systems were called unit records and only a small amount of electronic equipment was used with the punch card sorters. However, IBM was familiar with the idea of large-scale modern computation. During World War II, its engineers, under the direction of Professor Howard Aiken of Harvard University, had built the first computer in the world. This machine was the electromechanical Mark I and was presented to Harvard by IBM. Mark I was put into operation, 24 hours a day, 7 days a week, in the basement of Harvard University's Cruft Laboratory. By 1946, when it was moved to the Harvard Computation Laboratory, the Mark I had revolutionized the calculation of mathematical tables.

The Mark I has been described as several large calculating machines strung together and operated by paper tape. This description may have some validity; however, it remains true that this machine was the first large-scale general-purpose computer that had internal storage and



Mr. Schussel is working toward the degree of Doctor of Business Administration (DBA) at Harvard, specializing in managerial economics, which is concerned with the mathematical and economic modes of analysis that can be applied to decision problems. He has served in technical capacities with Aerospace Corp., Douglas Aircraft, and Allied Chemical, and holds a BA in physics from UCLA and an MS in applied math from Harvard.

[1] "Sperry Rand: Still Merging," *Fortune* reprint U2190, March 1960, p. 10.
[2] See the Technical Comparison section.
[3] "Can IBM Keep up the Pace?" *Business Week*, Feb. 2, 1963, p. 92.

logical abilities. The one most important difference between the Mark I and modern day computers lies in the speed of operation. It could do on the order of one to ten calculations per second.

The next machine of this type that IBM built was the Selective Sequence Electronic Calculator, completed in 1947, which used tubes and relays and was capable of conditional branching.

Neither was exploited for commercial uses. The first large-scale data processing system that IBM developed for sale to the public was the IBM 701 Data Processing System. The development of this computer was begun at the end of 1950 and one model was put into operation late in 1951. The first production machine was delivered at the end of 1952, about 20 months after Remington Rand had delivered its first large-scale system, Univac I.

remington rand's first computers

In 1950, Remington Rand was the second largest manufacturer of office equipment in the United States. It competed with IBM along almost the entire range of office machinery. Remington got into the calculating machine business by buying out two small companies that had pioneered in this area.

In 1950, James Rand, the head of RemRand, bought out the company formed by two University of Pennsylvania professors, John W. Mauchly, a mathematician, and J. Presper Eckert, an engineer and genius in electronic circuitry. The Eckert-Mauchly Computer Corp. had already contracted to sell a computer to the Bureau of the Census. This computer was the Univac I.

Univac I was the direct descendent of two other computers that had been built at the University of Pennsylvania, Eniac and Edvac. Eniac had the special purpose of computing firing and ballistic tables for the Aberdeen Proving Ground of the United States Army Ordnance Department. This computation required the integration of a simple system of ordinary differential equations involving arbitrary functions. The Eniac was completed in 1946 and thus became the first large-scale all electronic computer. In one sense, however, this machine was not a full-fledged computer. Elaborate preparation of the wiring was required each time that the problem changed slightly. These connections required from 30 minutes to a full working day to set up and constituted a serious limitation of the system.[4] Because it was not programmed internally, the Eniac was conceptually inferior to the Mark I. Nevertheless, it was markedly superior in another characteristic . . . that of speed. Because Eniac was all electrical, it was much faster. A typical multiplication of the Mark I would require about three seconds, while the Eniac required 2.8 milliseconds.

After working on the Eniac, Eckert and Mauchly helped design the Edvac, also at the University of Pennsylvania. The Edvac was a stored program machine, as opposed to the Eniac; ideas that were incorporated in this machine were used in many other computers, notably the Univac. The Edvac is still in operation at Aberdeen.

Another company that Rand acquired had done some outstanding development work in computers. Engineering Research Associates of St. Paul, Minnesota, specializing in scientific computers, was bought by Remington Rand in 1952. ERA and Eckert-Mauchly were run as separate divisions and were not combined until the merger with Sperry Instrument in 1955.

The computers that were made by these two groups outsold the 701 and 702 of IBM through 1955. In January of 1956, however, IBM brought along and delivered the first 704 and, by the middle of the year, IBM was already decisively ahead of RemRand in computer sales.[5] By one year after the Sperry Rand merger, in June of 1955, IBM had delivered 76 large machines to 46 for Univac and had firm orders for 193 against Univac's 65.

was ibm behind?

Considering the prior performance and position of IBM in the data processing industry, many people were surprised that RemRand was the first company to embark on all-out computer development, thereby capturing the initial market. However, the extent of IBM's temporary lag is not as great as generally held. The facts do suggest that had the decision to enter computers been made early enough, IBM could have been the leading company from the start.

IBM did not stop all of the developmental work on computers after it built the Mark I. Its Selective Sequence Electronic Calculator went into operation in December of 1947. This machine was not entirely electronic, according to modern definitions, as it used relays as well as tubes; however, it was fairly modern in concept. By 1948, IBM had developed an all-electronic calculator of small size, the 604; and in the period 1948-1949, it combined this machine with an accounting machine to make a data processing system (IBM Card Programmed Calculator). All these developments took place before Univac was developed and, although neither of these machines was in the same class as Univac, they showed that IBM had acquired knowledge that would prove transferable to a more sophisticated calculator.

The first IBM machine directly competitive with the Univac was the 701. IBM had an operating model late in 1951 and delivered the first production model at the end of 1952. By comparison, the first Univac was put into operation for the Bureau of the Census in the Spring of 1951. This model, however, was not a production model and it was further changed before deliveries to firms commenced. The reason that IBM was not further behind than about one year was that it kept the development time on the 701 down to a remarkably small period. Development of the Univac was started in about 1947 and the first working model was operating in the spring of 1951. IBM began development of its 701 at the end of 1950 and its first working model was in operation by the end of 1951.[6]

thomas j. watson, sr.

To understand why IBM did not get into this field earlier, it is necessary to understand why Thomas Watson, Sr., did not want to commit his company to the development of computers.[7] This fact is reasonably well documented, but the reasons for it are not. Watson, Sr., was opposed by his son, the present chairman of the board at IBM, who was the leader of the group that tried to push his father into wholehearted backing of the electronic computers.

> Eventually, though, dissension about computers came into the open in IBM. The argument put the younger Watson (who became executive vice president in 1949) in the unenviable position of leader of the progressive element that wanted to plunge into computers—with his father, Thomas Watson, Sr., then chairman and chief executive officer, counseling caution and refusing to put the bulk of the com-

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[4] R. Serrell, "The Evolution of Computing Machines and Systems," *Proceedings of the IRE*, May 1962, p. 1045.

[5] c.f., *Fortune*, p. 6.

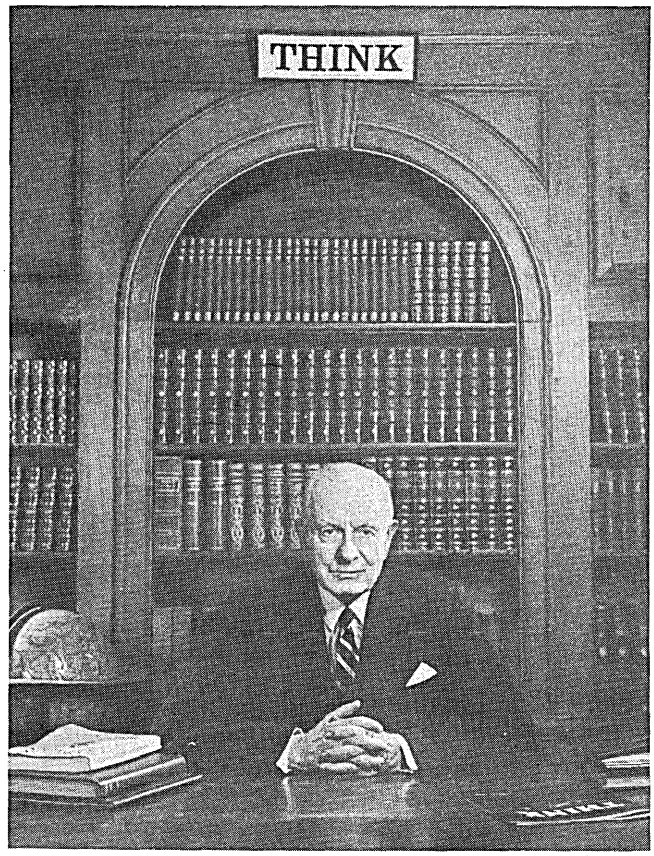
[6] Serrell, op. cit., p. 1050.

[7] Belden & Belden, "The Lengthening Shadow—The Life of Thomas J. Watson," Brown, Little & Co., 1961.

pany's resources behind a major computer development program.[8]

Watson, Sr. was a salesman and he did not want his company going into anything that would not prove commercially successful. The first computers that IBM built, Mark I and SSEC, were not in any way designed for commercial exploitation but were built only as a showcase for IBM engineering talent. Watson, Sr. thought of these machines as gifts to science and education. For example, he gave the Mark I to Harvard University. Watson did not believe that computers had commercial possibilities. Actually, in 1950, very few people believed that the market for computers would grow to its present day size.

Thomas J. Watson Sr. headed IBM for 42 years, retired in 1956. The company, which he molded, is a reflection of his beliefs from research to sales.



Just 13 years ago, electronic computers were a curiosity to most mathematicians, statisticians and scientists. Most predicted that eight or 10 of the big electronic brains—which then had about a hundredth of the power of one large-scale computer today—would satisfy the needs of the entire scientific community and the few businesses that might be able to use their strange talents.

This market miscalculation—one of the worst, yet most important, ever made—was accepted by most businessmen in 1950, including the top echelon at IBM. The worldwide market that has grown to about $3-billion a year for electronic computers and other equipment associated with automatic data processing was not recognized by most of the companies then qualified to develop the new technology.[9]

Even as late as 1956, market projections were sadly off. In 1956, an excellent and thoroughly comprehensive study of the industry was prepared by Arthur D. Little Inc., in cooperation with White, Weld and Co. It included technical comparisons of computers then on the market, estimation of market potential, backgrounds of the companies building computers, uses of them, etc. The report estimated that total future purchases of computers for all business, science and engineering, and government uses would total $2.4-billion. The study later hedged slightly by saying that "The $2.4-billion market will also tend to grow because of general economic expansion and replacement of obsolescent equipment." Considering that only seven years later the market for electronic computers had grown to $3-billion a year, it is obvious that market estimation by the most qualified of experts was considerably off even in 1956, let alone in 1950.

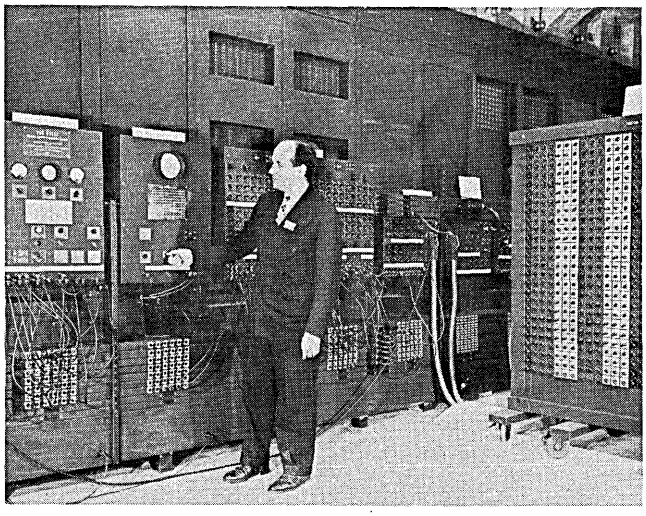
initial hesitation

In trying to analyze IBM's initial reluctance to enter the electronic computer market, one should also take into account the company's background and experience. IBM was not a company with a great deal of electronics experience. Most of its earlier equipment and experience had been electromechanical.

The same remark may validly be made about the Remington Rand Corp. If anything, RemRand was less knowledgeable about electronics than IBM was. The card systems that IBM had been marketing were electromechanical devices and used electrical contacts to activate the mechanisms. RemRand's punched card systems were mechanical. Pins were used to drop through the card holes and the information was conveyed by mechanical devices. RemRand, however, did not attempt to go into the field of electronics; it got into the field by buying other companies.

By buying out technologically skilled companies, RemRand gained a lead which enabled them to acquire most

Standing at the controls of the ENIAC, first electronic computer, is J. Presper Eckert. Developed at the Moore School of Engineering, Univ. of Pennsylvania, ENIAC contained more than 19,000 vacuum tubes, weighed almost 30 tons, occupied more than 15,000 feet of floor space.



of the first sales. Remington Rand did have a lead; they did have a superior computer. Why, by 1956, was IBM outselling Remington Rand in computers? And why, by 1963, had IBM sold and installed over 10 times as many calculating machines as Rand?

The answer to these two questions serves as the focal point for the rest of this article. Differences in company organization, background, attitudes, and policies played

[8] *Business Week*, op. cit., p. 93.

[9] Ibid., p. 92.

an important role, as did marketing and technical factors.

why ibm succeeded

One of the principal differences between Remington Rand and IBM was in organization. While IBM had developed an in-house capability, Remington Rand, and then Sperry Rand, were in the computer business through acquisition and merger. In IBM, the calculator had emerged naturally from the research and engineering done. The computer divisions at RemRand, on the other hand, went through at least two assimilations and complete changes of management within six years.

The computer organization that Sperry Rand inherited from Remington proved to be a large disappointment for the executive officers of the new Sperry Rand Corporation.

> Vickers (Sperry Rand president) and his Sperry executives knew about computers for complicated weapon systems; they knew nothing about making and selling Univacs for business. Vickers took it for granted that he had acquired from Rand, along with the machinery, all the kind of talent he needed for such merchandising. He knew, of course, that Jim Rand had run a one-man show for years, but he was completely unprepared to find Remington Rand so thinly organized. Soon it became apparent that nothing short of a complete reorganization was required, and Vickers began to move very cautiously and deliberately to get this done. He moved so slowly, however, that at times it appeared he was not moving at all. It must be remembered that James H. Rand, although sixty-nine years old in 1955, when the merger took place, was still a man of great force and strong character, that he did not retire as active head of his division until April, 1958, and that he remained as a director of Sperry Rand until February of last year (1959) [sic].[10]

When RemRand merged with Sperry, the merger was in many ways one of name more than of fact. Of course, merging the personnel, objectives, and resources of two companies as large as Sperry and Remington Rand was an extremely difficult proposition. RemRand's computer division continued to operate autonomously but under the direct control of James Rand.

> Early in 1958, Vickers finally began to act. He asked his old friend and colleague, Kenneth Herman, president of the Vickers division, to become executive vice president in charge of the Rand group. Vickers knew that under Herman's rather benign exterior lay great persistence, and that was needed. Less than four months after Herman took over, James Rand resigned. He chose his fiftieth business anniversary at seventy-one, as the date. Probably only Rand, Vickers, and Herman know the whole story of Rand's retirement, and they aren't talking.

IBM reacted to the challenge to its leadership in another manner.

> The loss of our business in the Census Bureau struck home. We began to act. We took one of our best operating executives, a man with a reputation for getting things done, and put him in charge of everything which had to do with the introduction of an IBM large scale computer—all the way from designing and development to marketing and servicing. He was so successful that within a short time we were well on our way.[11]

Thus, IBM's organization was completely centralized, as opposed to the RemRand system, where the groups that were formerly ERA and Eckert-Mauchly operated separately.

The two organizational policies seemingly present a paradox. In order to operate efficiently and with maximum speed, the management at IBM decided to adopt a centralized type of control, while the group at Sperry Rand believed that it had to "dismantle the one man show" before it could operate successfully.

There are important distinctions, however, that need to be made. The initial responsibility for getting the computer program under way was given to one man at IBM. Once the system was set up, it was a major goal of the IBM management to decentralize the whole company as well as the computer division. Speaking of the three-day session in 1956, when the whole organization of IBM was changed, Thomas Watson, Jr., said: "We went in a monolith, and we emerged three days later as a modern, reasonably decentralized organization, with divisions with profit responsibility and clear lines of authority."[12]

> Even after this subdivision of the monolith, the reorganization was not complete. Going into 1957, IBM had one large and four small divisions. . . . The big one, Data Processing Div., which made and sold unit record systems and computers, was doing a $700 million-a-year business by 1958—larger than IBM itself before the reorganization.
>
> The monster Data Processing Div. now had to be split—though DP people insisted it couldn't be done logically. Watson (Jr.) and his top aides labored at it a whole summer, tried various methods, found none that worked. Eventually, they did find a way—and out of the split came IBM's present form. . . .[12]

The situation at RemRand was quite different. Its computers were never under anyone lower than top management on the corporate level. The responsibility for their success was centered at the very top, in James Rand. Judging from the results, Rand was not able to integrate the efforts of his divisions effectively.

fast reactions

IBM's ability to react rapidly to a changing environment was also due to their organization. Repeatedly, IBM would show this talent once they realized the need for a change. IBM's first large commercial computer, the 701, is an excellent example of this. IBM executives realized the need for a machine of this type in 1949 and the total time from the start of development to the first production model was about two years. Another example of rapid development of a computer preceded this.

> The IBM Card Programmed Calculator line descended from the connection, made for Northrop Aviation in 1947-1948, of a multiplier to an accounting machine tabulator. . . . In 1948-1949, an IBM group produced the models I and II Card Programmed Calculator (sic) by connecting an IBM 604 to an IBM 402 Alphabetic Accounting Machine.[13]

The CPC was more of an adaptation of existing elements than an original development, but it was a versatile machine, models of which were still used in 1960.[14]

This ability to react quickly was prevalent throughout the IBM organization. An IBM consultant related that a working model of the completely redesigned electric typewriter, brought out in 1948 by IBM, had been designed and built in two months. ■

(Conclusion of this article will appear next month)

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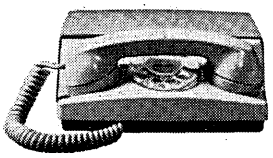
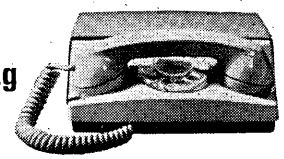
[10] *Fortune*, op. cit., p. 6.
[11] T. J. Watson Jr., "A Business and its Beliefs," McGraw-Hill, 1962
[12] *Business Week*, op. cit., p. 94.
[13] Serrell, op. cit.
[14] For example, the Bay State Abrasive Co. in Massachusetts.



Navajo Freight Lines takes the shortest route to faster billing



Navajo Freight Lines, Inc., uses Bell System Data-Phone* service to speed some 4000 bills a day.

At originating terminals, freight bills are cut on 35 ASR teletypewriter machines. Copies of the bills and an 8-channel by-product tape are produced simultaneously.

The tape is then transmitted over telephone lines at 1050 words per minute (or a bill every 3 seconds) to destination terminals and to Navajo headquarters in Denver.

At the destination terminals, tapes are inserted in 35 ASR teletypewriters which produce delivery copies of the freight bills.

At the same time in Denver, tapes are processed through a magnetic tape converter direct to computers which check for accuracy and produce copies of bills for preaudit.

This operation has made substantial savings for Navajo Freight. Billing steps have been reduced from 10 to 4. Accounting now takes just 2 days instead of 8. Current revenue figures are always available to Navajo management within 24 hours.

Find out how Data-Phone service can work for your data systems by talking with one of our Communications Consultants. Just call your Bell Telephone Business Office and ask for his services.

We'll be at the Spring Joint Computer Conference with the latest developments in Bell System data transmission services and data switching services. See our exhibit at booths 130-133.

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Bell System

American Telephone and Telegraph Co. and Associated Companies

CIRCLE 33 ON READER CARD

READY-READ CARD

new printed format

by JACK HORN

Probably the one item most widely associated with a data processing installation is the punched card. While other form of media exists and while a vast array of differing equipment is available, the lowly punched card is the most popular means of communicating with machines. It is evident in every country. Communist nations have modeled their computer equipment and their punched card code in the same manner as in the free world.

In the early 19th century, J.M. Jacquard, a French mechanic, developed novel cloth looms. The Jacquard looms, the name by which they are still known today, are controlled by what was then a revolutionary method. The mechanisms of his looms are controlled by a group of perforated cards. This was probably the first use of punched cards for process control—a common application today.

In the 1880's, the U.S. Bureau of the Census became apprehensive about the size and complexities of the forthcoming 1890 census. Dr. Herman Hollerith, a statistician, was engaged by the Bureau to develop mechanical means for the processing of census data. Hollerith was successful in developing working models of mechanical tabulation machinery. Primarily, his equipment utilized cards which contained coded data represented by holes punched in the cards.

The Dept. of Health of the City of Baltimore installed a set of equipment for the handling of vital statistics. This installation was the world's first (1889) electrically controlled punched card system.

Hollerith developed an electric sorting machine (at 300 cards per minute), a forerunner of the tabulator, and an electric key punch machine by the start of the new century.

The size of the punched card (3¼ inches by 7⅜ inches) was fixed by government specification. Legend says that this was to equal the size of the dollar bill at the time. Both 80 and 90-column cards have retained this size. The advent of the cut corner (for visually recognizing cards in juxtaposition or special or master cards) and the rounded corner (to minimize dog-earring of corners) were the only changes in the physical shape. Other materials besides paper stock, such as Mylar and plastics, were developed. But rather little was done to improve the printed format.

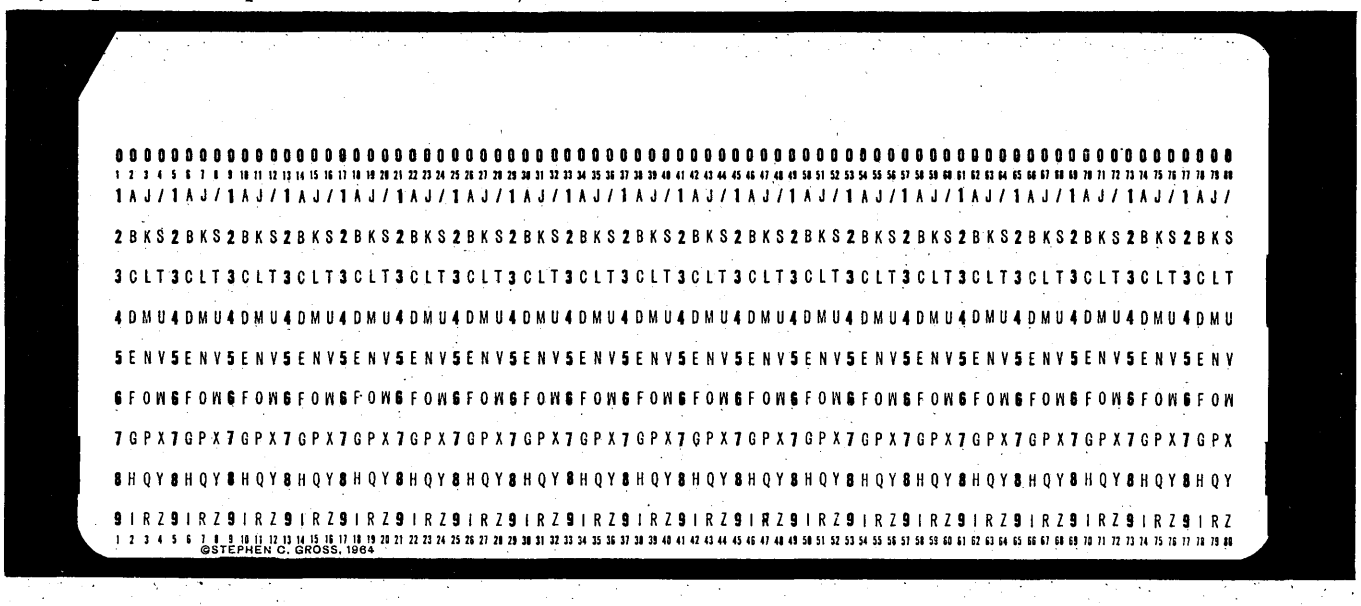
While Dr. Hollerith's machines have changed and the applications for electronic data processing are becoming endless, the format of the punched card as evolved in the last century has been unchanged. In the 1880's all data was viewed as being numeric. The printed format (0 through 9) was intended to assist in the visual reading of the cards. There was no need for letters as there were no letter equivalents punched in the card. Then, as until recently, cards were pre-printed with columns of the digits 0 through 9.

A new format, known as the Ready-Read card has been developed (see photo) which in time may replace the old format. Every fourth column contains the numeric equivalent in bold face type. The other columns contain the alpha equivalent in a lighter face type. The first group of letters associate with a twelve punch, the second set with the "X" punch and the third set with a zero zone punch.

A number of tests with users of the cards reveals that the card code need no longer be committed to memory. This permits easier training of new operating personnel and lessens the requirements for use of interpreting equipment. Fewer errors involving manual sorting and refiling of cards were evident in the tests.

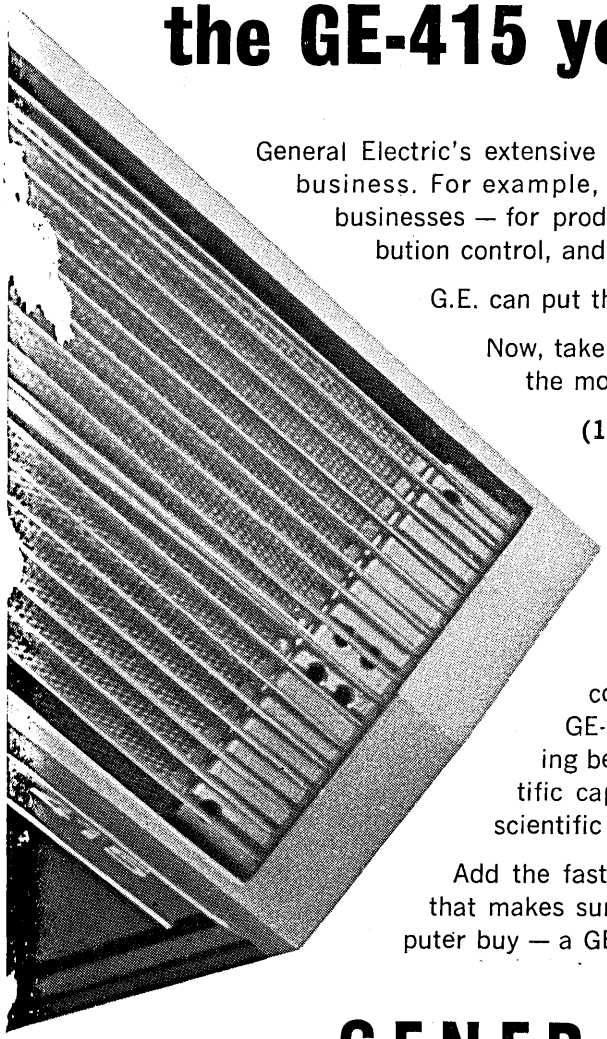
The federal government has been asked to consider the new format. A number of punched card manufacturers, who have user inquiries about the card, are contemplating the switchover. As the square cornered card is bowing out for the rounded corner card, the Ready-Read card may shortly eclipse the old numeric format. ■

A computer consultant in Weehawken, N.J., Mr. Horn is the author of a computer reference book soon to be published by Prentice-Hall.



GENERAL ELECTRIC'S USER EXPERIENCE MAKES A G.E. COMPUTER YOUR BEST PROFIT TOOL

And now—8 major advances make the GE-415 your best computer buy



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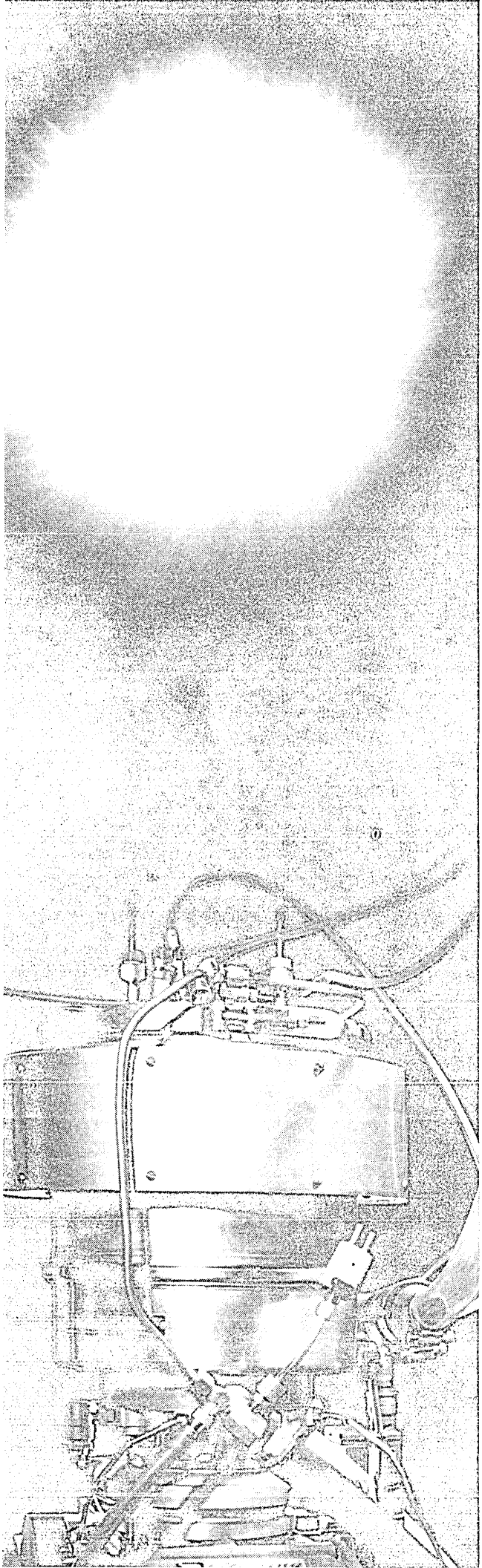
GENERAL ELECTRIC

CIRCLE 40 ON READER CARD

One of a series briefly describing GM's research in depth



Our Stirling Engine: Just Add Heat.

It's a thermal engine—a remarkably quiet device that can run even on heat from the sun.

There are no explosions in the cylinders, just quiet expansion and contraction of the working fluid, pushing the pistons. The fluid—hydrogen or helium—is sealed in the engine. Heat to expand it can come from any outside source . . . burning fuel, a nuclear reactor, a heat storage system, as well as the sun.

The Stirling cycle is reversible, too. Crank in mechanical power and the engine absorbs heat, becomes a refrigerator.

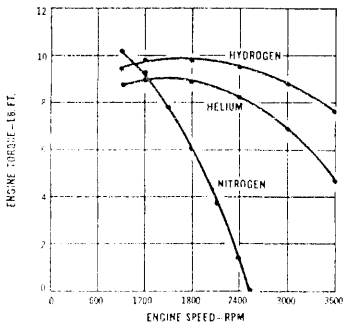
Invented back in 1816, the Stirling Thermal Engine is now becoming practical for modern applications. Current improvements have grown out of a cooperative development program with N. V. Philips' Gloeilampenfabrieken, of the Netherlands. Performance of the latest models is encouraging (40% thermal efficiency, for instance, compared to about 28% for conventional spark-ignition engines). An experimental three-kilowatt generator set is being tested for Army field use, where quiet is important. Inaudibility at 300 feet has already been attained.

The Research Laboratories and other GM groups are also studying Stirling systems from five to five thousand horsepower, for applications ranging from under the sea to outer space.

At GM Research, engineers study all kinds of engines. The research may be all-encompassing, from basic thermodynamics and engine cycle analyses to the design of prototype units. It helps us find a better way.

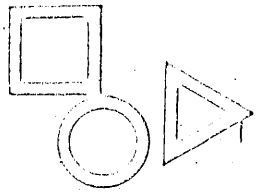
General Motors Research Laboratories

Warren, Michigan



Effect of working fluid on engine output—from a recent GMR paper on Stirling engine research.

CIRCLE 35 ON READER CARD



WORLD REPORT

UNIVAC INTRODUCES 1040 TO THE CONTINENT

Univac chose the largest of the European permanent exhibition sites, the German Industries Fair, Hanover, to introduce its 1040. This is the Sperry Rand reply to IBM's mod 20 and GE-Bull's Compatible 100's. Basically, it comprises a 1050 processor with on-line 1004. Released so far only on the Continental market, the 1040 is aimed at holding existing 1004 customers, located mainly in Germany, until a new integrated product range is announced. Anticipated date for the latter: September.

BRITISH, FRENCH DISCUSS JOINT COMPUTER EFFORT

Anglo-French cooperation in the development of large-scale computers is being discussed in government and industry circles of the two countries. Collaboration is seen as a solution to problems of small resources and markets that have made big machine projects in Europe a hazardous occupation. France is believed particularly well disposed to the idea since the U.S. State Dept. reportedly stopped a CDC 6600 from going to the French Atomic Energy Commission.

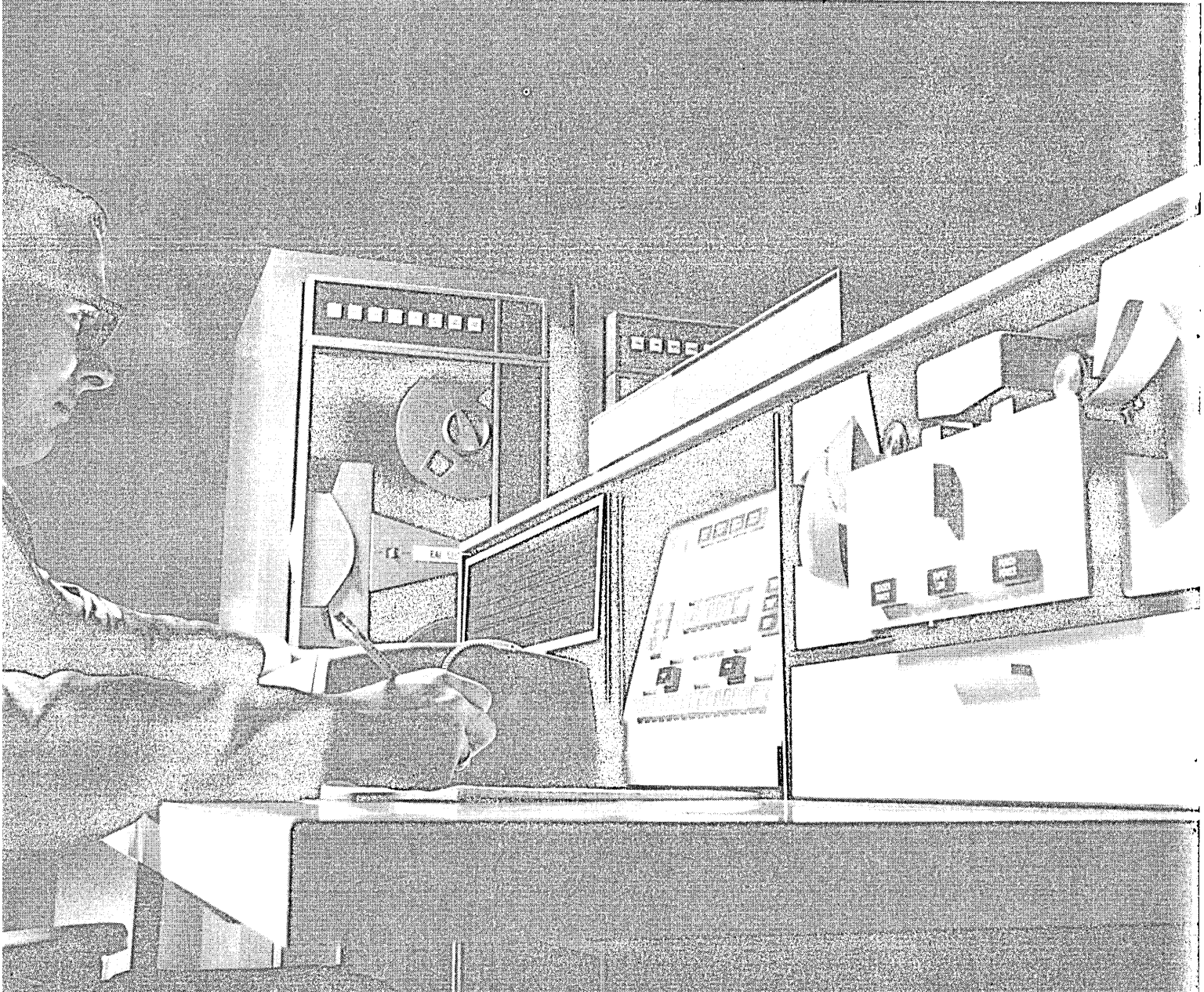
In Britain, ICT is known to support the idea; several other firms have been suggested as partners in a technical/marketing alliance. French participation could come from the small military R&D group in BULL that remained after the BULL-GE merger last year, or from SETI, Societe Europeene pour la Traitement de l'Information. SETI operates mainly in the scientific and industrial control field.

HOLLAND'S PHILIPS MOVES TO COMPUTER MANUFACTURE

The massive Dutch electrical combine of Philips has not unexpectedly stretched its tentacles into computers. In a two-way move the firm has taken a stake in Nillmy, an insurance group with the controlling interest in computer manufacturer Electrologica, and has established its own R&D and manufacturing facility at Apeldoorn in central Holland. The results of production at the new factory are not likely to appear before the end of this year. The company's main interest is in supplying its own needs and those of its military and communications customers. However, many Philips subsidiaries in Europe have been reorganized in the past year and this may result in an assault in '66 on the general purpose market. With a reputation for having the Midas touch, many industrialists fear Philips' awakening more than further U.S. competition.

ODDS & ENDS

The British Computer Society is expected to take over secretariat responsibility for IFIP. One of its first jobs will be to start planning for the next IFIP meeting, scheduled for London. ... One of the best kept secrets, an Australian Defence Dept. computer order for a classified application, has leaked out. The department has ordered a CDC 3400 ... First on-line, teleprocessed insurance application in Europe was placed on the air by the Drouot insurance group in France. It includes an IBM 7010/1410/1440 linked to 1050 terminals that service 40 provincial offices.



TALKING ON-LINE TO YOUR DIGITAL SIMULATION MODEL

A new technique of the Programming System for the EAI 8400 computer, Dynamic Storage Re-allocation, gets to the heart of digital computer simulation and model building. As the simulation reveals new insight into the physical model being studied, Dynamic Storage Re-allocation allows on-line changing of the mathematical model. Upon command, instructions and data can be inserted or deleted in-line as the program stored in memory is automatically expanded or contracted. This conserves memory storage and computation time by eliminating memory gaps and links to and from additions to the model. Like the many new techniques of the EAI 8400 system, Dynamic Storage Re-allocation is a combination of creative software and special hardware features. Programming Systems include Standard Monitor—Simulation Monitor—HYTRAN® Monitor. Write for details on the EAI 8400 Floating Point Computer and its Software for Simulation.

EAI® ELECTRONIC ASSOCIATES, INC., *West Long Branch, New Jersey*

NEWS BRIEFS

REAL-TIME SYSTEM USED IN AIRFRAME MANUFACTURE

A management information system for control of airframe manufacturing procedures is in the first of five phases at the Lockheed-Georgia Co., Marietta, Ga. Under the real-time InterLoc System, on the planning boards since 1960, 49 remote terminals are now on-line to two Univac 490's to send and receive updated information on the location and status of parts in production. Replacing a batch processing operation on an IBM 7080, the system increases production, inventory, and procurement control. The completed system, expected to be implemented by 1969, will include total manufacturing and accounting data; a quality history will be accumulated, and management decisions and results will be simulated and tested.

The present $100K/month system, which is expected to carry InterLoc through its second phase in 1966, includes: two 490's with 320K character capacity, four Fastrand drums with 64 million characters each, a Flying Head 880 drum, Univac communications multiplexer, 24 Southern Bell KSR-35 keyboard terminals, 12 IBM 1050 terminals, seven IBM 1001 stub card readers, three Univac 1004's, and four RO-28 receive-only terminals. About 100 RCA EDGE terminals are expected to go on-line by the end of the year. The REX executive program and a Lockheed-developed real-time program are included in software.

COMPUTER MAKERS MARKET VOTE-PROCESSING GEAR

Although negotiations between RCA and the publishing firm of Prentice-Hall have ended, computer manufacturers continue to expand their boundaries of information-processing activities. Both Univac and IBM have acquired marketing rights to vote-tallying devices—the former selling the Coleman Automatic Electronic Vote Tally System, product of Coleman Engineering Co. Inc., Los Angeles, and the latter getting the Votomatic.

The Votomatic is a notebook-sized device that holds a pre-scored punched card (which replaces the paper ballot) with up to 240 voting positions. The cards are then taken to a reader for computer input.

Univac's system is a ballot reader coupled to communications gear or to a computer. It enables retention of the ballot in case of a recount, and is said to simplify write-in votes.

DIRECT DIGITAL CONTROL USED IN GLASS MELTING

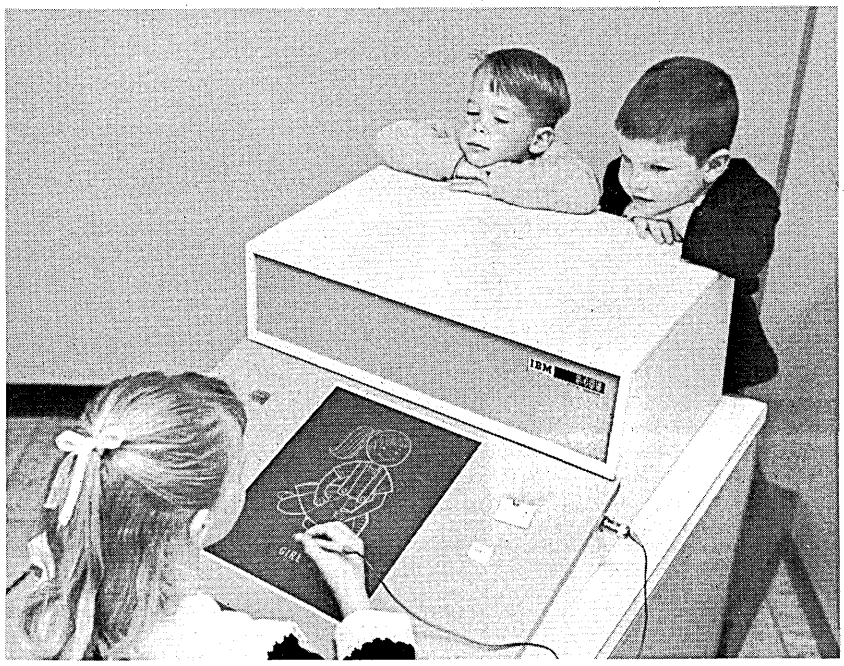
Direct digital control systems are replacing analog controllers at several Owens-Corning Fiberglas Co. plants. In a pilot project at Newark, an IBM 1710 process control system has been controlling a glass melting furnace round-the-clock for the last eight months. The system's accuracy is said to provide 60% more temperature control uniformity than the conventional closed-loop system. A possible 50% savings in cost of control instruments is also estimated. Two more process control systems are being planned for plants in Battice, Belgium and Aiken, S.C.

Under the system, the computer

STANFORD'S COMPUTER-BASED CLASSROOM ON THE AIR

The computer-based laboratory for learning and teaching at Stanford Univ. recently went on the air. The lab has six student stations, each equipped with a Philco CRT/keyboard console, IBM microfilm display terminal, and a soon-to-be-installed Westinghouse audio system; the latter provides random access to prerecorded messages for a student to hear. At present, 12 first-graders get 30 minutes a day at the terminals for math instruction. Two second-graders are also taking a mathematical logic curriculum, and two kindergarten kids are daily getting the first-grade program.

The experimental IBM terminal accepts microfilm packets with the lesson and question-answer frames. The equivalent of a 512-page book can be stored, and any frame displayed in one second. Communication with the computer is by light pen. Microimages are stored on film chips (four to a chip) in removable cells (64 chips to a cell). Each display unit also has two projectors, allowing for composite pictures when required. Also, portions of the screen can be masked. ■



PDP-6: A powerful on-line computer system for science and industry...

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In plain terms, PDP-6 is a lot of computer system for the dollar, and it's a bird in the hand.

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CIRCLE 37 ON READER CARD

NEWS BRIEFS . . .

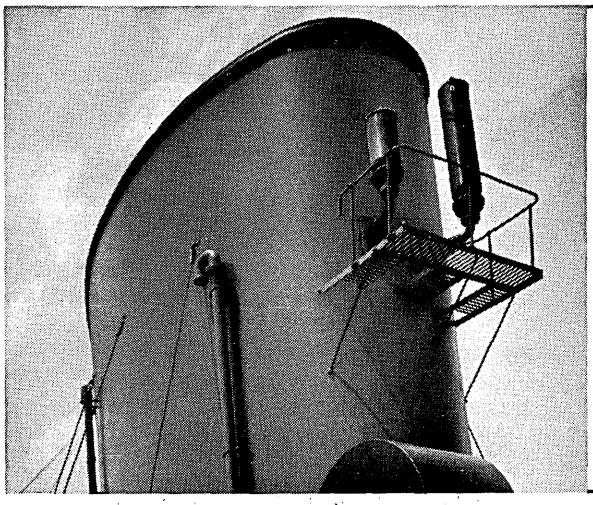
accepts and analyzes signals sent to it through an a-d converter from thermocouples and other sensing devices. The 1710 is programmed to scan the devices at varied intervals. When readings are outside set tolerances, the computer determines changes and outputs corrections.

● The numbers of digital computer installations and orders in 16 European countries both increased by nearly 50% during 1964, according to a study by Computer Consultants Ltd. of England. "European Computer Survey in 1965" gives the location, value, and model of installations and location and value of orders in Austria, Belgium, Denmark, Finland, France, Germany, Great Britain, Greece, Holland, Irish Republic, Italy, Norway, Portugal, Spain, Sweden, and Switzerland. At the end of 1963, the tally shows 3,919 digital systems installed and 2,335 on order; at the end of 1964, 5,880 were installed and 3,485 were on order. Leaders were Germany (1,413), France (1,084), Great Britain (948), and Italy (882). The total number of computers installed in the surveyed countries as of December 1964 was 9,534.

● A new wrinkle in computerized traffic control is a type of radar for scanning traffic, presently operating in Hamburg, Germany. Mounted over an intersection, the device is said to monitor all lanes of traffic approaching and leaving the intersection. The device was developed by Standard Elektrik Lorenz, subsidiary of International Telephone and Telegraph Corp., and compares with street-imbedded sensors in Toronto, Canada.

● A call for papers for the fourth conference on Electronic Computation has been issued by the sponsors, the American Society of Civil Engineers Structural Division Committee on Electronic Computation and the Los Angeles Section, ASCE. The meeting will be held Sept. 7-9, 1966, at UCLA. By Aug. 31, abstracts should go to Lucien A. Schmit Jr., Engineering Div., Case Institute of Technology, Cleveland, Ohio 44106.

● A modular on- or off-line information display system for use in public areas of airlines terminals has been announced by The Bunker-Ramo Corp. The Brite-Wall system can consist of different combinations of cath-



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CIRCLE 34 ON READER CARD

ode ray tubes ranging from 6 to 27 inches on a wall display up to 8 x 24 feet. The smallest tube can display one to three alphanumeric or symbolic characters about 3¼ inches high; the largest tube has a capacity of 12 lines of 32 cpl. The system permits error correction without redoing the entire message.

● Studying the feasibility of digital data transmission by light beam, and to determine terminal equipment requirements, the Computation Lab at NASA's Marshall Space Flight Center has installed a 2-mile optical data transmission system. It was built by GE's Radio Guidance Operation, Syracuse, N.Y. Advantages of modulated light-beam communication include information security, elimination of RF interference, low power requirements, and the availability of bandwidths into the gigacycle (thousand million cycles) range.

● Braniff International Airways, at the end of its eight-year contract with Bunker-Ramo for a vacuum-tube Magnetronic system, has signed a $1.5-million five-year contract with the same company for a more elaborate reservations system. In November, agent sets and teletype units in 30 major cities will tie into two 335 computers in the Braniff center in Dallas. The new system will be able to handle up to 30,000 reservations an hour; three-month seating inventories will be maintained in memory.

● Two hundred forty-five SCM teletypewriters, capable of printing 400 wpm, will be placed at U.S. Army Strategic Communications Command stations around the world this summer. The new units, model AN/FGC-80, can use either a single or double print hammer and are said to be up to four times faster than equipment now used by the Armed Services. The 64-character type units can provide lines of 72, 76, or 80 characters of standard or international communications symbols.

● Advanced students specializing in documentation and information science are eligible for 1965-66 scholarships at the School of Library Science, Western Reserve University, Cleveland, O. The awards are the result of a $5,000 grant from the Edwin W. Rice, Jr., Fund of the General Electric Foundation. Scholarship inquiries should go to the Dean of the School of Library Science.

● Almost 500 digital computers in 266 U.S. colleges are reported in the Sixth Survey of University Computing Facilities, published by the Computing Center of the Univ. of Rochester, N.Y. The figures are based on a questionnaire distributed in January of '63. Reported are 132 IBM 1620's, 41 IBM 1401's, and 23 LGP 30's. Geographically, California leads in number of machines (50), followed by New York (26) and Texas (25). Forty reporting institutions offer a degree in computer science.

● Plans for California's educational dp network have been modified to include the use of the Honeywell 2200 at three master regional centers and

the H-200 at nine satellite centers. The entire system, performing accounting and administrative dp and educational functions, may be operating as early as 1970. This July, a 200 is scheduled for delivery to two of the centers, one of which is to be upgraded to a 2200 in the fall.

● The Iowa State Treasury is $34,000 richer because of a new computer program the Iowa Insurance Dept. is using on its GE-235. The program accelerated the processing of records on $10.2 million in fees and premium taxes, and the returns were deposited with the Treasurer one month earlier than previous years. This earned the state additional dividends on investments. The Insurance Dept. also recently began processing agents' license procedures on the computer, trimming renewal delay from six weeks to one day.

● The Service Bureau Corp. has installed a teleprocessing system to link its New York and Washington, D.C. computer centers. The tape-to-tape system, which consists of two IBM 7711 communications units linked by a Telpak line, facilitates transmission of information for processing on the 7094 in New York. Each unit can transmit up to 5,100 cps.

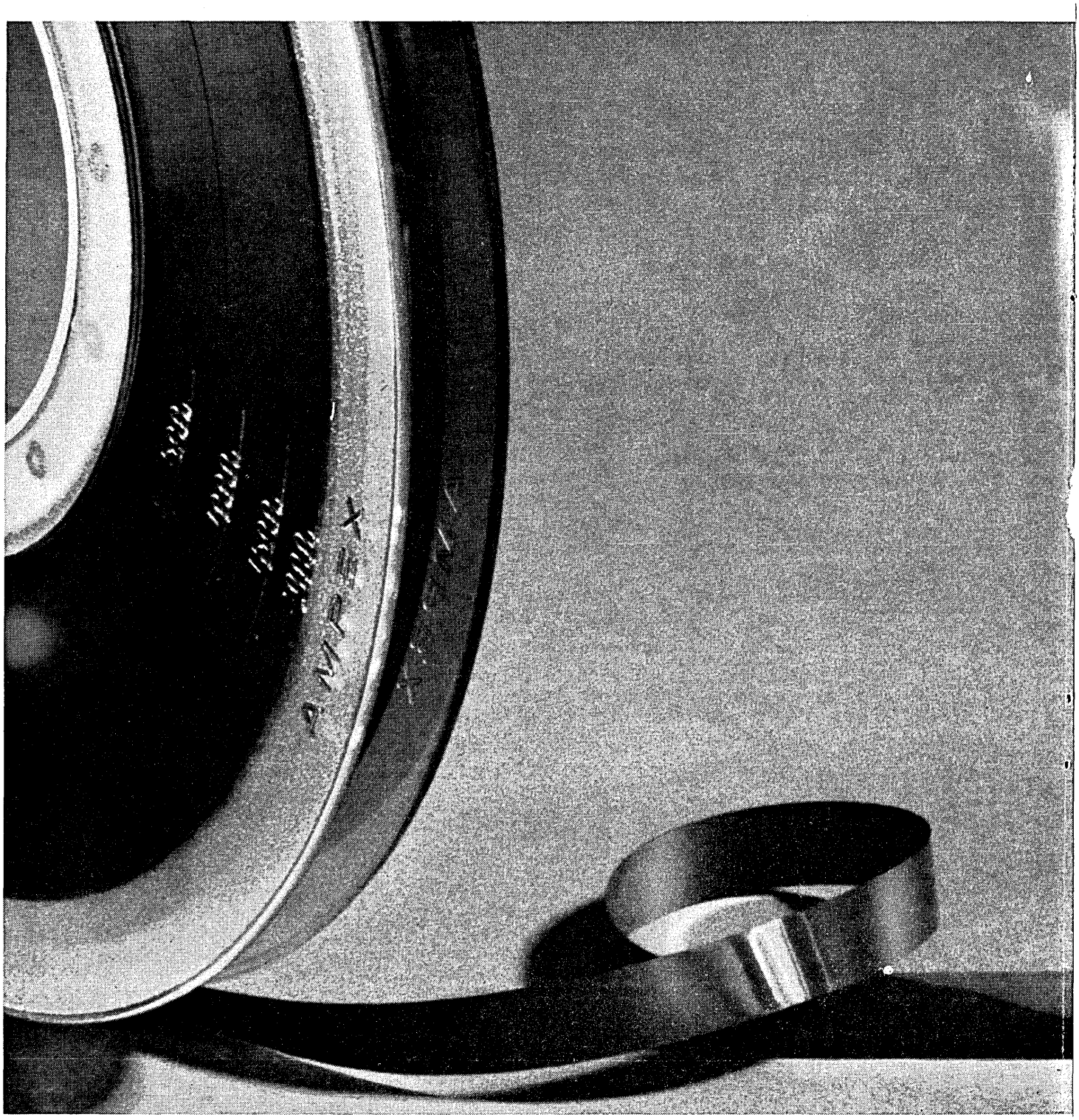
● A control system test facility, including a pilot petrochemical plant, is being built in San Jose, Calif., by IBM to study and develop process control techniques. Completion is scheduled for June '65. Areas to be studied include direct digital control, process optimization, and closed-loop adaptive control.

● A device capable of translating any eight-level bit configuration into any other eight-level code has been developed by Charles H. Popenoe, Institute for Basic Standards, National Bureau of Standards. The rack-mounted, independently-operated unit presently works with paper tape, but reportedly will also work with mag tape and teletypewriters. It recognizes two different codings for 50 alphanumeric characters, and its vocabulary can be expanded or reduced.

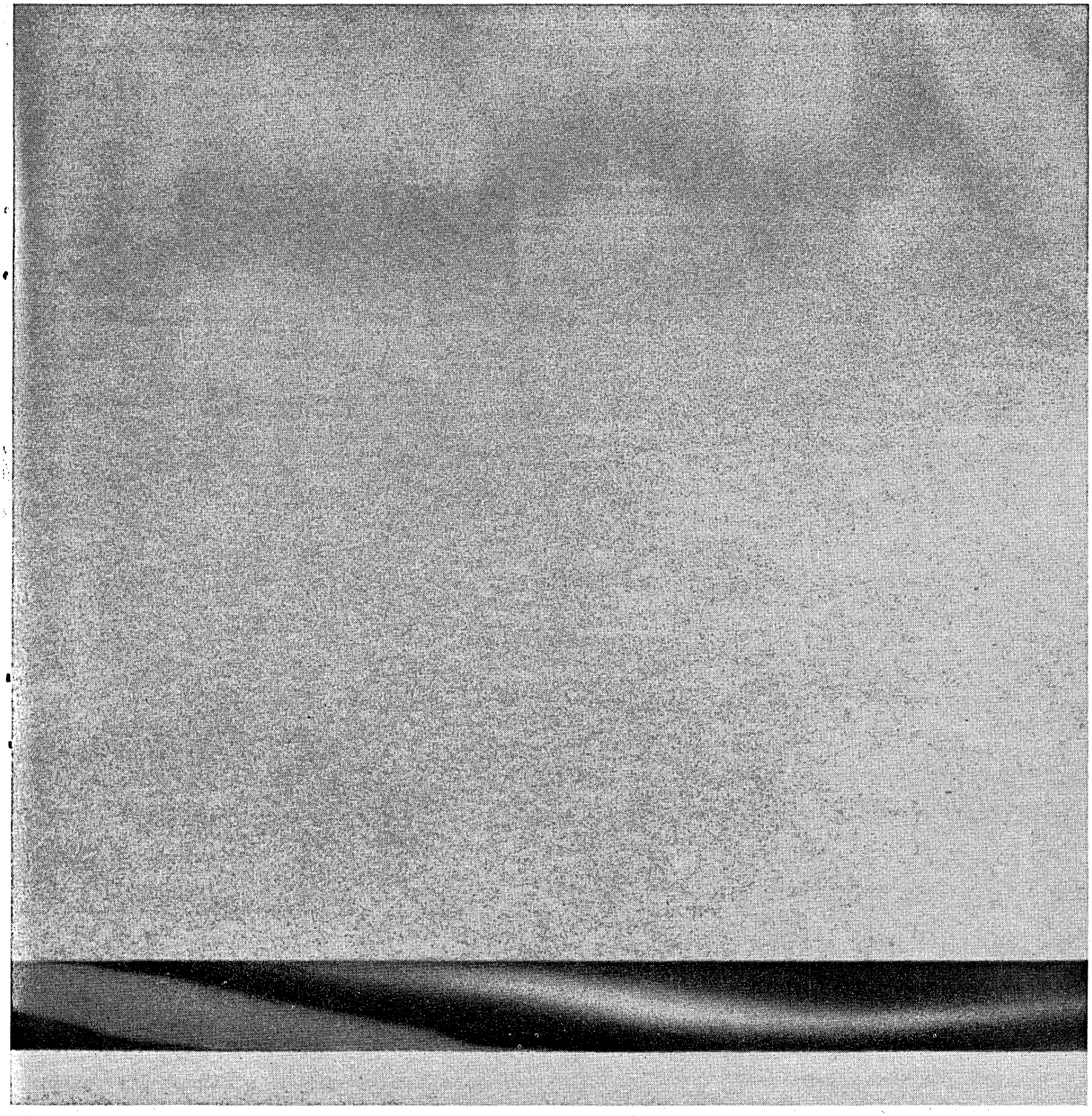
● Cut-rate keypunching service with seven-day turnaround and customer-specified levels of accuracy is being offered by CEIR, Inc., Washington, D.C. The firm has signed a marketing agreement with Value Service Ltd., Jamaica, West Indies, which has doubled its capacity to 100,000 cards daily. Accuracy levels range from 98-100%.

● The hybrid computer software/applications firm of Control Technology Inc., Long Beach, Calif., has been acquired by Milgo Electronic Corp., Miami, Fla., makers of analog computers. CTI management remains the same.

● The use of a computer to control and monitor the generation and dispatch of electric power has been announced by the 12-utilities combine, the Pennsylvania-New Jersey-Maryland Interconnection. To be installed late in '66 is an IBM 360/50.



Two entirely new, long-wear, heavy-duty Ampex computer tapes are now available. The two (Ampex 838 for 800 bpi applications and 832 for 556 bpi applications) are the result of an intensive 2 year development program. Using an advanced oxide formulation, these new tapes feature a mirror-smooth surface that consistently gives the cleanest, most reliable performance ever possible. The proof of the new formulation is in the using: no other tape on the market does as much to reduce 'temporary errors' and static build-up. Even the reel is new: IBM compatible configurations are available on solid



Announcing: the most important advance in computer tape in four years.

flanged plastic reels with new aluminum hubs. Who benefits from this remarkable new tape? Anyone who uses IBM (including full width tested), IBM compatible, RCA 301, and most Univac computer systems. Try it. Test it. Use it. We think that you'll agree that the time spent in developing this remarkable new tape was time well spent. For a demonstration, call your Ampex representative, or write the only company providing recorders, tape and core memory devices for every application: Ampex Corp., 401 Broadway, Redwood City, California.

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CIRCLE 43 ON READER CARD

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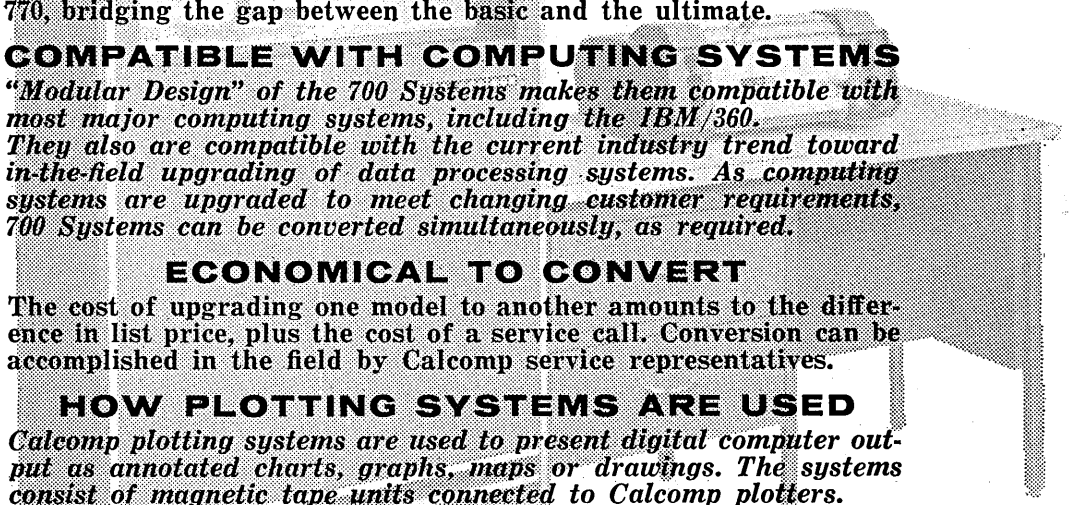

As a customer's plotting requirements become more complex, Calcomp 700 Systems can be converted upward from one model to another.
Today's Model 750 can become tomorrow's Model 780 by adding or substituting appropriate modules. In between are Models 760 and 770, bridging the gap between the basic and the ultimate.

COMPATIBLE WITH COMPUTING SYSTEMS

"Modular Design" of the 700 Systems makes them compatible with most major computing systems, including the IBM/360.
They also are compatible with the current industry trend toward in-the-field upgrading of data processing systems. As computing systems are upgraded to meet changing customer requirements, 700 Systems can be converted simultaneously, as required.

ECONOMICAL TO CONVERT

The cost of upgrading one model to another amounts to the difference in list price, plus the cost of a service call. Conversion can be accomplished in the field by Calcomp service representatives.

HOW PLOTTING SYSTEMS ARE USED

Calcomp plotting systems are used to present digital computer output as annotated charts, graphs, maps or drawings. The systems consist of magnetic tape units connected to Calcomp plotters.
Model 750 drives 500 series plotters and provides display and search features.
Model 760 also drives 500 series plotters, provides display and search, and employs tape format which reduces computer time required to prepare tape for plotting.
Model 770 works with high speed 700 series plotters and introduces variable step sizes (.005 and/or .01 inches) and ZIP MODE® capabilities which permit finer plotting resolution at advanced speeds.
Model 780 provides all of the features of the 770 plus the ability to read higher density tape, and increases computer efficiency by packing more data per inch of tape.
For additional features of the "700 Systems," their advantages over other digital systems, and their capabilities — one compared with another — write "Marketing."

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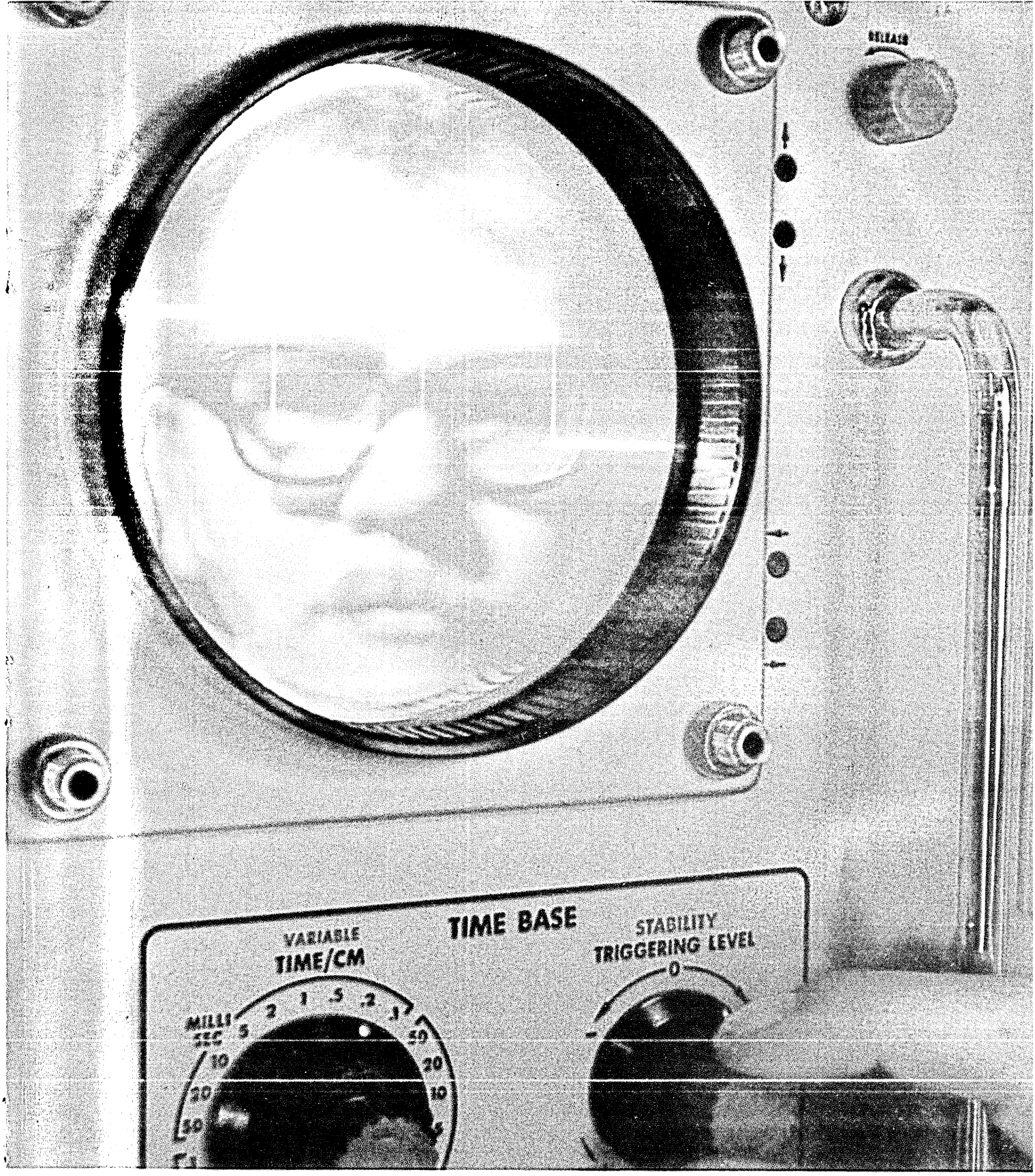
FOR MEMOREX, CIRCLE 45 ON READER CARD →



John Klein checks an idea John has a research project which aims to improve frequency response and signal-to-noise ratio of ultra-thin coated magnetic tape. The idea he is checking out could add significantly to the capability of your recording equipment. Research projects like John's have already stepped up frequency response, resolution, and durability of Memorex premium tape.

John's technical skills, and those of his fellow scientists, have a lot to do with the fact that Memorex tape is specified for the most critical recording and data processing applications. When you benefit from a Memorex tape improvement—such as superior response—remember John Klein. Talented people like John make Memorex... and Memorex makes premium tape you always rely on—reel after reel.

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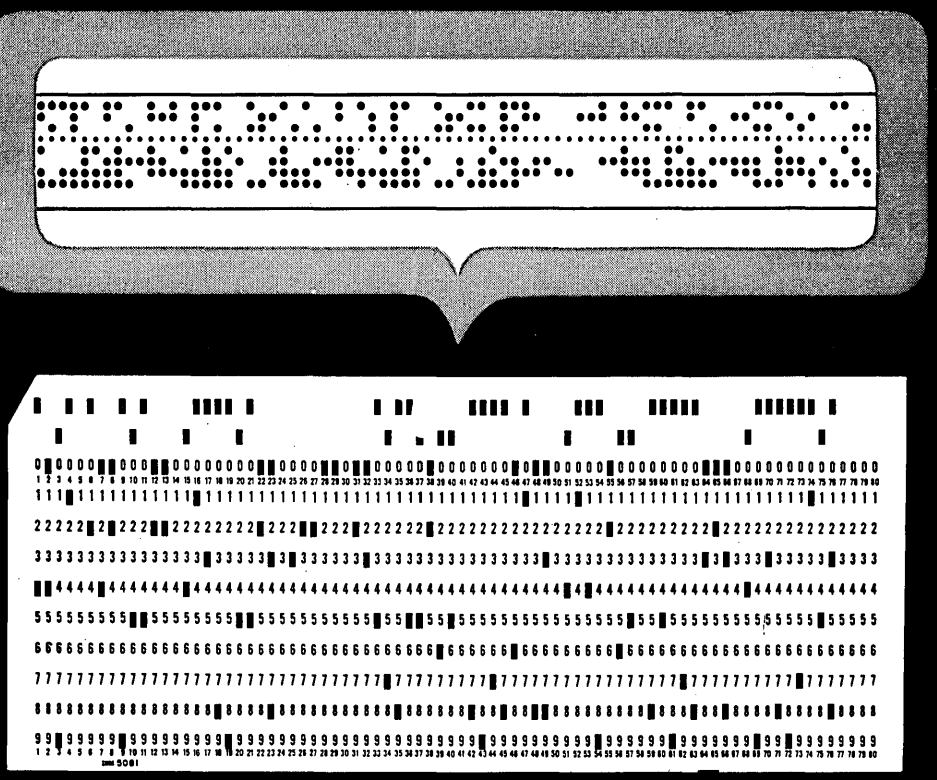
a tab card is about to say a few words in 8-channel tape...



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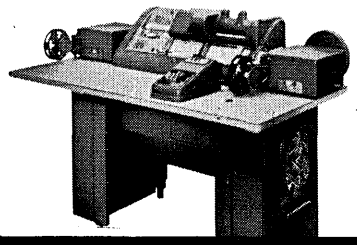
Plugboards and wiring templates match 80 column cards and all known 5, 6, 7 and 8 channel tape codes including the new A.S.A. code.

For complete details on Dura Converters, call your local Dura representative or write: Dept. D-15-55, Dura Business Machines, 32200 Stephenson Highway, Madison Heights, Michigan 48071.



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IFIP CONGRESS 65

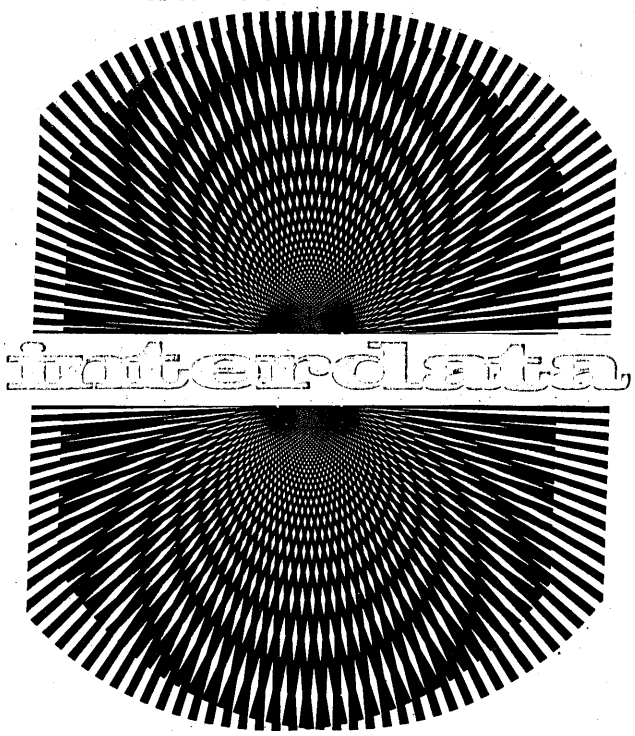
INFORMATION SYSTEMS

PROGRAMMING

AUTOMATA THEORY

EQUIPMENT DESIGN

MATHEMATICAL METHODS



SYSTÈMES D'INFORMATION

PROGRAMMATION

THEORIE D'AUTOMATION

DESSIN D'EQUIPMENT

MÉTHODES MATHEMATIQUES

CONGRÈS IFIP 65

IFIP: MECHANISM FOR INTERNATIONAL PROGRESS

by ISAAC L. AUERBACH

All the world has seen the effects of the "information gap" —the lack of knowledge and understanding between one country and its neighbors, one race and another. It is this lack that causes much of the friction in our society. Governments and people are continually striving to overcome it.

Triennially, IFIP holds an international congress to make sure no information gap appears in the information-processing field. This meeting—IFIP Congress 65—will bring together 5,000 scientists and engineers from 50 countries. These people will be coming from Eastern and Western Europe, Africa, Asia, South America—from all over the globe—for a common purpose: to exchange ideas and information on the impact of the information-processing sciences and technology on mankind in this century; to discuss trends, developments and problems; and to clarify and re-emphasize objectives.

The special significance of the congress is its international scope. We hold many domestic conferences on the advances of the information sciences, in which important developments are recorded. But the fact is, information processing has expanded so much that it is considered essential now to find out what is happening in the field abroad. The benefits of meeting periodically with our foreign colleagues are mutual. Such parleys provide a stimulant and an incentive to forge better tools for the future. And, at the same time, they open the way to understanding, friendship, and goodwill.

IFIP is aware of the need for and value of this international view of information-processing progress. The organization of IFIP Congress 65 reflects this awareness. Two groups are responsible for this congress. One, composed of members of AFIPS, the host technical society, has made all of the arrangements for the congress; the other, made up of members of national societies from all over the world, has put together the congress program. The international character of the IFIP Congress 65 program is established by this multi-national group and reinforced by the multi-national Council of IFIP, which reviews all program plans.

The internationalism of IFIP is not limited to its congresses. It is a stated part of the organization's three original objectives: (1) to sponsor international conferences on information processing, including the mathematical and engineering aspects; (2) to establish international committees to handle special tasks falling within the realm of member societies; and (3) to advance the interests of these member societies through international cooperation.

And this internationalism pervades all the work IFIP is doing. The IFIP technical committees are all working on problems that transcend the interest of any one country and are in the best interests of all countries.

IFIP Technical Committee 1, which has been formed jointly with the International Computation Centre (ICC) in Rome, has developed a multi-lingual vocabulary of information-processing concepts and terms. Plans call for the ultimate publication of several monolingual volumes. The first volume, in English, is already in galley form and will be published in July 1965.

Each volume will consist of two parts. The first will contain definitions of over 1500 information-processing concepts for which there is an international consensus. Appended to each concept is the term for the concept. Entries of the concepts will be arranged so that related subjects and ideas are grouped together for easy reference. The arrangement of the concepts will be the same in all volumes. Each concept will bear a unique key consisting of a letter and a numeral, which will be the same in all volumes.

The second part of each volume will consist of an alphabetical listing of terms in the language of the volume. With each term will be listed the unique key of the concept to which the term applies.

Because both the format and key system will be standard from volume to volume, sets of the different language volumes will constitute a multi-lingual dictionary. The standard serial number used for each concept throughout all volumes will enable a user to conduct a rapid search from language to language.

IFIP Technical Committee 2 is promoting the develop-

(Continued on page 80)

Mr. Auerbach is founder of Auerbach Corp., Philadelphia, Pa., and president of IFIP. He was responsible for the organization of the IFIP Congress 62 in Munich, for this meeting in New York City, and of IFIP Technical Committees for Terminology, Programming Languages, and Education.

IFIP: MECANISME POUR LE PROGRES INTERNATIONAL

Par ISAAC L. AUERBACH

Le monde entier a vu les effets du "retard d'information"—le manque de connaissances et de compréhension entre un pays et ses voisins, entre une race et une autre. C'est ce manque d'information qui est responsable d'une majeure partie des frictions présentes dans la société actuelle. Les gouvernements et les peuples s'évertuent sans cesse à rattraper ce retard.

Tous les trois ans la IFIP réunit un congrès international pour s'assurer qu' aucun retard d'information ne se produit dans le domaine du traitement des données à l'aide de calculateurs. Celui qui se tiendra à New York en Mai—Congrès IFIP 65—réunira 5.000 savants et ingénieurs de 50 pays. Ces gens viendront de l'Europe de l'Est et de l'Ouest, d'Afrique, d'Asie, d'Amérique du Sud—du monde entier—dans un but commun: pour échanger des idées et des renseignements sur l'influence des sciences et techniques d'opérations des calculateurs pour le traitement des donnécs sur l'humanité durant ce siècle; pour discuter les nouveaux courants d'idées, les développements et les problèmes; et pour clarifier et réaffirmer les objectifs.

La signification spéciale de ce congrès est son étendue internationale. Nous tenons plusieurs conférences domestiques sur les progrès des sciences d'information, au cours desquelles sont enregistrés les développements importants. Mais le fait est que ces traitements des données par calculateurs se sont tellement developpées qu'il est devenu essentiel d'apprendre ce qui se passe dans ce domaine à l'étranger. Les avantages de réunions périodiques avec nos collègues étrangers sont mutuels. De tels dialogues fournissent un stimulant et un aiguillon pour forger de meilleurs outils pour l'avenir. Et, en même temps, ils ouvrent la voie à la compréhension, l'amitié et la bonne volonté.

La IFIP se rend compte de la nécessité et de la valeur d'avoir ce point de vue sur les progrès des opérations de renseignements par calculateurs. L'organisation du congrès IFIP 65 reflète cette prise de conscience. Deux groupes sont responsables pour ce congrès. L'un, comprenant les membres de AFIPS, la société technique qui sera l'hotesse, a fait tous les arrangements pour le congrès; l'autre, comprenant les membres de sociétés nationales du monde entier, a établi le programme du congrès. Le caractère international du programme du congrès IFIP 65 est établi par ce groupe de plusieurs nations et renforcé par le conseil multinational de la IFIP, qui revoit tout les plans du programme.

L'internationalisme de la IFIP ne se limite pas à ses congrès. C'est une partie intégrale des trois buts originaux de l'organisation: (1) de patronner les conférences internationales sur le traitement des données par calculateurs, y compris les aspects mathématiques et travaux d'ingénieurs; (2) d'établir des comités internationaux pour s'occuper des travaux spéciaux qui tombent sous la jurisdiction des sociétés membres; et (3) d'encourager les intérets de ces sociétés membres grâce à une coopération internationale.

Et cet internationalisme domine tous les travaux que la IFIP exécute. Les comités techniques de la IFIP se consacrent tous à des problèmes qui transcendent les interêts de n'importe quel pays et sont dans l'interêt principal de tous les pays.

Le comité technique IFIP Numéro 1, qui a été formé de concert avec le Centre International de Computation (ICC) à Rome, a développé un vocabulaire multi-langue de concepts et de termes de traitement de données par calculateurs. Les plans proposent la publication éventuelle de plusieurs volumes monolingue. Le premier volume en anglais, est déjà sous presse et sera publié en Juillet 1965.

Chaque volume consistera en deux parties. La première contiendra les définitions de plus de 1500 concepts d'évaluation de données pour lesquels il y a un consensus international d'opinion. Ajouté à chaque concept se trouve le terme pour le concept. L'ordre des concepts sera arrangé de telle sorte que les sujets et les idées qui s'y rattachent soient groupés pour permettre une référence facile. L'arrangement des concepts sera le même dans chaque volume. Chaque concept aura une clé unique qui consiste en une lettre et un chiffre, qui sera le même dans chaque volume.

La seconde partie de chaque volume consistera en une liste alphabétique de termes dans la langue des volumes. Avec chaque terme il y aura la clé unique du concept auquel le terme s'applique.

Parceque le format et le système de clés sera standardisé d'un volume à l'autre, la collection des volumes en différentes langues constituera un dictionaire multi-langue. Ce numéro standard de la série employé pour chaque concept à travers tous les volumes, permettra au lecteur d'opérer une recherche rapide de langue à langue.

Le comité technique IFIP Numéro 2 s'occupe du développement, de la spécification et du raffinement de la langue commune pour la programation, avec provisions pour révisions futures, élargissement et amélioration.

Jusqu' ici, le concile de la IFIP à approuvé trois documents de langue pour la mise en programme tels qu'ils lui ont été soumis par le CT 2 de la IFIP. La Langue Algorithmique ALGOL 60, façons de procéder d'entrée/sortie pour ALGOL 60 et un document sur le sou-programme de la IFIP pour l'ALGOL 60.

Le travail continue vers le développement de langues améli-

ment, specification, and refinement of common programming languages, with provisions for future revision, expansion, and improvement.

To date, the Council of IFIP has approved three programming-language documents as submitted to it by IFIP TC-2: the Algorithmic Language ALGOL 60, Input/Output Procedures for ALGOL 60, and a document on IFIP Subset ALGOL 60.

Work continues toward the development of improved programming languages. Working Group 2.1 of this committee is studying ALGOL X and ALGOL Y.

The need for more standardized programming languages will become more urgent in the years ahead as data communications networks link computers, companies, countries, and continents. The anticipated pace of this future growth will increase the demand for languages that can improve man-machine communications.

IFIP Technical Committee 3 is working on the international problem of education. Authorized during IFIP Congress 62, IFIP TC-3 is currently working in cooperation with the International Computation Centre on establishing information processing training programs for teachers from the developing countries. These teachers will be equipped to set up similar programs in their own countries to train personnel in the use of the computer as a basic tool.

In addition, IFIP TC-3 has been encouraging the more industrialized countries to establish courses in the computer sciences as part of their university curricula. Efforts are continuing in this direction so that complete course work in this field will be available, on both a graduate and undergraduate level, to aspiring information scientists.

Plans are also being made for training scientists from other disciplines in the use of information processing to advance their own technologies. Part of this plan calls for promoting a working liaison with international organizations having allied interests, so that the groups may cooperate in projects that will further mutual aims.

In accordance with all these efforts, IFIP TC-3 will act as an international clearing house for material pertaining to information processing—its development, application, and implications. This function will include the generation of information for the layman in terms he can understand.

All of these activties, as well as the IFIP Congress 65, add up to a clear answer to the often asked question: "What is the obligation of the computer scientist in the information revolution that is taking place?"

It seems to me that the primary obligation of the computer scientist is to work through his national technical societies, through IFIP, through his job to continue advancing the technology that will speed up and ease the information revolution our society is passing through. The fact is that the computer and information scientist has mastered a technology that promises mankind many benefits, and he can best serve society by further developing and utilizing his skills as a creative scientist. For he has something unique to contribute to the solution of those problems that transcend the interest of any one country and are in the best interests of all mankind. ■

orées pour la programation. Ce Groupe d'étude 2.1 de ce comité etudie Algol X et Algol Y.

La nécessité d'avoir des langues de programation standardisées deviendra plus urgent dans les années à venir où les réseaux de communication d'information relieront les calculateurs, les compagnies, les pays et les continents. Le taux anticipé de cette future croissance augmentera la demande pour des langues qui pourront améliorer les communications de l'homme à la machine, et vice versa.

Le comité technique 3 de la IFIP s'occupe du problème international de l'éducation. Autorisé pendant le Congrès 62 de la IFIP, le CT 3 de la IFIP est en train de travailler—en coopération avec le Centre International de Computation—à établir des programmes pour l'entrainement dans la manipulation des données pour les instituteurs des pays en voie de développement. Ces instituteurs seront équipés pour développer des programmes semblables dans leurs propres pays pour entrainer le personel dans l'emploi des calculateurs comme outils de base.

De plus, le CT 3 de la IFIP encourage les pays les plus industrialisés à créer des cours de sciences calculatrices comme partie intégrale des cours universitaires. Des efforts en ce sens continuent pour que des cours complets dans ce domaine soient offerts au niveau de la license et au delà, pour les futurs experts en information.

Des plans sont aussi tracés pour la formation d'hommes de science d'autres disciplines dans l'emploi du traitement des données par calculateurs pour faire progresser leur propre technologie. Une partie de ce plan nécessite la création d'une liaison active avec des organisations internationales ayant des intérêts similaires, de telle sorte que les groupes coopèrent dans des projets qui feront progresser leurs buts communs. D'accord avec tous ces efforts, le TC 3 de la IFIP agira comme un bureau de clearing pour les matières du domaine du traitement des données, ses développements, applications et implications. Cette fonction comprendra la géneration d'informations pour le non-technicien en termes qu'il peut comprendre.

Toutes ces activités, aussi bien que le Congrès 65 de la IFIP, se somment en une simple réponse à la question souvent posée: "Quelle est l'obligation de l'homme de science des calculateurs devant cette révolution du système d'information qui se produit à l'heure présente?"

Il me semble que l'obligation principale de l'homme de science de calculateurs est de travailler par l'intermédiaire de ses sociétés techniques nationales, de l'IFIP, de son emploi, afin de continuer à faire progresser la technologie qui hâtera et facilitera la révolution dans l'information que notre société traverse. Le fait est que l'homme de science des calculateurs et des renseignements a acquis la connaissance approfondie d'une technique qui promet des avantages multiples pour l'humanité et il peut en outre servir la société en développant et en utilisant ses talents scientifiques créatifs. Car il a quelque chose d'unique à contribuer à la solution de ces problèmes qui transcendent les intérêts de n'importe quelle nation isolée et sont dans l'intérêt de l'humanité entière. ■

THE CONFERENCE PARTICULARS

New York is the city of superlatives—the largest "melting pot" of nationalities, the most cultural and business opportunities, the best restaurants, the tallest buildings. (Some diehards might also say the most crowded streets and subways, the highest air-pollution rate, and the longest lines, lines, lines wherever you go). But for the IFIP Societies, New York will soon be the scene of what's promised to be the largest and best gathering of international personalities in the information processing field.

The third in the triennial IFIP conferences, IFIP Congress 65 will draw more than 5,000 participants from 50 countries to the New York Hilton, May 24-29. They will be treated to a very generous blend of technical and nontechnical activities planned to stimulate not only intellectual but also social international friendships.

Open to the public, the AFIPS-hosted conference has late registration fees (after April 1) of $35; full-time students may register at the Congress for $5. The registration desk, on the second floor of the Hilton, will be open every day. The two-volume proceedings are included in the fee.

The formal opening session on Monday will begin at 10 a.m.; it features as keynote speaker Dr. Donald F. Hornig, special assistant to the President on Science and Technology. That afternoon a massive technical program of 76 sessions will be launched. The sessions, which break down into general and special sessions, symposia, and panels, will primarily cover the areas of information systems, programming, mathematical methods, equipment design, and automata theory. The major sessions will have simultaneous interpretation from English or French to Russian, Spanish, English, or French. Each day the technical program will run from 9 to 11:30 a.m. and 2 to 5 p.m.

The formal closing session Saturday morning boasts discussions on "Man as an Information Processing System" by Heinz Von Foerster, Warren S. McCullough, W. L. Kilmer, and Donald M. McKay.

More than 80 manufacturers and publishing companies —unfortunately, few from abroad—will show their wares at the Interdata 65 exhibition. This will be held on the second floor of the Hilton from May 24-27 (noon to 6 p.m. on Monday, 9 a.m. to 5:30 p.m. on Tuesday and Thursday, and 9 a.m. to 9 p.m. on Wednesday). Several exhibitor's lectures are also slated.

The Information Sciences Cinema will offer a diversified film repertory throughout the week. The films, 21 of them, will range from 12 to 60 minutes and run the gamut of computer interest from Rand Corp.'s "Tomorrow's Programmers" on teaching a class of 12-year-olds, to "Design Automation," and "X-Ray Spectometry."

A highlight of the special events is the IFIP banquet, to be held in the Grand Ballroom Thursday evening. Surprise technological achievement awards will be presented, and the audience will be entertained by international folksingers. Other special events include an early registration get-together Sunday evening, a reception at the Hilton Monday evening, a tour to Princeton, N.J., a night baseball game, and a theater party for "Hello Dolly!" After the conference on Saturday, participants can travel to the World's Fair for what has been declared Information Sciences Day. (For speed in exhibit-hopping, ask your weatherman for a rainy day). Plant tours will also be available during the week.

For their enjoyment, the ladies can choose from among tours up, down, and around (by boat) town, to a fashion show, the United Nations, the National Design Center, and the Good Housekeeping Institute.

Many of the international visitors who do remain to tour in the U.S. will be invited to be guests of their U.S. colleagues. Four guided tours to manufacturer plants, computer installations, and historic and scenic points are offered during May 31 to June 4. Three are concentrated in the northeast, but the fourth takes the interested visitor across the continent to California (home of Datamation's Editorial World Headquarters). ■

THE CHAIRMAN'S WELCOME

by W. BUCHHOLZ

Three years ago the International Federation for Information Processing (IFIP) accepted an invitation from its United States member, the American Federation of Information Processing Societies (AFIPS) to hold IFIP Congress 65 in New York City. Being hosts to a major international congress will present a unique opportunity for U.S. participants to hear about progress in other countries. At the same time they will be able to greet the large number of visitors taking advantage of this occasion to witness the progress made in this country.

An important function of this gathering of scientists from many countries will be to establish channels of communication among the participants. They will meet the leaders in the computing field of perhaps 50 different countries, as well as colleagues specializing in their own fields of endeavor. Views will be exchanged by discussion among speakers or panelists and by audience participation. Personal contacts will continue during special events in the evenings. Some will take advantage of the previously announced People-to-People program and be individual hosts to visitors of similar interests in their own city, before or after the congress. Communication thus established need not end with the congress; it may continue through the years.

IFIP Congress 65 will be held at the modern New York Hilton hotel near Rockefeller Center, in the heart of Manhattan. In some ways, of course, the congress will follow the familiar format of the Spring Joint Computer Conference that would normally have been held in New York at this time. In other ways, however, the event will be distinctly different. The additional visitors from other countries, combined with the normally large attendance at New York conferences and the extra interest generated by an international congress, are expected to produce the largest attendance ever (a mixed blessing, to be sure, which the organizing committee accepts as a fact of life).

A program of wide scope and interest has been assembled by an international Program Committee under Borje Langefors of Sweden as chairman and Alston S. Householder of the U.S. as vice chairman. The program covers areas of interest of all five of the AFIPS constituent societies. The program will extend over the entire week. After the opening session on Monday morning, May 24, which will include a distinguished keynote speaker, the technical program will last from Monday noon to Saturday noon. On a typical half day there will be two major sessions, aimed at a general audience, in parallel with six or seven smaller symposia or panel sessions, aimed primarily at the specialist.

The Closing Session on Saturday morning, May 29, is entitled "Man as an Information Processing System." It will be a single plenary session that promises to be of unusual interest. Three distinguished scientists, who are doing research on what we can learn from nature about the fundamentals of information processing, will present talks that may stimulate fresh ideas for processing information by machine.

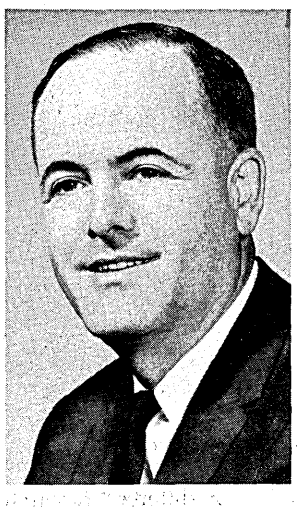
At the major sessions, papers may be given in either English or French, the official languages of the congress, and simultaneous interpretation into French or English, Russian, and Spanish will be provided. Paper abstracts will be available in these four languages. A bilingual scientific secretary will assist the session chairman in running the session. There will also be other linguistic evidence that this is indeed an international congress.

Simultaneous with the congress and under the same roof will be the Interdata 65 exhibition, which will include exhibits of foreign as well as U.S. manufacturers. Several of the exhibitors are planning to supplement their exhibits with special lectures on their equipment. Films with an international accent will be shown at the Information Sciences Cinema. A number of plant tours are being set up.

No technical sessions will be held in the evenings, so as to give participants a chance to meet each other informally and to attend a number of special events. These include an early registration get-together on Sunday afternoon and evening, May 23, a cocktail party, a special showing of the famed Broadway musical "Hello Dolly!," a ballet performance, the IFIP banquet, and a sports night. There will be an afternoon and evening trip to Princeton, New Jersey. Following the Congress there will be an opportunity to visit the World's Fair, an all-day Sunday outing up the Hudson River, and post-congress tours combining plant visits with sightseeing.

The Proceedings for IFIP Congress 65 will be published in two volumes. The first volume containing full papers given at the major sessions will be distributed to registrants during the congress. The second volume will carry summaries of symposia and panel discussions as well as a full report on what actually happened at the congress, and will be distributed to registrants shortly afterwards. Both volumes will be available for sale through the publisher, Spartan Books.

Since an IFIP congress is held once every three years in a different country, it is unlikely that information processing specialists from the United States will have another such opportunity in the foreseeable future to meet so many visitors and to hear talks about the latest developments all over the world. Dr. E. L. Harder, chairman of the AFIPS Board of Governors, joins me in extending a cordial invitation to each reader to attend IFIP Congress 65 and to plan to spend the entire week with our visitors from other countries.



Dr. Buchholz is a senior engineer at the IBM Systems Development Lab in Poughkeepsie, N.Y., where he is on the systems architecture staff. He was associated with the planning of the STRETCH system, as well as the 702 and 701, and is co-author of the McGraw-Hill book, "Planning a Computer System." A Fellow of the IEEE, he holds a PhD from Caltech in electrical engineering.

THE TECHNICAL PROGRAM

how to decide what sessions to attend

by BÖRJE LANGEFORS

In taking on the job of constructing the program for IFIP Congress 65 the Program Committee had, of course, the experience of the two earlier congresses, Paris 1959 and Munich 1962, as a background for its work. We also had been provided with published criticism of the earlier congresses. With this background we tried to establish goals for the next congress which would best take care of the interests of the participants. From this came, in addition to the tradition from the two earlier congresses, three main points:

1. To give special concern to such advantages that the Congress could offer by being large and being international.
2. To stimulate or encourage research and development in such areas of information processing which appear to be given too little consideration at present, or else deserve special attention.
3. To emphasize the need for a scientific approach to data processing in its large practical fields of application.

The most natural advantage to expect from the congress is, of course, to obtain an overview of most recent developments in the whole field of information processing, in research and in applications.

It is too optimistic to think that such an overview would come automatically from having a congress with a vast set of different specialist-oriented symposia. Experience indicates that most symposium papers of a research kind are understandable only to experts. This is also natural if the researchers shall be able to discuss significant problems of research and, by being given only 20 minutes for the talk, have no time for orienting listeners to their subject. Papers on practical applications, on the other hand, mostly miss the opportunity to inform about new developments, if any, by a tendency to merely list historical facts in a non-analytical way. In these cases a more scientific approach is desirable.

There are reasons to believe that while specialist researchers do have a lot to gain from participating in a number of scientific symposia, it will be still more important to them to make use of the opportunities to get an overview from a large congress. Also symposia concerning a narrow, special field could well be arranged in a smaller and less expensive way.

For other categories of congress attendants, the orientation is still more an important thing to get. The conclusion has been that the congress program shall contain, in addition to the symposia and panels, a carefully designed "orienting" part which, while still being on the high professional level to be required by a large international scientific attendance, will make it possible to get information about development in all fields of information processing.

Another advantage that could be obtained from the large congress is that specialist researchers could have discussions with specialists of other fields about problems of common interest. Therefore the selection of topics for symposia and panels should be done with special emphasis on interdisciplinary topics.

It appears that the great number of different research areas within the field of information processing have much more in common than merely the interest in using computers. For instance, the problems of automata theory have much in common with problems of programming and with computer hardware design as well as with some mathematical research. Likewise problems of data structures, in a large sense, have an interest for both programming specialists, hardware experts and designers of data processing application systems. It would have been of value if the program could have been designed in a way that would bring out the interesting potential advantage of these common models of thought which grow independently in the different fields of information processing and even in other scientific or intellectual disciplines. This, however, we have only been able to do in a few cases. An example is the session on "Form Recognition in Medicine, Music, Literature, and Law." It is to be hoped that the orientation part of the program and the interdisciplinary sessions will give many chances for the participants to find out, themselves, many instances of this kind.

The second of the goals for the program, stimulating some kinds of research, is a very obvious one for any program work for a scientific congress.

The third goal, of promoting a scientific approach to large application areas, has special importance in the field of information processing. This is because when we come to the applications, we do not have, as in other fields, just applications of scientific results; we have applications of hardware as well. And this can be produced at a pace which has no synchronization with the scientific development of the field. And it is not always in the interest of the salesmen to give recognition to the fact that complicated application systems need knowledge, not only machines.

". . . the program does not contain many session titles having the words 'business' or 'commercial' in them, but this does not make it difficult for the educated business systems analyst to find sessions of significant importance to the development of his field."

A boom of this sort is apt to produce an application field where in many cases the "experienced dilettante" takes control and manages to keep the ambition at a sufficiently low level to meet no problems. In contrast to this attitude, the unexperienced scientist in a new field may instead set his ambitions too high, with the effect that he meets too many problems and no solutions. The result too often has been that scientific methods are not only neglected but, in some cases, even despised or defied. To meet this problem one will not only have to decide to have many scientific sessions on an important field of applications. The response will perhaps then not be as desired.

In trying to meet this problem, the program committee has started out concentrating on the important applications to business data processing, but doing this by trying to define some of its most important problem classes. We have

found that these have a much more general field of applications than merely business data processing and that they could in fact be regarded as typical for a wide class of "Information Systems." It was then, of course, important to give explicit recognition to this fact. Consequently the program does not contain many session titles having the words "business" or "commercial" in them, but this should not make it difficult for an educated business systems analyst or anybody else working in some field of computer application systems to find in the program a set of orienting sessions, or symposia or panels, which are of significant importance to the development of his field.

We mention as examples the orienting sessions, "Design of Information Systems," and the symposia, "Methods for Describing Information Systems," "Information System Reliability," "The Strategy of File Organization," and the series of sessions under the heading "Man-Machine Interaction" . . . and many others. Before leaving this subject let me express the hope that many business system analysts will be able to find valuable things in sessions on, for instance, mechanization of creative processes, self-organizing systems or programming languages.

organization of the program work

In organizing an international congress one will have, of course, to be very careful to obtain a maximum international distribution of the scientific contributions. One wants to have a fair representation of all countries, and as complete a coverage of the total, international development as possible. While this goal seems to indicate the need to have every country represented in the program committee, we have interpreted earlier experience (as well as basic working principles of systems theory) as learning that a too ambitious project along such lines would counteract its main goals by its inherent complexity and the consequent impossibility of sufficient communication over many long distances.

In the search for a reasonable optimal solution to this problem it was decided to have the main body of the program committee consist of five people in addition to the chairman. These were to be selected from different parts of the world. It was then also natural to select these five to be experts in different fields of information processing so that each of them could then also take the responsibility for a certain area of the field by acting as "area chairman" for a subcommittee for his area.

In order to follow the working principle laid out above one has to make a reasonable partitioning of information processing into five areas. It must be stressed at once—and it had to be recalled several times during the program work—that when defining the partition to be used we do not claim to have a "scientifically founded" partitioning. We just wanted to find a reasonably practical subdivision for the administration of the work involved, and to ease identification of which area a session or contribution would belong.

The choice of areas was:

Automata theory (including Artificial Intelligence and Machine Learning as well as Mechanical Translation of Natural Languages).
Hardware (or design of computers).
Mathematical Methods.
Programming (including Programming Languages and other programming problems).
Information Systems (including Business Data Processing).

It was decided to have the area "Automata Theory (and related topics)" handled in the Soviet Union, "Hardware" and "Information Systems" in the U.S., "Mathematical Methods" in France, and "Programming" in the U.K.

construction of the orienting part of the program

Because an overview of the whole field was considered one of the valuable features of a large international congress, the committee decided to organize a specific part of the program to achieve this. I personally would have liked to have, each afternoon, one single orienting session with no other sessions in parallel.

While such a rigorous doctrine could not be followed for many practical reasons, we decided to have one general orienting session on each of the five afternoons. It was natural to try to handle this by letting each area subcommittee construct one such session. This would give a set of orienting sessions which would cover the field reasonably well.

In addition to this set of general sessions it was also decided to have another set of two orienting sessions each day called "special sessions" which would go into somewhat more depth by being oriented towards a somewhat more specialized audience.

The orientation program is not designed to be tutorial, but is designed to be on a high scientific level: speakers may talk of specific research work rather than making a survey, if they so prefer, because it was considered that even a set of such talks, if presented by the suitable set of scientists, would give as good an overview of the most recent development as any other. The "orienting" character

". . . many symposia will not be very informative to non-experts. The great number of different symposia will, instead, give rich opportunity for research specialists to take up informal discussions regarding their research problems."

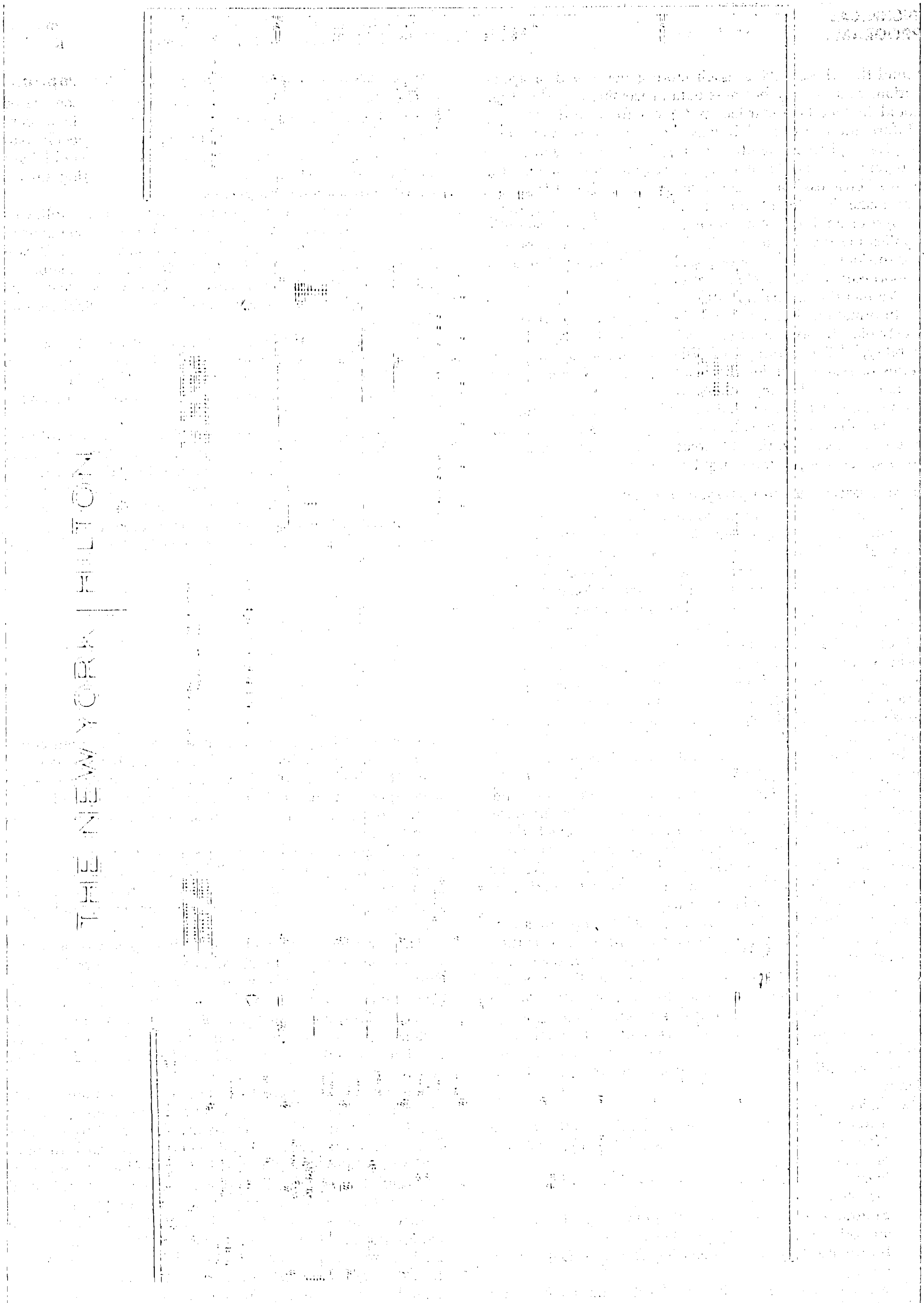
was aimed at by giving more time to each talk than could be done in a specialist symposium so that the speaker can present a background to give the proper perspective for a nonspecialist. It is, of course, considered to be of great value also to a specialist to hear such a talk within his own field.

The "special sessions" of the orienting part of the program will differ structurally from the general sessions by having shorter times assigned to each author and, in most cases, having invited commentators for the talks presented.

The symposia and panels do not belong to the orienting part of the program, which relieves the speakers from the duty of presenting a general orientation. As a consequence, many symposia will not be very informative to nonexperts. The great number of different symposia will instead, we think, give rich opportunity for research specialists to take up informal discussions regarding their research problems.

However it is thought to be one of the main advantages of large congresses that it gives opportunities for specialists within different fields to discuss problems relating to other fields, and the program committee has given much thought to the possibility of defining such interdisciplinary subjects. We think the reader will find many examples of this kind in the list of symposia and panels of the program.

Advantage is taken from the fact that symposia and panels aim at informal discussion to permit the authors to finalize their papers only by the day of the symposium. In this way the most up-to-date material can be presented. This is mostly in agreement with earlier IFIP congresses. ■


THE NEW YORK HILTON

THE TECHNICAL PROGRAM

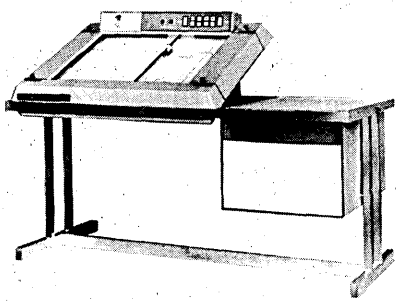
	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Information Systems	Organization of Large Storage Systems - I General Session 2 p.m., East Ballroom	Methods for Describing Information Systems Symposium 9 a.m., Ballroom Foyer Experience in Multiprogramming Symposium 9 a.m., Mercury Ballroom Batch Processing and Direct Processing Panel 2 p.m., Ballroom Foyer System Simulation by Computers Symposium 2 p.m., Gibson Suite	Organization of Large Storage Systems - II Special Session 9 a.m., East Ballroom The Strategy of File Organization Symposium 2 p.m., Trianon Ballroom Man-Machine Interaction: Engineering Design Symposium 2 p.m., Mercury Ballroom	Information System Testing Symposium 9 a.m., Le Petit Trianon Computer Controlled Message Switching Systems Symposium 9 a.m., Mercury Ballroom Large Interconnected Programs Symposium 2 p.m., Mercury Rotunda Man-Machine Interaction: Conversational Programming Symposium 2 p.m., Trianon Ballroom Problems of Data Processing Organization in Government Panel 2 p.m., Mercury Ballroom	Design of Information Systems Special Session 9 a.m., East Ballroom Man-Machine Interaction: Graphic Data Processing Symposium 9 a.m., West Ballroom Information System Reliability Symposium 2 p.m., Gibson Suite
Programming	General Purpose Programming Languages Symposium 2 p.m., Ballrom Foyer	Requirements and Prospect for Commercial Programming Symposium 9 a.m., Trianon Ballroom Testing, Correction, and Documentation of Programming Panel 9 a.m., Green Room Computer Programming General Session 2 p.m., East Ballroom Automated Software Production Symposium 2 p.m., Le Petit Trianon	Formal Aspects of Programming Languages Symposium 9 a.m., Mercury Ballroom Programming Theory Special Session 2 p.m., West Ballroom List Processing Symposium 2 p.m., Ballroom Foyer	Legal Aspects of Computer Software Panel 9 a.m., Green Room Programming Practice Special Session 9 a.m., East Ballroom Languages for Simulation Symposium 2 p.m., Le Petit Trianon	Design of Programming Language Processor - I Symposium 9 a.m., Le Petit Trianon The Economics of Programming Panel 2 p.m., Trianon Ballroom Design of Programming Language Processors - II Symposium 2 p.m., Le Petit Trianon
Automata Theory and Switching Theory	Pattern Recognition & Self-Organizing Systems - I Symposium 2 p.m., Mercury Ballroom Mechanization of Theorem Proving Symposium 2 p.m., Le Petit Trianon	Trends in Computer Logic for Non-Arithmetic Processors Panel 9 a.m., Mercury Rotunda	Artificial Intelligence Special Session 9 a.m., West Ballroom Automata Theory & Simulation of Thought Processes General Session 2 p.m., East Ballroom	Algebraic Automata Theory Symposium 9 a.m., Mercury Rotunda Mathematical Models of Language & Machine Processing of Language Information Symposium 9 a.m., Gibson Suite Mechanical Translation Special Session 2 p.m., West Ballroom Pattern Recognition & Self-Organizing Systems - II Symposium 2 p.m., Gibson Suite A	Mechanization of Creative Processes Panel 9 a.m., Mercury Rotunda Automata Theory & Switching Theory Special Session 2 p.m., West Ballroom

Equipment Design	Parallel & Concurrent Computer Systems Symposium 2 p.m., Trianon Ballroom Hybrid Digital-Analog Techniques Symposium 2 p.m., Mercury Rotunda	The Future of Switching Elements Special Session 9 a.m., East Ballroom Pattern Recognition Devices Symposium 9 a.m., Le Petit Trianon Outlook in the Memory Area Special Session 2 p.m., West Ballroom Digital Automatic Control Symposium 2 p.m., Trianon Ballroom Hybrid Digital-Analog Computation in the Aerospace Industry Symposium 2 p.m., Mercury Rotunda	Microelectronics & Integrated Circuits Symposium 9 a.m., Trianon Ballroom Computer Arithmetic - I Symposium 9 a.m., Mercury Rotunda Hybrid Analog-Digital Applications Symposium 9 a.m., Le Petit Trianon Optical & Electro-Optical Information Processing Symposium 2 p.m., Le Petit Trianon Content Addressable Memories Panel 2 p.m., Mercury Rotunda	Ultra-High Speed Computers Symposium 9 a.m., Ballroom Foyer Man-Machine Interaction: Remote Consoles & Displays Symposium 9 a.m., Trianon Ballroom Trends in Computer Design General Session 2 p.m., East Ballroom	Mass Memories Symposium 9 a.m., Mercury Ballroom High Speed & Read-Only Memories Symposium 2 p.m., Ballroom Foyer Computer Arithmetic - II Symposium 2 p.m., Mercury Rotunda
Mathematical Methods	Mathematical Methods of Optimization Special Session 2 p.m., West Ballroom	Partial Differential Equations Special Session 9 a.m., West Ballroom Monte Carlo Methods Symposium 9 a.m., Gibson Suite Problems in Partial Differential Equations Symposium 2 p.m., Mercury Ballroom Scheduling Problems Symposium 2 p.m., Green Room	Linear Algebraic Systems Symposium 9 a.m., Ballroom Foyer Mathematical Programming Symposium 9 a.m., Gibson Suite Constructive Analysis & Not Well Set Problems - I Symposium 2 p.m., Gibson Suite	Non-Numerical Methods Symposium 9 a.m., West Ballroom Constructive Analysis & Not Well Set Problems - II Symposium 2 p.m., Mercury Rotunda Approximation Theory Symposium 2 p.m., Green Room	Application of Computers to Number Theory & Discrete Problems Symposium 9 a.m., Ballroom Foyer Errors in Numerical Computation Symposium 9 a.m., Gibson Suite Application of Function Spaces to Numerical Analysis General Session 2 p.m., East Ballroom
Others	Library Data Processing Symposium 2 p.m., Gibson Suite		Application to the Graphic Arts Symposium 2 p.m., Green Room		Education Panel 9 a.m., Trianon Ballroom Form Recognition in Medicine, Music, Literature, and Law Symposium 2 p.m., Mercury Ballroom

IFIP: PRODUCT PREVIEW

CALMA COMPANY
Los Gatos, Calif.
Booth No. 74

The Model 300 analog plot digitizer converts analog graphical information into digital codes for mag tape, generating incremental coordinate data without potentiometers or a-d con-



verters. Maximum tracing rate is 50 inches/minute, accuracy is ±0.012 inch, and resolution is ±0.010 inch. One inch of analog plot is recorded on every half-inch of tape. Other features: inter-record gap and end-of-file buttons.

CIRCLE 169 ON READER CARD

INTERNATIONAL COMPUTERS & TABULATORS LTD.
London, England
Booth No. 15-19

Two products being shown are a Demand Data Recorder and an Alphanumeric Keyboard. The former is for recording electrical power consumption on the user's premises, using 35mm sprocketed mag tape, seven channels. The keyboard is for linking to any electrically-operated device, features from 20 to 55 switch assemblies, each operated by a key depression.

CIRCLE 170 ON READER CARD

LOCKHEED ELECTRONICS CO.
Los Angeles, Calif.
Booth No. 128-129

Coincident current core memory system to be shown will be a 4K x 72-bit system, one of a line of new designs with complete read/write cycle times from 1 to 5 usec, capacities to 32K and 74 bits. The demo unit will be linked to a memory exerciser. Addressing in these systems can be random access, sequential non-interlaced or sequential interlaced.

CIRCLE 171 ON READER CARD

POTTER INSTRUMENT CO., INC.
Plainview, N.Y.
Booth No. 167-169

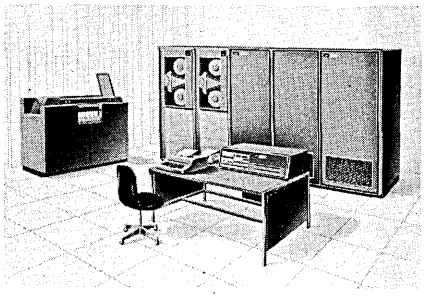
Being introduced are a twin-cartridge model of the RAM and a high-speed tape transport. The Duplex RAM has the same price and 50-megabit capacity as the RAM, but two tape-pack cartridges, each with two rows of four magnetic tape loops, are used to permit copying of data content from one cartridge to another. Information is recorded serially at 1000 bpi; data

transfer rate is 600,000 bps. The single-capstan transport, Model SC-1150, operates bidirectionally up to 150 ips at 800 bpi with no program restrictions, said to be a first in transports. Other features are 7- or 9-channel operation for IBM 360 and ASCII compatibility; a tape path with no rollers or air guides; and a read/write head which is retractable during rewind and stop.

CIRCLE 172 ON READER CARD

RAYTHEON CO., COMPUTER OPERATION
Santa Ana, Calif.
Booth No. 174-176, 181-183

The 520 is a scientific/engineering computer with a memory cycle time of 2 usec, capacity of 4,096 to 35,512 (24-bit) words. Add time is 1 usec, and 8-bit multiply time for data systems work is 2.5 usec. Other features:

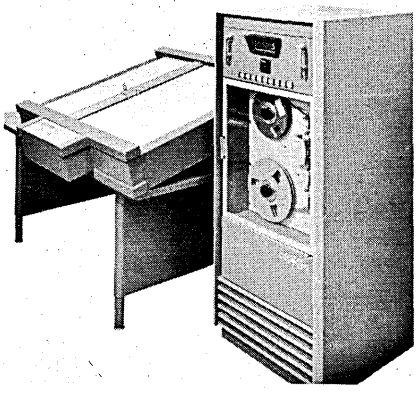


direct memory access channels, standard controller for connection of up to 512 real-time data sources, seven programmable registers, and register-to-register instructions. Software includes a 1620 simulator and FORTRAN II.

CIRCLE 173 ON READER CARD

CALIFORNIA COMPUTER PRODUCTS INC.
Anaheim, Calif.
Booth No. 24-27

Modularity in digital plotting systems is being introduced, the variables being the capabilities of the tape drives and plotters. The 700 series can be

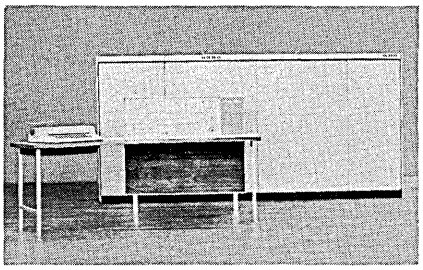


upgraded at installations, features numerous tape formats and densities, as well as plotting modes, speeds, and resolutions. The tape units can also drive 500 series plotters.

CIRCLE 174 ON READER CARD

SCIENTIFIC DATA SYSTEMS
Santa Monica, Calif.
Booth No. 86-91

Making convention debuts are the 9300 computer and the DES-1 differential equation solver. The former is the firm's largest of six, has a 1.75-usec memory cycle time and up to 32K words of core. The latter is built



around the 9300, and includes operator's console, mathematical operator language, enabling the user to work directly from differential equation or a block diagram, and special software.

CIRCLE 175 ON READER CARD

UPTIME CORP.
Golden, Colo.
Booth No. 220-221

Additions to the line of I/O gear are the 800, which reads 80-column cards at an asynchronous rate of 800 cpm. The input hopper has a capacity of 2,500 cards, the output hopper holds 2,000 cards. The 400 has a 400-cpm

reading rate; its input hopper holds 1,500, and the output holds 1,000. Both are photoelectric units, and have as optional features a 51-column card operation and card reject hopper.

CIRCLE 176 ON READER CARD

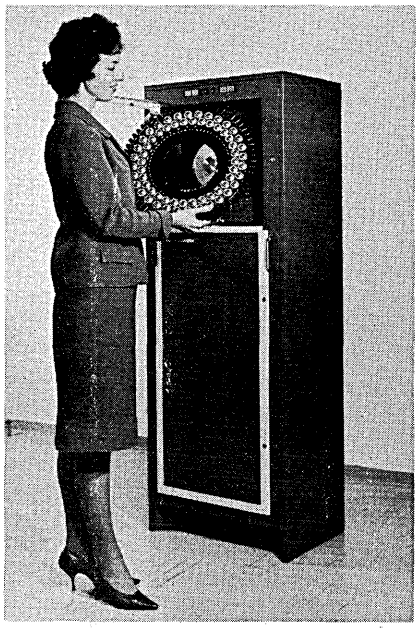
RECORDAK CORP.
New York, N.Y.
Booth No. 60-62

Continuous forms from tab and line printers are automatically microfilmed, unburst, by the Continuous Forms Feeder, Model MF-1. Forms from 4½ to 21 inches in width and fold depths from 5 to 28 inches are accommodated. When used with a Tab Code Converter, each image is coded for use in the MIRACODE I.R. system.

CIRCLE 177 ON READER CARD

FACIT-ODHNER INC.
Stockholm, Sweden
Booth No. 66-68

Being exhibited in the U.S. for the first time are the Carousel random access system and paper tape units that read, punch, and reproduce. The Carousel has lengths of mag tape on 64 removable reels, holds 5.2 million (4-bit) decimal numbers, and has a

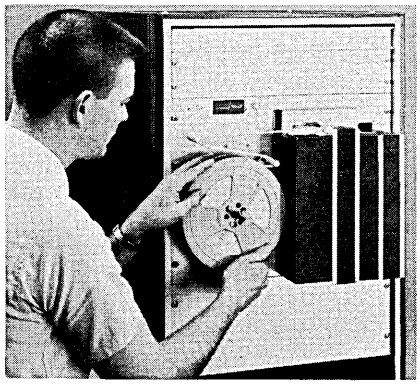


minimum access time of 0.2 seconds. The tape reader, PE 1000, takes 5- to 8-track tapes, operates at 0-500 or 0-1,000 cps. The PE 1500 punches at 0-150 cps, takes the same tapes. The 1300 tape reproducer uses the two devices above.

CIRCLE 178 ON READER CARD

TALLY CORP.
Seattle, Wash.
Booth No. 138-139

A new tape perforator, the P-120, operates asynchronously at 120 cps. It takes 5- to 8-level tapes of paper, plastic or foil, and features integral

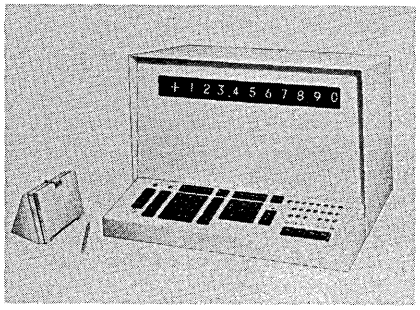


tape supply and take-up reeling. Added-cost features include error control options and unidirectional tape advance with remote tape back-up. The tape supply and take-up capacity is 1,000 feet.

CIRCLE 179 ON READER CARD

WANG LABORATORIES INC.
Tewksbury, Mass.
Booth No. 189

The Loci-1 and 2 are electronic desk calculators capable of raising a number to integer or fractional powers or roots. With one keystroke, it will



square a number, take the reciprocal of the square, or its square root or the reciprocal of the square root. Answers are to 10-digit precision. Mod 2 has a card reader for programmed operation and extra storage registers.

CIRCLE 180 ON READER CARD

DINING IN MANHATTAN

A stout press relations man who has the enviable task of entertaining working journalists at New York's finest eateries, the author is obviously well qualified to offer IFIP visitors the following list of recommended NY restaurants, distilled from over 1500 dinner and luncheon engagements.

Inexpensive	Up to $2.50
Inexpensive to Moderate	$2.50 to $5.50
Moderate to Expensive	$5.50 to $8.50
Expensive	Over $8.50 (Oh, what the hell!)

Dining in New York City is like circling a giant smorgasbord table. Chefs, as numerous as the flags flying in front of the United Nation's Plaza, tempt the palates of visitors with hundreds of traditional favorites.

The willingness to try various nationality restaurants can almost launch a visitor into a world tour without ever leaving Manhattan. Even avowed "meat and potatoes" fans will suddenly discover that a full-bodied Chateaunuef du Pape or Pommard (red wine) or, for the foam fanciers, a good German bock beer or English ale, can hone the enjoyment of their accustomed fare to a fine edge.

If you have never tried chopsticks . . . so what . . . you were probably going to throw that tie away anyhow. And, if you are reluctant to experiment, please make a beeline to the nearest supermarket, purchase a TV dinner, a container of canned heat and go to your hotel room. You can probably get some matches from the bellhop.

After a busy day attending IFIP lectures and seminars, a relaxing meal can do wonders for the constitution. I personally feel that Japanese restaurants have found the key. Before dining, first remove your shoes and seat yourself on the floor at one of the short tables with the electric plate in the center. Then, accept a steaming rolled towel from your waitress, place it on your face, and the cares of the moment will vanish.

For convenience, the recommended restaurants are grouped by nationality. Many are within walking distance of IFIP Convention Headquarters at the New York Hilton (53rd and Avenue of the Americas). I wish you "Bon Appetite."

AMERICAN

1. **The Cattleman** (5 E. 45th) . . . Decorated in the mode of the "Old West"; the beef is served as ordered. Hearty fare! Have a good mug of ale with your beef . . . also a tossed salad and a generous slab of pie. Inexpensive to moderate.
2. **Old Homestead** (56 Ninth Ave.) . . . In the heart of Manhattan's meat district. Has the best steaks in town. Don't forget a giant baked potato and a tossed salad. Moderate to expensive.
3. **Tavern-on-the-Green** (In Central Park at 67th St.) . . . Depending upon the weather, it is possible to dine inside or out. Overlooks Central Park. Good selection. Moderate to expensive.
4. **Black Angus** (148 E. 50th) . . . Convenient mid-town restaurant known for its prime ribs and steaks. Has good tossed salads. Moderate to expensive.
5. **Christ Cella** (160 E. 46th) . . . The best prime ribs in Manhattan. A limited menu but everything is served exactly as ordered. Strictly a man's restaurant. Moderate to expensive.
6. **Cavanagh's** (256 W. 23rd) . . . Open since 1876. Excellent selection of meat and fish. Abounds in atmosphere of yesteryear. Moderate to expensive.

FRENCH

7. **La Potiniere Francais** (60 W. 55th) . . . Pleasantly French. Try the canard roti (broiled duckling with cognac) and a good Pouilly Fume (white wine). They have the best chocolate mousse in town. Enjoy it with filtered coffee. Moderate to expensive.
8. **Le Veau D'Or** (129 E. 60th) . . . Dine here and you may see members of the French UN staff. Small, but one of the best French restaurants in NYC. Their fish is superb. Excellent wines. Moderate to expensive.
9. **Pierre Au Tunnel** (306 W. 48th) . . . Serves the best mussels in Manhattan. Fre-e-nch waitresses. Close to the Hilton. Inexpensive.
10. **A La Fourchette** (342 W. 46th) . . . Excellent cuisine and bartender. Try the capon bar celonette (stuffed boneless chicken with noodles and cream sauce). Moderate to expensive.
11. **Lutece** (249 E. 50th) . . . Easily, the best French restaurant in all of New York. Order the liver pate; you get four different kinds imported from France. The coeur de charollais Wellington (roast beef with a thin pastry shell) with Madeira and truffles is beyond belief. Expensive.
12. **Le Marmiton** (41 E. 49th) . . . Try their beef borguignonne with a bottle of Chateauneuf du Pape. For dessert, have a strawberry tart and expresso. Moderate to expensive.
13. **Chateau Henri IV** (37 E. 64th) . . . If your wife is with you, try this one. The entrance is over a drawbridge on a moat. Violins at night. Romantically dark. Food is excellent. Moderate to expensive.
14. **Maud Chez Elle** (40 W. 53rd) . . . Very convenient to the Hilton. Try the striped bass with sauce mousseline or the cote veau cordonbleu (veal stuffed with Swiss cheese and ham in a Madeira sauce). Moderate to expensive.
15. **Oscar's Delmonico** (56 Beaver St.) . . . The best downtown restaurant. Dine in the opulent Roman Room. Order the Dover sole, but first try the smoked salmon. For dessert, have the fresh fruit and kirsch. Expensive.

GERMAN

16. **Blue Ribbon** (145 W. 44th) . . . Just off Times Square. Dine in wood-paneled surroundings and enjoy traditional German fare. Inexpensive to moderate.
17. **Luchow's** (110 E. 14th) . . . Internationally known and serves the best German food in Manhattan. Delightful Old World decor. After four rounds of bock beer, you almost expect to see the Valkyries riding out of the oil paintings on the wall. For an appetizer, try

the homemade head cheese, then have the brochette of pork with wild rice. For dessert have the rote grutze. Inexpensive to moderate.

18. **Hapsburg House** (313 E. 55th) . . . Actually Viennese. Very quiet at lunch but busy at night. Features zither music in the evening. Try the estrahazy tokany (bits of veal served in a sour cream sauce). Food is superb. Moderate to expensive.

ITALIAN

19. **Romeo Salta** (39 W. 56th St.) . . . Best Italian restaurant in town, with an amazing selection, and excellent bar. Delicious squid. Enhance your meal with Soave (white) or Bardolino (red) wine. Expensive.
20. **Barbetta** (321 W. 46th) . . . Also a fine Italian restaurant. Glistening chandeliers and tapestry chairs. Excellent bar. Beautiful courtyard with fountain for outdoor dining. Try smoked eel for an appetizer and medaglione di manzo al funghetto, which is a split filet mignon sauteed with red wine and mushrooms. Order a good bottle of Gattinara (red) wine with it. Moderate to expensive.
21. **Louise, Jr.** (317 E. 53rd) . . . A terrific luncheon buy. For an antipasto they serve platters of crab meat, shrimp, pickled mushrooms, melon with Italian ham, and salami. You scarcely need an entree. Somewhat more expensive at night. Inexpensive to moderate.
22. **Marchi's** (251 E. 31st) . . . Open only in the evenings. Has been serving the same delightful seven-course meal for 30 years . . . an antipasto platter, crusty fried fish, pickled beans and mushrooms with veal and chicken, ravioli, cheese and fruit, Italian pastry and expresso. No bar but wine may be ordered. Inexpensive to moderate.
23. **Italian Pavilion** (24 W. 55th) A lovely court for spring and summer dining. Specializes in Northern Italian food. Fine bar. Expensive.

SCANDINAVIAN

24. **Gripsholm** (324 E. 57th) . . . Best smorgasbord in NYC. To start, try akvavit with Tuborg beer, a polite boilermaker. While swinging around the table be sure and try the liver pate and shrimp with dill sauce. Inexpensive to moderate.
25. **Stockholm** (151 W. 51st) . . . You can try the conventional Swedish smorgasbord or take a 90° turn and sample an Italian smorgasbord. Located in the Abbey Hotel. Inexpensive to moderate.
26. **Three Crowns** (12 E. 54th) . . . You can enjoy the revolving smorgasbord here or stay at your table, sip akvavit and revolve by yourself. Try the cold chicken, very tasty. Inexpensive to moderate.

ORIENTAL

27. **Saito** (131 W. 52nd) . . . Japanese. Relax, take off your shoes and feel the weariness depart as you rinse off your face with the steam-hot towels. If you want to be conventional, have the beef sukiyaki prepared at the table. Try the soybean soup and by all means, have some hot sake (rice wine). For dessert, go the sherbet or melon route because bean cake is for the purist. Moderate to expensive.
28. **Kabuki** (135 Broadway) . . . Japanese. Here's the favorite downtown Japanese restaurant. About the same as Saito but not nearly as roomy. If the sake doesn't appeal to you, try some Japanese beer. Moderate to expensive.
29. **Ho-Ho** (789 Seventh) . . . Serves both Mandarin as well as Cantonese food. Try the swan la t'ang (sour & hot soup). World travelers have acclaimed it the best soup ever made. Have everyone order a different entree, then share it. Pour some meat or fish sauce on the rice, pick up the bowl and let the chopsticks fly. Inexpensive.
30. **King Wu** (18 Doyers St. in Chinatown) . . . Be the last of the big spenders. Located in the heart of Chinatown. No liquor license. You can spring for six of your friends and not spend over $15. Try the steamed jiao tze (ancestor of ravioli). And, order the sea bass. It's served with a delightful fruit sauce. Inexpensive.

SEAFOOD RESTAURANTS

31. **Sweet's** (2 Fulton St.) . . . Right across the street from the odorous Fulton Fish Market. They won't take reservations, but they still have the best seafood in Manhattan. Don't order steak, or they will throw you down the stairs. Stick to beer with the meal because the wine tastes like it had a rough passage from the West Coast. For dessert, have some nesselrode pie, much too good for the common people. Moderate to expensive.
32. **King of the Sea** (879 Third) . . . Not a "whale" of a lot of atmosphere, but the seafood is terrific. Try the rock crab served cold. Wash it down with ice cold Bass ale. Moderate to expensive.
33. **The Lobster** (145 W. 45th) . . . A plain, but hearty fish house. The seafood is fresh, inexpensive, and properly prepared. Just bring a good appetite. Inexpensive.

CONTINENTAL

34. **The Forum of the Twelve Caesars** (57 W. 48th) . . . Best food selection in the city. The menu is something to behold. Order as your wallet dictates . . . you can't go wrong. Order your wine by the glass. Try the coffee diablus for dessert . . . it's wild. Very expensive.
35. **Twenty-One** (21 W. 52nd) . . . Try the superb hunter's pie. The Dover sole is also excellent. Restaurants in this classification do **everything** well! Just bring money. Very expensive.
36. **Four Seasons** (99 E. 52nd) . . . Dine by the side of a lovely pool. Everything is served with a flourish. If you are worried about the cost, dine elsewhere. It's a tribute to the expense account.

MISCELLANEOUS

37. **La Fonda Del Sol** (123 W. 50th) . . . A delightful Latin-American restaurant that is almost a "one-in-a-kind." Try a refreshing sangria (wine-punch) with the Mexican platter. If you wait at the bar, enjoy the salted pumpkin seeds. Strolling musicians at night and on Sunday. Moderate to expensive.
38. **Keen's Chop House** (72 W. 36th) . . . An English pub-type restaurant with hundreds of churchwarden (clay) pipes affixed to the ceiling. Try the mixed grill with a little "half & half" (half Stout and half light beer). If this doesn't strike a responsive chord, forget English restaurants. Moderate to expensive.
39. **Trader Vic's** (7 E. 58th) . . . For a Polynesian restaurant, it swims in atmosphere. Dugout canoes, colored glass fishing floats and shields hang from the ceiling and walls. The cocktails carry names like "fog cutter" and are usually rum and fruit based. The food is similar to oriental fare. Moderate to expensive.
40. **Le Coq Hardi** (248 E. 49th) . . . A petite Belgian restaurant operated by a Belgian family. For a cocktail, order their 12-year old Belgian whiskey and drink it neat. Have the spinach or leek soup to start and for an entree have the beer stew. For dessert, enjoy the chocolate mousse. Inexpensive. ■

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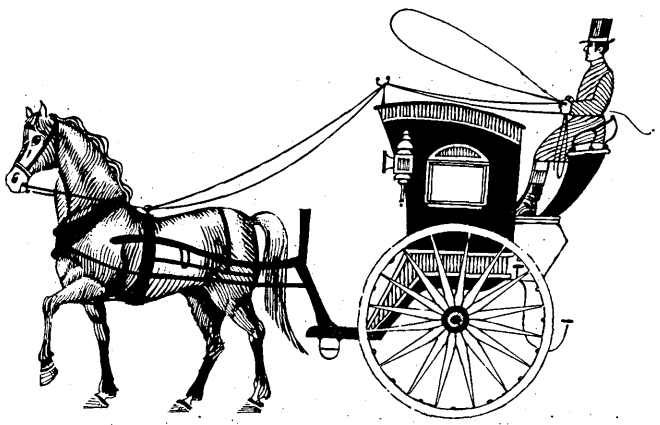
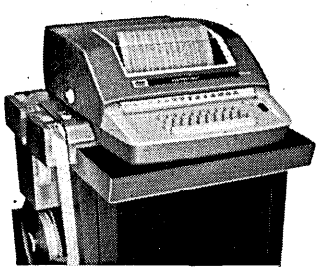
CIRCLE 73 ON READER CARD



IS YOUR TAPE CONVERSION STILL WORKING AT HORSE AND BUGGY SPEEDS?

THINK AHEAD...THE NEW KLEINSCHMIDT *321 ADS* CONVERTS TAPE TO HARD COPY AT 400 WORDS PER MINUTE!...TODAY



Think of tape conversion four times faster than you may be getting now. Think of less tape backup. Think of the Kleinschmidt™ 321™ ADS. Whether it's used "on line" or "off line," the 321 ADS gives you complete and reliable facilities for tape preparation, tape duplication and hard-copy print-out. For further information on the efficiency of the 321 ADS and other Kleinschmidt Electronic Data Communications equipment, write: KLEINSCHMIDT, Division of SCM Corporation, Lake Cook Road, Deerfield, Illinois.

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SCM® KLEINSCHMIDT DIVISION OF SCM CORPORATION

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Your existing IBM 1401 computer programs will run without change on IBM SYSTEM/360.

Look at these remarkable test results!

Application	1401 Time	SYSTEM/360 Time	How much faster?
Freight reconciliation	9.4 minutes	4.5 minutes	**2.0 times faster**
Matrix inversion	9.5 minutes	3.2 minutes	**2.9 times faster**
COBOL compile	22.0 minutes	5.1 minutes	**4.3 times faster**
FORTRAN compile & go	28.0 minutes	6.5 minutes	**4.3 times faster**
Cash distribution	20.0 minutes	7.9 minutes	**2.5 times faster**
Manufacturing: production program	42.0 minutes	18.0 minutes	**2.3 times faster**
Inventory analysis	45.0 minutes	15.3 minutes	**2.9 times faster**
Tax reporting	1.8 minutes	0.8 minutes	**2.2 times faster**
Inventory update	37.0 minutes	16.1 minutes	**2.3 times faster**

Emulators – special hardware devices we have developed–enable SYSTEM/360 to use your existing computer programs without costly reprogramming.

We invited customers to bring their 1401 programs to us and test them on a SYSTEM/360.

And they came–more than 125 of them – from as far away as Sweden.

They came with card programs and tape programs...with payroll programs and inventory programs...with COBOL and FORTRAN programs . . . with scientific and mathematical problems. They came with programs they had written, programs they had been using successfully on IBM 1401 systems.

We ran all these programs on SYSTEM/360 without changing any of them.

And they ran faster–sometimes three times faster... sometimes four times faster... sometimes only 20% faster–but, on the average, about twice as fast.

Programs that are written for IBM 1620, 1410, 1460, 1440 and all 7000 series computers also will work on SYSTEM/360 as long as you choose to use them.

Eventually, you will want to reprogram to take full advantage of SYSTEM/360 speed and versatility. But you don't have to do it right away. You can convert a program at a time, any time you choose.

SYSTEM/360 is ready to start working for you the day it moves in. It's ready to go like 65 right now–1965–with your 1960 programs.

Imagine what great things it will do when you reprogram!

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CIRCLE 49 ON READER CARD

NEW PRODUCTS

magnetic tape handlers

The Class 333-102, the 334-131 with controller, and the 334-132 without controller have been added to the NCR 315 line. The 333-102 has an 83.4 KC transfer rate; the latter units have a 33.3 KC transfer rate. All operate at 200 or 556 bpi. The 334-131 with controller is necessary to operate the 334-132 and can control up to four 132's. NATIONAL CASH REGISTER CO., Dayton, O. For information:

CIRCLE 148 ON READER CARD

typewriter/punch

The 2201 Flexowriter, Programmatic model, has a removable control panel for changing programs. The unit produces punched cards and paper tape as a byproduct of typing source documents. A desk houses the 2201 and any auxiliary units, such as the 2212 tape reader, 2214 reader, and 2215 tape punch. FRIDEN INC., San Leandro, Calif. For information:

CIRCLE 149 ON READER CARD

buffer

The DTI 100 Universal buffer can simultaneously handle up to 100 telegraph lines, or other data channels. Capabilities include code and format conversion, line identification, I/O timing, communication line monitoring, and error detection and retransmission of incorrect messages. DATA TRENDS, INC., Parsippany, N.J. For information:

CIRCLE 150 ON READER CARD

data terminals

Transmission terminals use the reverse channel data-phones, reportedly keep telephone line charges at a minimum. The Dial-o-verter series includes an on-line printer, transmitter and receiver for paper tape, punched card transmitter, mag tape terminal. DIGITRONICS CORP., Albertson, N.Y. For information:

CIRCLE 151 ON READER CARD

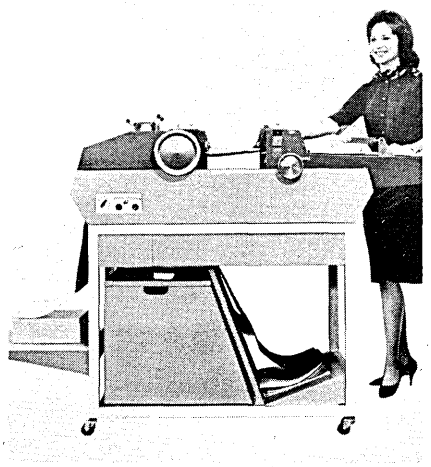
continuous form binding

The Planax method eliminates forms bursting or punching by binding sheets on one edge with a synthetic resin adhesive. This allows edge-to-edge visibility and permits printing close to the fold, a factor said to reduce form consumption by over 10%. CUMMINS-CHICAGO CORP., Chicago, Ill. For information:

CIRCLE 152 ON READER CARD

forms detacher-stacker

The Series 300 slits, detaches and stacks multi-part, continuous forms at up to 300 feet/minute; speeds may be varied. Form depths from 4¾ to 19 inches are accommodated. Two margin slitters remove up to 1 inch on each side; mid-form slitters are optional. Paper stock to 125 pound tag can be handled by the unit which measures 81 x 30 inches, stands 46 inches high. MOORE BUSINESS FORMS INC., Niagara Falls, N.Y. For information:



CIRCLE 153 ON READER CARD

disc files

The RAD 9167 has a capacity of 8 million characters, average access time of 17 msec, and transfer rate of 480KC. The RAD 9166 has a capacity up to 2 million characters, average access time of 34 msec, and transfer rate of 60KC. The files have a controller and one to four storage units, each with four 12-inch discs rotating at 1,800 rpm. Also featured: fixed read/write heads for every track. SCIENTIFIC DATA SYSTEMS, Santa Monica, Calif. For information:

CIRCLE 154 ON READER CARD

film reader

The 1010 reader, with a 24:1 lens available, can handle all National Microfilm Association standard microfiche, including a 5 x 8-inch format. The unit also accepts strip film in acetate jackets and has an optional 16mm roll film attachment. Other features include an opaque reading surface at a 25-degree angle and a 90-degree swivel microfiche holder to permit image rotation. DOCUMENTATION INC., Bethesda, Md. For information:

CIRCLE 155 ON READER CARD

message storer

The TR 2900 is a 100-track tape transport capable of storing 2,500 5-minute messages on a 3-inch-wide, 600-foot reel of mag tape. Five head

PRODUCT OF THE MONTH

On-line, mass storage devices for the Series 200 have capacities from 15 million to more than two billion (6-bit) characters. The basic storage medium is a magnetic tape strip about the size of a punched card, and housed in a removable cartridge. The latter weighs less than five pounds, carries 512 strips, and is said to be replaced in less than 20 seconds.

The smallest file is called the mod 251, takes one cartridge (15 million characters), and has an access time of 95 milliseconds. Larger files, the 252 and 253, use a cartridge with a capacity of 60 million characters accessible in 150- and 225-msec, respectively. The former holds but one cartridge at a time; the latter takes up to five cartridges, or 300 million characters. In addition, eight 253's can be handled by one controller—making a total of 2.4 billion characters on-line.

Monthly rentals range from $650 to $2,225, and prices from $14,625 to $100,125. Individual cartridges cost $375. First delivery is scheduled for the third quarter of '66. HONEYWELL EDP, Wellesley Hills, Mass. For information:

CIRCLE 156 ON READER CARD

Him say, "When reliability counts, count on Mylar®."

There'll be no signaling from your computer (or its operators) if you make certain that all your tapes are on a base of "Mylar"*. That's because "Mylar" is strong (a tensile strength of 20,000 psi), stable (unaffected by temperature or humidity changes) and durable (no plasticizer to dry out or become brittle with age). No wonder it has been the most used tape base for the past ten years. Remember: When reliability counts, count on "Mylar".

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

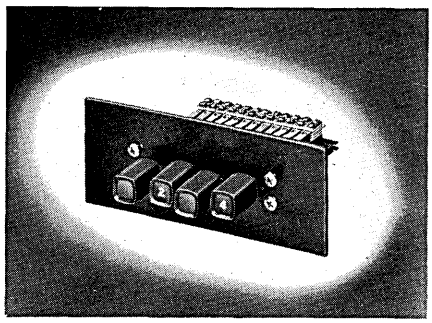
CIRCLE 50 ON READER CARD

stacks of 20 channels each in a staggered arrangement provide 100 parallel track capability. Tape speeds are 15/16 or 1 7/8 ips. Wind/rewind speed of 300 ips reportedly permits required message to be brought into play position in 10 seconds. TELECTRO INDUSTRIES CORP., Long Island City, N.Y. For information:

CIRCLE 157 ON READER CARD

switch buttons

Neither illuminated nor non-illuminated, these console buttons seem to light up when depressed, but require no bulb or electrical power. The Glo-Button is available with numerals 1



through 18, letters A through R, "on" and "off." They mount on standard 0.050 x 0.187 plungers for horizontal or vertical panel layouts. SWITCHCRAFT INC., Chicago, Ill. For information:

CIRCLE 158 ON READER CARD

military computer

The D84 uses monolithic IC's throughout, occupies less than 1½ cubic feet, and consumes 110 watts. Modularity allows multiprocessing, memory expansion from 4-64K words. Housed separately are the processor, memory, and I/O control. Delivery begins third quarter of '65. BURROUGHS CORP., DEFENSE & SPACE GROUP, Paoli, Pa. For information:

CIRCLE 159 ON READER CARD

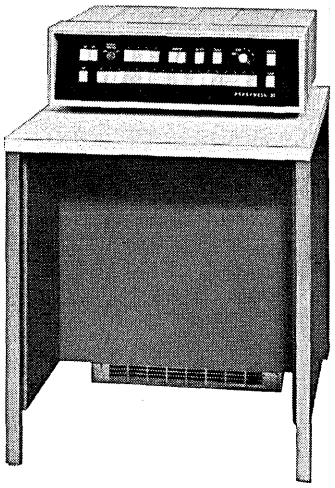
price-marking labels

Tabulabels, self-adhesive and mounted on backing with pin-feed holes, can be printed with price information on computer printers at up to 1,000 labels a minute. Perforations between multi-width labels allow bursting. AVERY PRODUCTS CORP., AVERY LABEL CO., Monrovia, Calif. For information:

CIRCLE 160 ON READER CARD

digital logic system

The DES-30 was primarily designed to provide basic hybrid capabilities to the Pace TR-48 analog computer, but it may also be linked to other



if you can find a better main frame for the price . . . get it!

We're talking about the H21 – central processor for the new Honeywell 20 Digital Control System. The main frame price, starting at $21,000* is one of many features which make it an attractive component for real-time systems.

Some other features are:

Word Length: 18 bits plus parity and memory guard bits. Single word instructions provide 8192 directly addressable core locations.

Priority Interrupts: Up to 16 hardware levels.

Memory: Magnetic core, random access; 2,048 to 16,384 words capacity; prewired for field expansion; non-volatile on power failure.

Memory Guard: Gives "padlocked" protection against accidental modification of guarded core locations.

Direct Memory Access: Independent path to memory for external I/O operations on a fully buffered, cycle-steal basis.

Silicon Hybrid Circuits with low active component count insure reliable system operation from 32 to 120° F.

Indexing may be combined with indirect addressing.

Three-Address Register Commands allow three-address arithmetic and/or logical operations with single word, one cycle instructions.

Double Length Accumulator facilitates 36-bit arithmetic.

Parallel I/O Channels — designed to provide efficient and convenient interface with user's system equipment.

Typical Operating Speeds (in microseconds, including accessing and indexing): register arithmetic/logical operations, 6.0; load/store, 12.0; multiply, 54.0.

Options: Auxiliary drum memory, magnetic tape unit, high speed paper tape punch and tape reader, priority interrupts, DMA.

Software—An extensive software package includes CONTRAN, the new compiler-level programming system for real-time control; FORTRAN IV with linkage capability to executive programs; and CAP assembly system plus arithmetic, utility, and diagnostic programs.

The H22 central processor with a cycle time of 1.75 microseconds is available at a slightly higher price.

For additional information . . .
call or write A. L. Rogers, Sales Manager
Special Systems Division, Queen & South Bailey Sts.,
Pottstown, Pa. 19464. Telephone: 215-FA 3-4000

*Basic price of $21,000 includes H21 central processor with 2K core and input/output typewriter with integral tape punch and reader.

Honeywell

CIRCLE 52 ON READER CARD

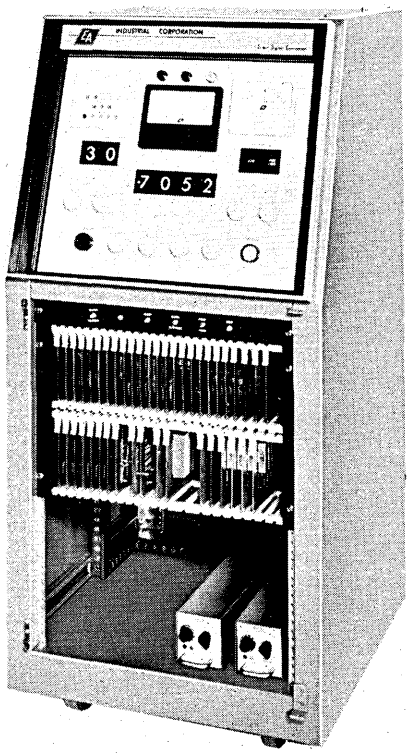
NEW PRODUCTS . . .

general purpose analog or digital computers or used alone as an aid to digital instruction or design. Features of the modular unit, which has a desktop or standard 19-inch rack-mount, are: synchronous logic; internal clock or triggering by external signal; 540-hole removable patch panel; one type of flip-flop module which may be used as a shift register, counter, or as four flip-flops; and programs which may be run manually or at one step a second. ELECTRONIC ASSOCIATES INC., Long Branch, N.J. For information:

CIRCLE 161 ON READER CARD

digital control computer

The EA 101 features microprogrammed position and velocity algorithms, time-shared scanning of up to 100 loops, which reportedly eliminates need for numerous single-loop analog controllers. Basic scanning rate is 1 cps, each cycle controlling

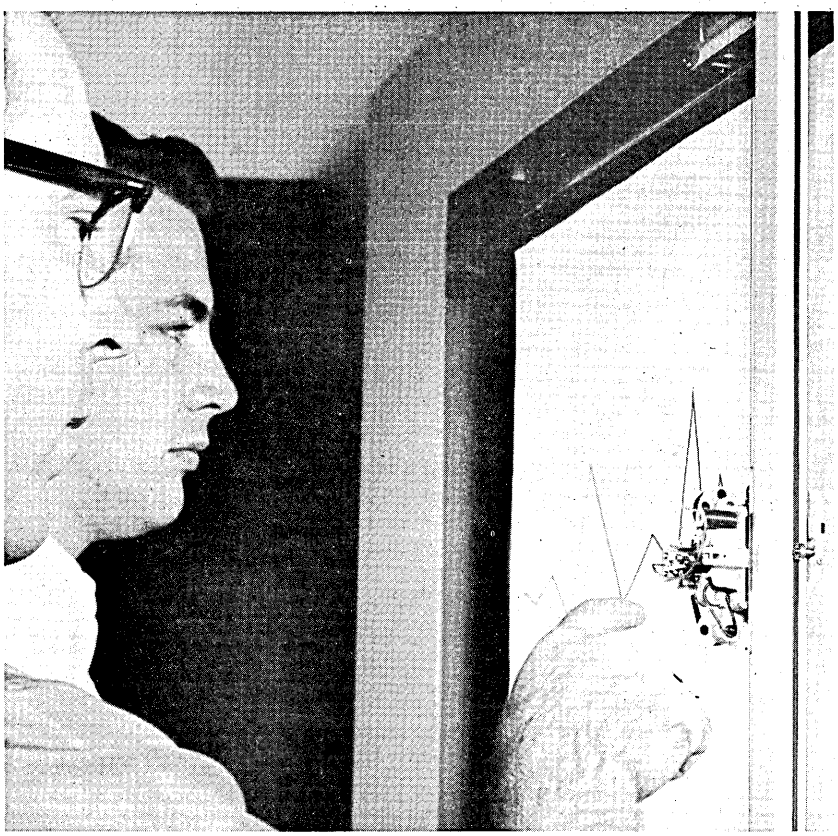


up to 100 loops; scanning rate is increased with fewer loops. Arithmetic register is 24 bits plus sign; loop parameters can be resolved to 1 part in 10,000. E-A INDUSTRIAL CORP., PROCESS AUTOMATION DIV., Los Angeles, Calif. For information:

CIRCLE 162 ON READER CARD

graphic input

The Grafacon 1010 is based on the Rand Tablet, has a "writing" surface and control electronics. It does not require a computer-controlled scan-

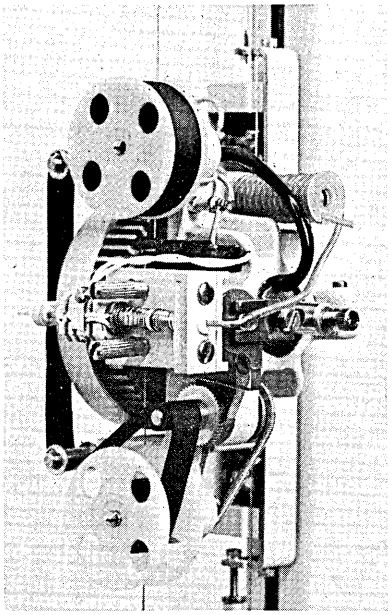


If you really care what your data-display dollar is buying...

Take a cold, hard look at Milgo's New 30" x 30" Vertical-plotting X-Y Recorder.

Compare it for speed. Repeatability. Accuracy. Reliability. Plot visibility. Add-on flexibility. Versatility. Quality. Floor space. Delivery time.

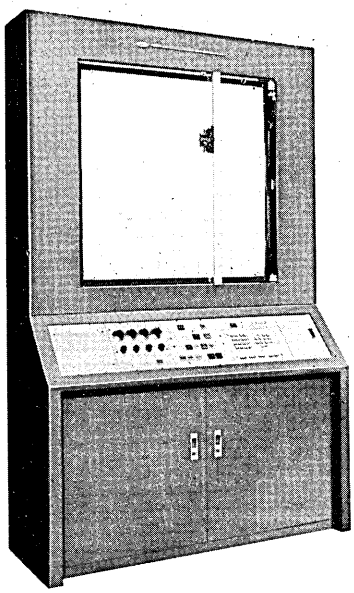
The Milgo solid-state 4021D X-Y Recorder accepts on-line digital inputs from any digital computer; off-line inputs from magnetic tape, punched paper tape, punched cards, a manual keyboard or an analog source. The pen/printer draws lines, curves, and point-plots; it symbol prints with a 50 character symbol printer. Pen and symbol printer interchange electronically in milliseconds. The pen/printer has a slew of 30 ips, with a continuous writing speed of 20 ips. The pen/printer point-plots in either pen or symbol mode at 500 ppm. It prints a random selection alpha-numeric character at 300 per minute. The plotting surface is evenly back-lighted by a variable powerstat control. Plots are clearly visible for 10 feet or more. The complete unit only occupies a 50 by 18 inch floor space. The 4021D was developed and is produced to military standards of quality and



reliability. It is rugged and of modular construction. Installed and operating, it has the lowest feature-for-feature price tag of any 30 by 30 inch plotter available to industrial and commercial users.

Take a cold, hard look, for instance, at the symbol printer and its integral pen and inking system.* The complete unit is 1/3 to 1/4 smaller than competitive units. It has no dangling umbilical cord. Pens are low-mass, jewel-bearing suspended, solenoid actuated. Capillary action prevents spilling at any slew speed or acceleration, and the ink reserve can be filled without disassembly. Ink supply is indicated visually. The arm, only 1 1/4 inches wide, is servo-motor driven at both top and bottom. It is ball-bearing mounted on stainless steel rails, precision ground to within 0.004 inch. It allows accelerations of 400 ips^2 in both X and Y; provides static accuracy within ±0.05% of full scale, and repeatability of ±0.02%.

Milgo offers analog and/or digital recorders in vertical or horizontal models with plotting surfaces up to 45 x 60 inches. If you need to know what your "data-display dollar" can buy, call Tom Thorsen,



Marketing Department, at Milgo Electronic Corporation, 7620 N.W. 36th Avenue, Miami, Florida 33147. Phone: 305 691-1220. TWX: 305 696-4489.

*U.S. Patent No. 3,120,214.

milgo

CIRCLE 54 ON READER CARD

NEW PRODUCTS . . .

ning system to locate and track the stylus. The 10 x 10-inch writing surface can accommodate 10^6 input locations with 100 lines/inch resolution in both x and y. DATA EQUIPMENT CO., Santa Ana, Calif. For information:

CIRCLE 163 ON READER CARD

document retrieval/display

Micro-images of documents up to 18 x 24 inches are filed at random on aperture cards, retrieved in some 10 seconds by entering document number on keyboard. Hard copy can also be made. The unit takes 11 square feet of floor space. MOSLER SAFE CO., New York, N.Y. For information:

CIRCLE 164 ON READER CARD

non-impact printer

Priced at under $6K is a 6,000-lpm, 32-column printer with alphanumerics appearing in synchronous and asynchronous modes. The printout on photo-treated paper lasts about 30 days exposed to normal light, longer when stored away from light. Delivery is 120 days. MONROE DATA/LOG DIV., LITTON INDUSTRIES, San Francisco, Calif. For information:

CIRCLE 165 ON READER CARD

control computer

The 335 is a parallel machine with 4-16K (16-bit) words of core and a cycle time of 1.7 usec. It also features memory protection against power failure, program interrupt, multi-level indexing and indirect addressing, double-length accumulator. Software includes FORTRAN and a real-time monitor. First delivery is June '65. BUNKER-RAMO CORP., Canoga Park, Calif. For information:

CIRCLE 166 ON READER CARD

manual tape punch

Hand-operated field encoder produces up to 41 codes in 5-8 level tapes. The DCN-41 has selector knob and indicator window to show code being punched, and is available with heavy base for desk-top use. ROBINS DATA DEVICES INC., Flushing, N.Y. For information:

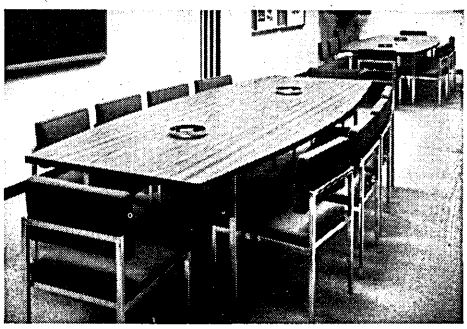
CIRCLE 167 ON READER CARD

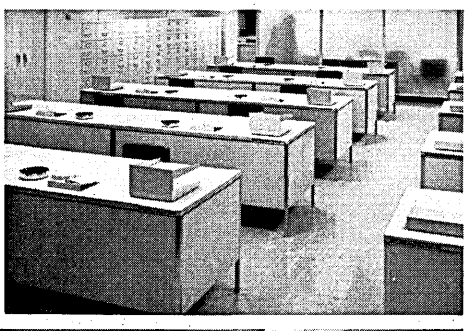
machine room desk

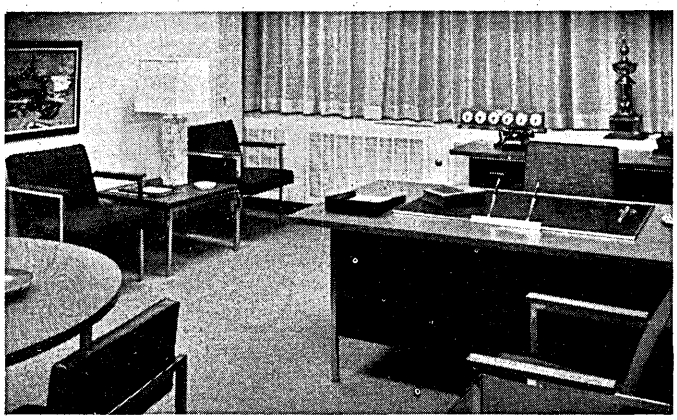
Formica-top desks have two- or three-drawer pedestal with work shelf and drawers for tab cards. The latter have transparent front panels. Furniture is classified as computer console or card punch desk. MONARCH METAL PRODUCTS INC., New Windsor, N.Y. For information:

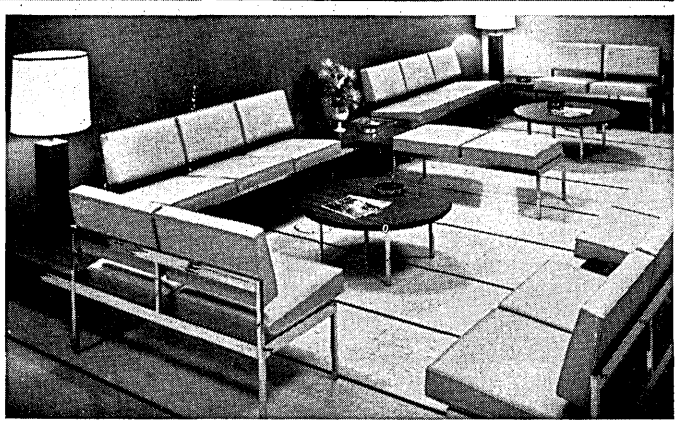
CIRCLE 168 ON READER CARD

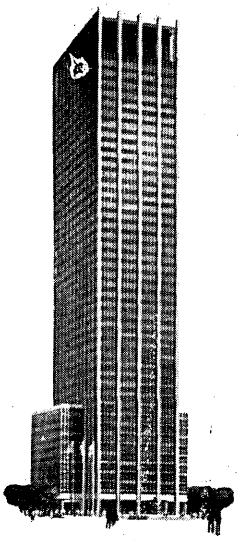
We go farther than the DP department











Steelcase/Datacase recently furnished offices in J. C. Penney Company's new 45-story headquarters building in New York

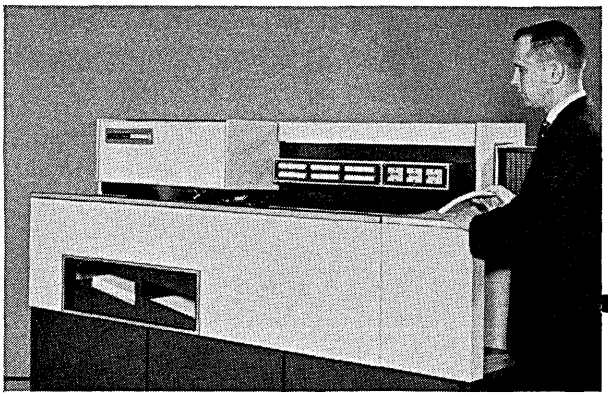
Data processing department, executive offices, general offices, reception areas —almost any place you look in J. C. Penney Company's handsome new building, you'll see furniture by Steelcase/Datacase. All perfectly coordinated in design, color and function—and so durably constructed that the entire office complex will retain its fresh appearance for years. Your local Steelcase/Datacase dealer offers you a broad choice of furniture and data processing auxiliary units. And, he delivers, installs and services quickly and knowledgeably. Call him, he's in the Yellow Pages. Or, write Dept. D, Steelcase Inc., Grand Rapids, Michigan; Los Angeles, California; Canadian Steelcase Co., Ltd., Don Mills, Ontario.

DATACASE®/BY STEELCASE

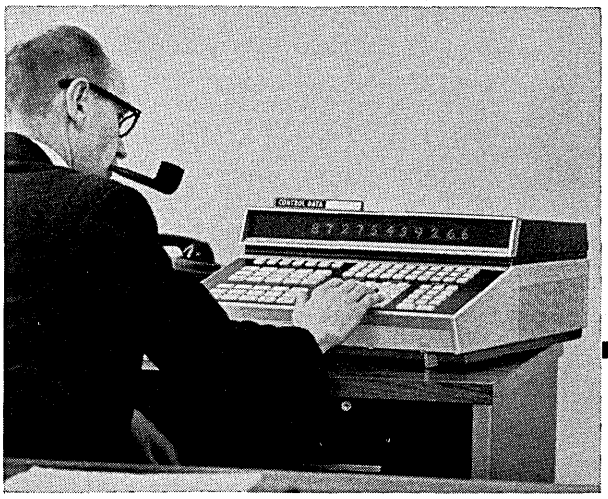
OFFICES AND SHOWROOMS: NEW YORK • CHICAGO • GRAND RAPIDS • ATLANTA • DALLAS • LOS ANGELES • PHILADELPHIA • PORTLAND, OREGON • TORONTO • MONTREAL

CIRCLE 55 ON READER CARD

Here's how Tom, Dick and Harriet can now "talk directly" to a CONTROL DATA® computer...



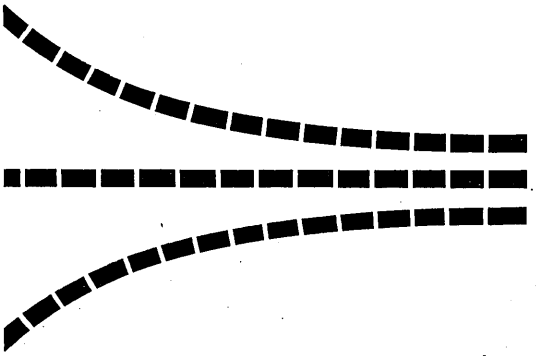
NEW OPTICAL READER Reads printed and typewritten material — and inputs data directly, without converting it into punchtape, punchcards or other intermediate formats. CONTROL DATA Model 915 Optical Reader recognizes all letters of the alphabet, standard punctuation, 0 through 9, and special symbols used in programmed functions. It handles documents, and continuous fanfold sheets. This new high-speed Reader can be used simply as an input device, or as a complete small system for data processing and storage.



NEW REMOTE CALCULATOR Revolutionary desk calculator allows simultaneous on-line computing service for many engineers, scientists, and mathematicians from their home or office. The Remote Calculator provides direct, remote access in a time-sharing system to any Control Data 6000 Series computer. Remote connections can be made anywhere, via standard telephone channels, through the common-user dial network. And for the first time, the user's need for programming is completely eliminated. Users merely query the computer from a keyboard containing all conventional functions and symbols of mathematics . . . answers are immediately shown on the remote calculator's display panel. All the features and power of the world's most powerful digital computers are made instantly available at extremely low cost.

NEW VISUAL DISPLAY UNIT Anyone who can use a typewriter can now "talk" to a computer and get answers on the spot. The operator of a CONTROL DATA 210 simply types in the query and presses the "transmit" key; the answer appears immediately on the screen. Access time to central computer: 140 milliseconds . . . virtually instantaneous! Screen displays up to 1000 characters. Central logic handles in excess of 20,000 entries an hour. Up to 63 stations can be tied into a single computer, with simultaneous access for all. Options cover many diverse applications and there are input interfaces for digital computers, telephone subsets and other digital sources.

You can see these new devices working at IFIP Congress, New York Hilton, May 24-28.



NOW *anyone* can communicate directly with a CONTROL DATA Computer — in ordinary English and in real time and get answers right back. Individuals at hundreds of scattered points can work with the same computer at the same time, as if each had it all to himself. This is the wave of the future — "man/computer interfacing." Here today from CONTROL DATA is the ability to query the computer by remote keyboard. Also available is a way for individuals at *various* remote points to time-share large digital computers as a personal tool of work. In addition, CONTROL DATA provides systems for optically reading ordinary print . . . allowing simplified input techniques, and opening new wells of information to computer compilation. CONTROL DATA supplies today's most advanced computer systems, software and support . . . everything you need for a perfect meeting of minds between man and computer.

Never before have instant answers been so available to so many! Simultaneously!

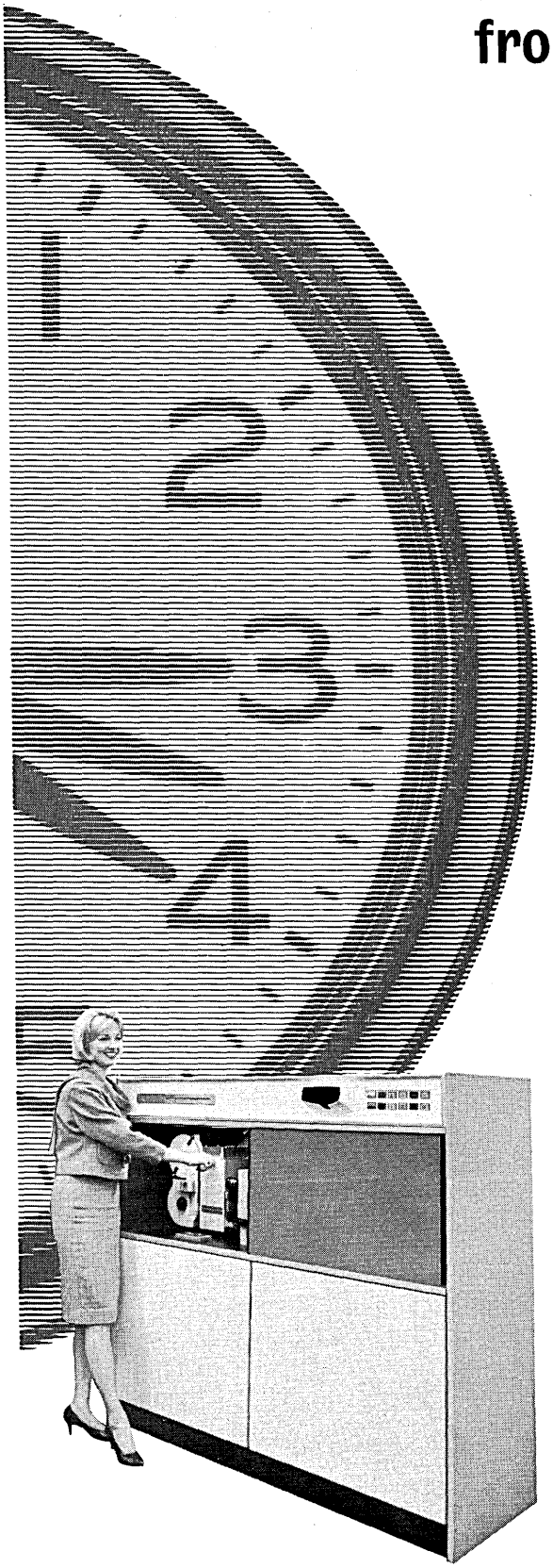
At CONTROL DATA *you* are the difference in computers: the pattern for a uniquely customized system delivering more for every dollar you invest. For more information please write CONTROL DATA Corp., Dept. H-55.

CONTROL DATA
CORPORATION

8100 34th AVENUE SOUTH, MINNEAPOLIS, MINNESOTA 55440

CIRCLE 58 ON READER CARD

The S-C 4400 document recorder has to work only one hour per day to cut $3,000 a month from computer printing costs!



If you now operate two mechanical computer printers, the S-C 4400 can save you thousands of dollars a month. At the same time it speeds output, increases retrieval rates and reduces data storage problems by recording all or part of your data on microfilm. The S-C 4400 can do all of this by operating as little as one hour per day.

For the second printer you pay approximately $200 per day or more. An S-C 4400 can do the same job in less than an hour, making a million line entries every sixty minutes. The cost? Approximately $182.00 based on one hour per day usage; the actual hourly rate will of course decrease with increased usage. Besides cutting printer costs by $400.00 per month, the S-C 4400 can usually replace one operator per shift as well as eliminate several thousand dollars a month or more in business forms inventory. The total result is a conservative $3,000 a month savings.

The S-C 4400 simplifies mass data processing by taking information from a computer and recording it directly on 16mm or 35mm microfilm. Today's automatic microfilm systems permit finding one document out of a million in 15 seconds.

Operation—In the S-C 4400, computer data is displayed on the face of a CHARACTRON® Shaped Beam Tube and then photographed automatically. It saves time and money by eliminating the costly step of producing paper output before microfilming. The S-C 4400 can operate on-line with a computer or off-line from magnetic tape. Magnetic tapes and paper need not be manually transported to other machines to get microfilm output. When you desire selected paper copies, they can be produced easily on a microfilm reader/printer.

No Forms Needed—Large inventories of pre-printed business forms are no longer necessary. Instead, forms are photographed on slides and inserted in the S-C 4400 projector. As needed, forms are projected by program control directly to the microfilm for recording with the computed data. One company estimates the S-C 4400 system can save more than $25,000 per month in business forms alone.

Codes Film—Film coding for retrieval systems is accomplished automatically by the S-C 4400. Line indexing marks, image count blips and MIRACODE retrieval codes can be imprinted on the film at electronic speeds.

Typical Applications—S-C 4400 can simplify data processing by recording customer histories; account, payroll and personnel records; route and rate information; credit figures; stock transfers; transaction journals; inventory reports; configuration management reports, etc. on easy to use and easy to store microfilm.

If you are interested in obtaining additional information on how to reduce your computer output costs and at the same time expand the capabilities of your computer operation, write Stromberg-Carlson Corporation, Data Products—San Diego, Department F-29, P. O. Box 2449, San Diego, California 92112.

STROMBERG-CARLSON
CORPORATION
DATA PRODUCTS-SAN DIEGO

CIRCLE 59 ON READER CARD

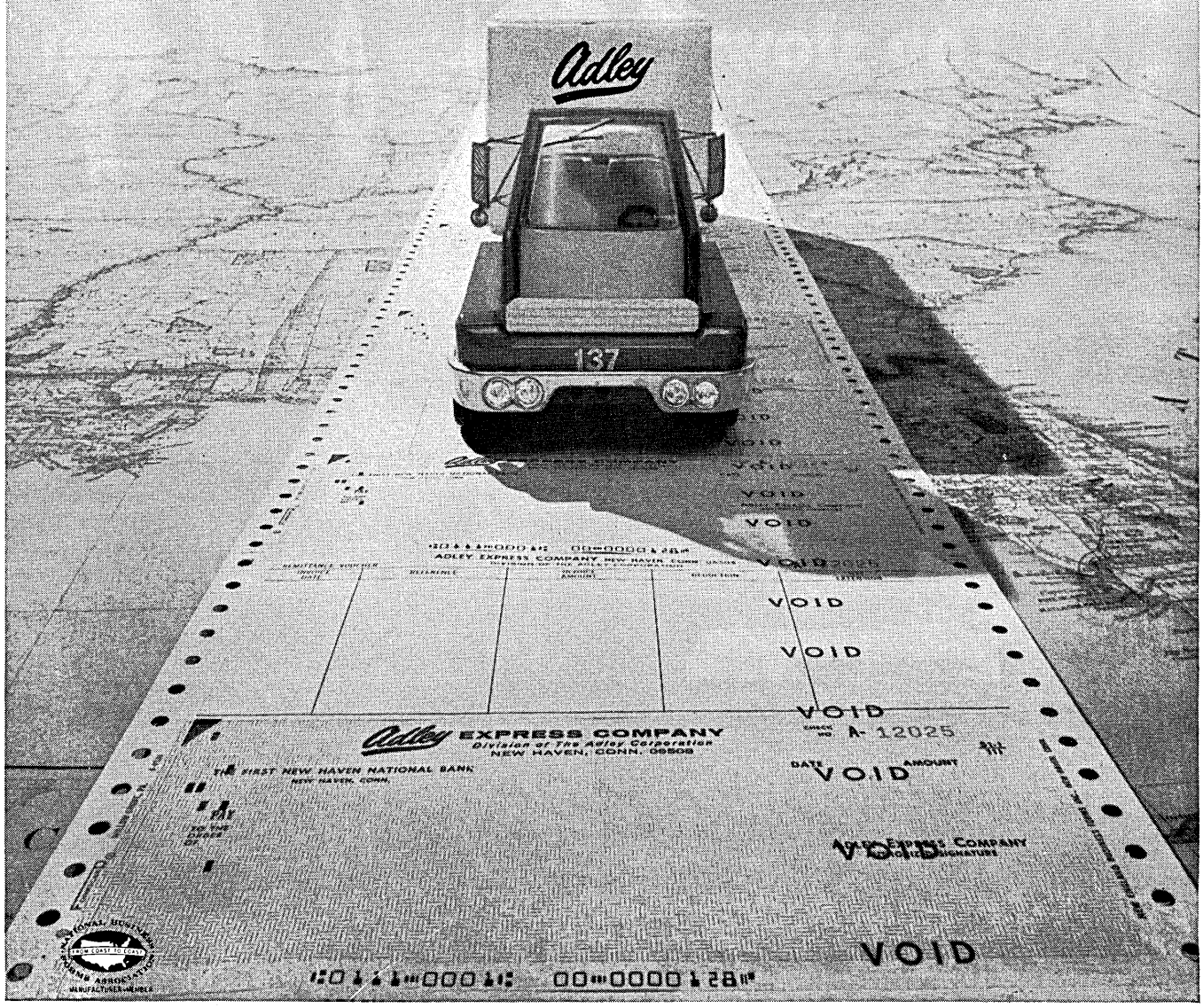
The Adley Express Company of New Haven, Conn. has three iron-bound rules of operation; service, efficiency and speed—a philosophy which dictated FORMSCARDS as the continuous tabulating cards for Adley's accounts payable and payroll.

FORMSCARDS are unique; they don't have medial waste strips between the cards. So you don't waste money shipping useless medial strips around. You don't waste space storing medial strips. You don't waste time running them across your processing equipment. You don't waste time bursting them. And finally, you don't wind up with a truck-load of medial strips to throw out. (See why those little strips between cards are called "**waste** strips?")

Isn't it time you followed the route Adley took to faster, waste-free tabulating card operations? There's a FORMSCARD system to fit your every need. Let us tell you all about the time, trouble and money you could be saving with FORMSCARDS; drop us a line and we'll send you our brochure telling the whole amazing FORMSCARD story. Or, if there's a rush, give us a call. Phone: OLdfield 9-4000 Area code 215.

Forms inc
WILLOW GROVE, PENNA.

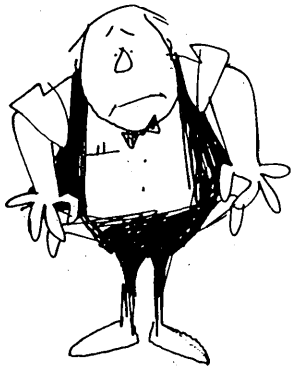
Adley Express saves a truckload of time with Formscards



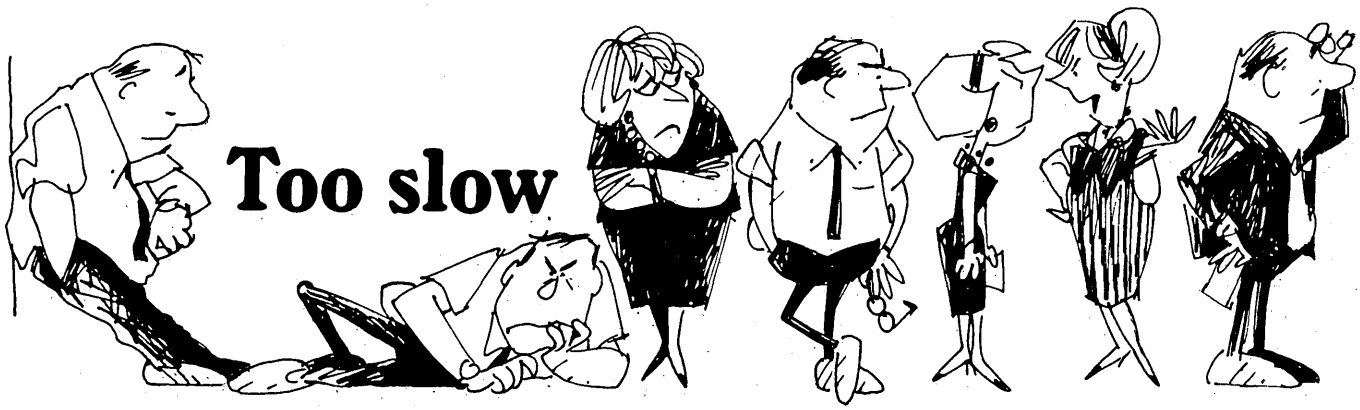
CIRCLE 60 ON READER CARD

There are 3 kinds of line printers

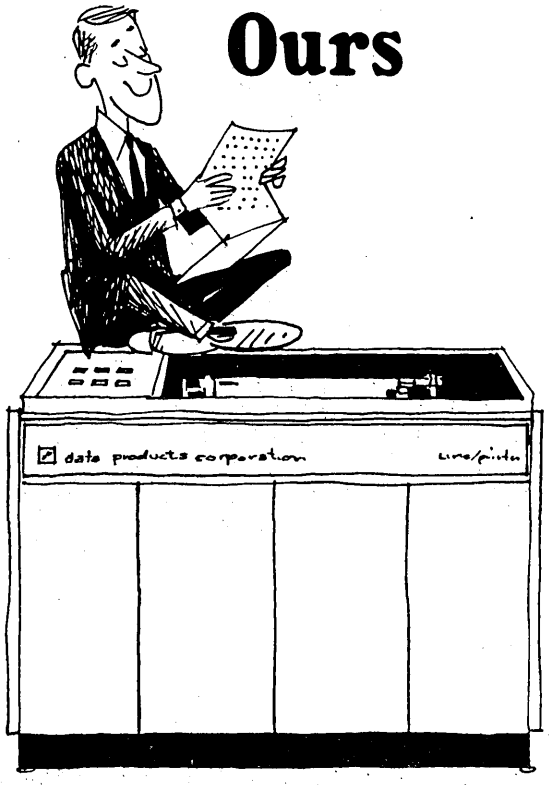
Too expensive



Too slow



Ours



Try our new LINE/PRINTERS. They're not like other printers. They're faster to save you time. Low cost to save you money.

OFF-LINE: Try our 300, 600, and 1,000-lines-per-minute off-line print stations. They are complete IBM-compatible mag or paper tape-to-printer systems. They save time. They save money. They're delivered in 90 days ARO.

ON-LINE: Our 300, 600, and 1,000-lines-per-minute printers interface to any computer. They save time. They save money. With an IBM 1620 or CDC 160A interface, they're delivered in 90 days ARO.

We haven't mentioned reliability. We should: MTBF is 434 hours. We had to create a friction-free hammer system and a clutchless, brakeless, springless, dogless paper feed system to do it. We did. That's yet another way we've saved you time and money.

About money: We sell, lease or rent. Systems prices start at $29,000. Off-line stations start at $1,050 per month. On-line systems start at $795 monthly. Service contracts available throughout the United States. Prices sound low? You should see the operating costs: Rock bottom!

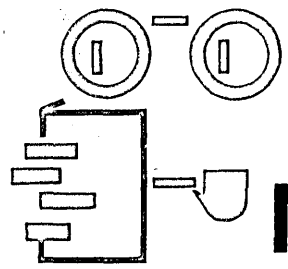
Oh yes. All models are completely buffered. They're also IBM program-compatible. And we've even soundproofed the cabinet.

Want to save time? Want to save money? Want to know more about our 4600-Series on-line and off-line printer systems? We'll deliver a data packet in 5 days ARO.

data products corporation

8535 Warner Drive, Culver City, California

CIRCLE 61 ON READER CARD



NEW LITERATURE

THEORETICAL CYBERNETICS ABSTRACTS: Translated from the Russian "Referativnyy zhurnal, Matematika," 99-page book includes such topics as theory and application of logical systems, automatic control theory, information theory, computer theory, mathematical linguistics. Annual subscription: $135. SCENTIFIC INFORMATION CONSULTANTS LTD., London, Eng.

DRUM MEMORIES: 10-page brochure describes drum memories, modules, and special systems. Chart gives mechanical, electro-mechanical, magnetic, packaging, and performance specifications of 15 models of drum memories in three series. VERMONT RESEARCH CORP., North Springfield, Vt. For copy:
CIRCLE 130 ON READER CARD

READOUT DEVICE: Data sheet describes Series 360 rear-projection readout device. Unit displays characters up to 2-inches in height and may be read from 50 feet. Engineering details, mounting dimensions, lamp specifications and a chart of standard displays are provided. INDUSTRIAL ELECTRONIC ENGINEERS, INC., Van Nuys, Calif. For copy:
CIRCLE 131 ON READER CARD

READER/PUNCH STATIONS: Spec sheet includes timing charts and price information for Models 580 and 581. The units share a common housing and motor drive, but are electrically independent. ROYAL MCBEE CORP., INDUSTRIAL PRODUCTS DIV., Hartford, Conn. For copy:
CIRCLE 132 ON READER CARD

MICROFICHE AND ROLL FILM READER: Brochure describes portable 1010 reader and lists such features as opaque reading surface, angled at 25° for easy reading, a 90° swivel fiche holder and acceptance of all NMAS microfiche including 5- x 8-inch format. DOCUMENTATION INC., Bethesda, Md. For copy:
CIRCLE 133 ON READER CARD

DIGITAL COMPUTERS IN NUCLEAR RADIATION COUNTING: Designed to inform the researcher of the latest development in the application and measurement of radioactivity, bulletin outlines the mathematical calculations encountered in radiation measurement and how they can be quickly resolved by a digital computer program. NUCLEAR-CHICAGO CORP., Des Plaines, Ill. For copy:
CIRCLE 134 ON READER CARD

GRAPHIC DISPLAY: Data sheet describes transistorized portable facsimile system designed for military field operations. The AN/GXC-5 system provides transmission and reception in graphic form of combat information, orders, maps and general message traffic. Facsimile system uses radio or wireline circuits and can receive through noise that makes voice and teleprinter systems unusable. WESTREX COMMUNICATIONS. DIV. OF LITTON INDUSTRIES, New Rochelle, N. Y. For copy:
CIRCLE 135 ON READER CARD

DIGITAL CONTROL SYSTEM: Typical process applications that can be performed by H20 digital control system are outlined in 16-page brochure. Described with block diagrams are how the system can be used for monitoring and data logging, supervisory control, direct digital control, high-speed data acquisition, batch processing and production control. CONTRAN and other programming aids are also discussed. HONEYWELL INC., SPECIAL SYSTEMS DIV., Pottstown, Pa. For copy:
CIRCLE 136 ON READER CARD

RESEARCH ON COMPUTER NEURISTOR DEVICES: Attempts at construction for computers have convinced researchers that it will be an extremely difficult technical feat to achieve such devices and make them competitive with present logic systems. 13-page booklet points out topics related to neuristors. Work in this field is going on in Japan and Russia. Price: $1. STANFORD RESEARCH INSTITUTE, Menlo Park, Calif.

LIQUID SCINTILLATION SPECTROMETER: 12-page illustrated brochure describes system designed primarily for counting softbeta emitting isotopes and electronically computes the count rate and error correction every 1.2 seconds, allowing for continuous digital display of the counts per minute. BECKMAN, SCIENTIFIC & PROCESS INSTRUMENTS DIV., Fullerton, Calif. For copy:
CIRCLE 137 ON READER CARD

JOURNAL DATA TRANSMISSION: System 960A permits the transmission of sensor information and recorder controls and system alarms from three dual trackside locations over a 3kc bandwidth. Brochure includes system description, block diagram and photos of "hotbox" detection equipment. LENKURT ELECTRIC CO., INC., San Carlos, Calif. For copy:
CIRCLE 138 ON READER CARD

DIRECT DIGITAL CONTROLLER: Eight-page brochure describes design philosophy, application, programming and operation of EA-101. PROCESS AUTOMATION, DIV. OF E-A INDUSTRIAL CORP., Los Angeles, Calif. For copy:
CIRCLE 139 ON READER CARD

AUTOMATED VENDOR ACCOUNTING: Six-page brochure describes NCR 500 punched card computer configuration which can be used to control vendor accounting procedures. Diagrams show data flow for vouchering, distributing, disbursing, and reporting. The NATIONAL CASH REGISTER CO., Dayton, Ohio. For copy:
CIRCLE 140 ON READER CARD

LABORATORY INSTRUMENT COMPUTER: Brochure describes LINC, designed for biomedical research. Can generate stimuli, control stimuli/response relationships, and display responses for on-line monitoring. LINC stores data and displays stored data selectively before or after statistical analysis. DIGITAL EQUIPMENT CORP., Maynard, Mass. For copy:
CIRCLE 141 ON READER CARD

What's so great about Magne-Flo coating on MAC Panel computer tape?

in a few words: Uniformity of Signal Response!

Tests prove that since all base materials have uneven thicknesses — hills and valleys across the width of the web — most coating methods leave heavy oxide deposits in the valleys and a thin coating on the hills. This variation in thickness results in a variation in signal response and unreliable tape performance.

MAC Panel's coating method — Magne-Flo coating — is based on a gravure printing principle, and so a uniform, pre-determined oxide thickness is guaranteed throughout the entire tape width and length. This method assures consistent signal response from channel to channel, from reel to reel.

Sounds reasonable, doesn't it, that only a tape that assures uniform signal response will give you assured tape performance? MAC Panel heavy duty computer tape with Magne-Flo coating guarantees it!

Your MAC Panel representative can give you additional facts. Call him today.

MAC PANEL COMPANY MAC PANEL **High Point, North Carolina**

Representatives Throughout the World

CIRCLE 62 ON READER CARD

NEW LITERATURE . . .

USED EQUIPMENT: Price lists for used LGP-30's, RPC-4000's, G-15's Clary DE-60's Ampex FR-300 tape transports, and several digital line printers are available. THE LAMELLAR CORP. OF AMERICA, Pacific Palisades, Calif. For copy:
CIRCLE 142 ON READER CARD

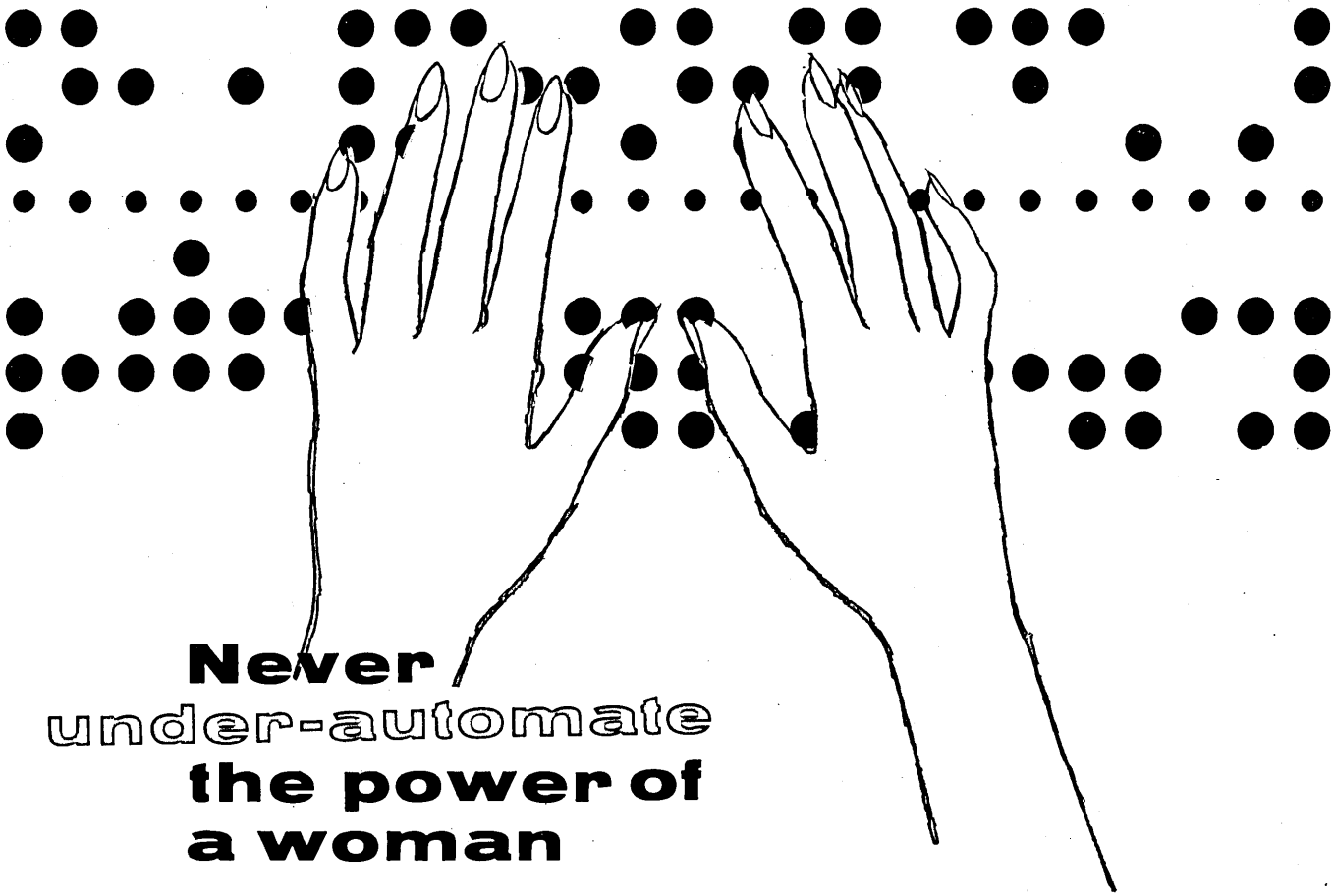
OSCILLOGRAPH RECORDING PAPER: DATACOLOR 88 comes in basically a two-color emulsion paper (red & cyan), but several color tones can be obtained through use of filters. Data sheet lists physical and photographic characteristics. CONSOLIDATED ELECTRODYNAMICS CORP., Pasadena, Calif. For copy:
CIRCLE 143 ON READER CARD

REFERENCE TABLE FOR IBM TAPE UNITS: Table is used to determine the number of reels of mag tape required for a file and for approximating the running time per reel for most of the tape drives now in use. COMPUTER METHODS CORP., White Plains, N.Y. For copy:
CIRCLE 144 ON READER CARD

MULTIPROGRAMMING: 12-page brochure describes GE Compatibles/600 features for multiprogramming, including the five modules of the General Comprehensive Operator Supervisor (GECOS) executive system and such associated hardware features as a dual mode processor and Base Address Register (BAR). GENERAL ELECTRIC, COMPUTER DEPT., Phoenix, Ariz. For copy:
CIRCLE 145 ON READER CARD

VISUAL READ/PRINTOUT COUNTERS: Four-page bulletin contains specifications, operating characteristics, dimensions, and typical installation diagrams to assist engineers in specifying printing counters for all types of applications. LANDIS & GYR, INC., New York. For copy:
CIRCLE 146 ON READER CARD

ENVIRONMENTAL ANALYSIS: Booklet explains how calculation is made possible by computer of building heating and cooling loads and energy requirements. The load program determines heat gains and losses for each zone or conditioned space within building. Calculations account for variations in parameters for every hour throughout the year. WESTINGHOUSE ELECTRIC CORP., Pittsburgh, Pa. For copy:
CIRCLE 147 ON READER CARD



Never under-automate the power of a woman

(or . . . for that matter, the power of SCM Typetronic 7816)

Low cost source data automation turns any typist into a one-woman army . . . by developing all other business information as a 100% by-product of the initial typing operation! For example, let us say your girl is typing a sales order. On the 7816, only 10% of her typing is manual . . . 90% is automatic and all computations are automatic. And as a plus, the 7816 produces punched tape as a 100% by-product of the typing operation . . . for use in billing, accounts receivable, sales analysis, or whatever related information is needed. Let us show you without cost or obligation how YOUR business can benefit from the applications of source data automation.

SCM TYPETRONIC®7816™ DATA COMPUTING SYSTEM • SCM TYPETRONIC 2816™ AUTOMATED TYPING SYSTEM

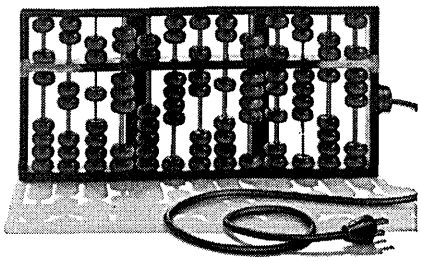
SCM DATA PROCESSING SYSTEMS
® DIVISION OF SCM CORPORATION

SCM CORPORATION DATA PROCESSING SYSTEMS D-5-5
410 Park Avenue, New York, N. Y. 10022

Gentlemen:
I would like to learn more about the features of SCM TYPETRONIC SYSTEMS and their applications — no cost or obligation on my part, of course.

Name:_____
Title:_____
Company:_____
Address:_____
City:_____ State:_____ Zip Code:_____

CIRCLE 63 ON READER CARD



"LOOK AT LOCKHEED IN COMPUTERS AND PROGRAMMING..."

ANALOG
BUSINESS
SCIENTIFIC
DIGITAL

Lockheed Missiles and Space Company operates the largest single industrial digital computer facility in the United States. It provides exceptionally versatile and advanced computation and data reduction services to all parts of the Company.

Degree and appropriate experience are required for the following assignments:

DESIGN computer systems and evaluate equipment for information retrieval, graphic processing and real-time missile component testing.

DEVELOP advanced software operating and programming systems on IBM 1410/7094 computers and Univac 1107/1108 computers.

OPTIMIZE commercial programs for efficiency and cost reduction and adapt programs to new equipment, certifying for conformance.

DEVELOP real-time data systems for commercial applications such as source data acquisition, updating, retrieval and administrative control systems.

ANALYZE and program new business applications on medium and large scale computers. Develop financial, engineering, manufacturing and procurement integrated systems for real-time and off-line functions.

PROGRAM and operate analog or hybrid computers and differential analyzers. Define models for simulation of aerospace guidance and control problems and analyze results.

Please write Mr. K. R. Kiddoo, Professional Placement Manager, Lockheed Missiles & Space Company, 443 Industrial Relations Building, P. O. Box 504, Sunnyvale, California

LOCKHEED
MISSILES & SPACE COMPANY
A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION
An equal opportunity employer

CIRCLE 129 ON READER CARD

COMPUTER PROGRAMMERS

...to help Develop Basic Techniques in Information Systems Technology

Today there is a vital need to develop advanced programming and system modeling techniques for tomorrow's electronic information system design.

MITRE is making important contributions in this area through its extensive computer facilities in the new Systems Design Laboratory at Bedford.

Programmers are needed now for assignments in the following broad areas:

- **Real Time System Design**
- **Man-Machine Languages**
- **Applied Systems Programming**
- **Automated Data Management Systems**
- **Information Storage**
- **Compilers, Monitors, Time-Sharing Systems**
- **Displays**
- **Facility Statistical Analysis**

Experienced programmers, as well as recent college graduates with high scholastic achievements and an interest in these fields, are invited to apply. Write in confidence to Vice President —Technical Operations, The MITRE Corporation, Box 208 AU, Bedford, Massachusetts.

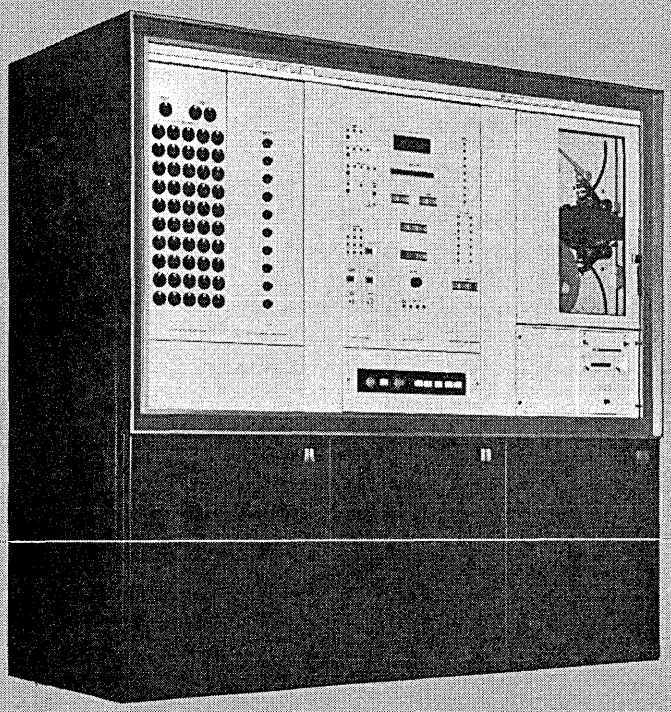
THE MITRE CORPORATION
An Equal Opportunity Employer

Pioneer in the design and development of command and control systems, MITRE was chartered in 1958 to serve only the United States Government. An independent nonprofit corporation, MITRE is technical advisor and systems engineer for the Electronic Systems Division of the Air Force Systems Command, and also serves the Department of Defense, and the Federal Aviation Agency.

CIRCLE 94 ON READER CARD

SEL MAKES

SEL 600 SERIES DATA ACQUISITION SYSTEMS



- HIGH SPEED DATA ACQUISITION TO 220,000 SAMPLES/SECOND
- SLOW SPEED DATA LOGGING FOR LARGE INPUT CHANNEL CAPACITY
- DIRECT LOW LEVEL OR HIGH LEVEL INPUTS
- COMPUTER CONTROLLED RANDOM ACCESS SAMPLING

SEL 600 BASIC SYSTEM SPECIFICATIONS	
NUMBER OF CHANNELS	1 to thousands
INPUT VOLTAGES FULL SCALE	± 4 MV to ± 100 volts
ACCURACY	to ± 0.05% ± ½ bit
RESOLUTION	to 14 bits binary or 17 bits BCD
SYSTEM SAMPLING RATES	to 220,000 samples per second

SEL 600 OPTIONS

On-line reduction with SEL 800 computers
Computer programmable channel sampling
Computer addressable gain and offset
Quick-look displays
Auto self-test features

NOW YOU CAN PURCHASE TOTAL SYSTEM CAPABILITY FROM ONE SOURCE — COMPATIBLE ACQUISITION AND COMPUTER SYSTEMS REPRESENT THE ULTIMATE IN AN ENGINEERED APPROACH TO YOUR REQUIREMENTS FOR.....

FOR MORE INFORMATION WRITE FOR THESE BULLETINS

9032 — SEL 810 General Purpose Digital Computer
9042 — SEL 600 Data Acquisition Systems
9056 — SEL 840 Scientific Digital Computer

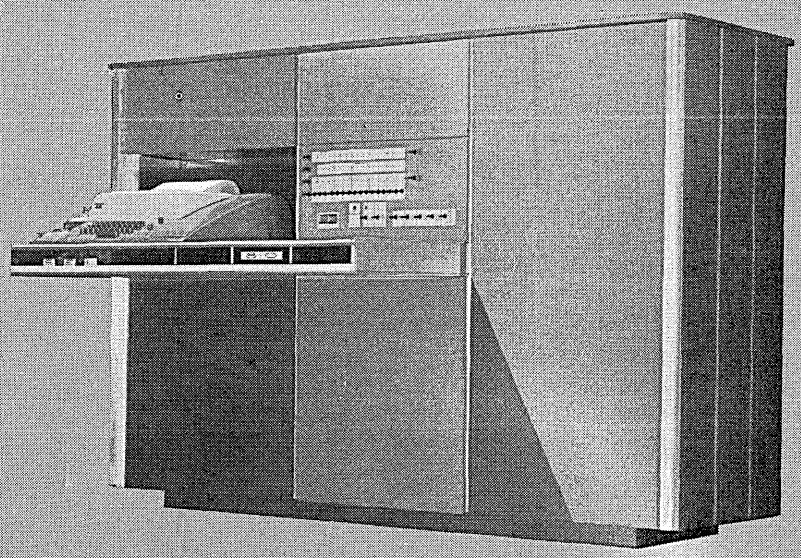
IMMEDIATE OPENINGS FOR LOGIC DESIGN ENGINEERS

SEL is an equal opportunity employer

BOTH ●●●●●●●●●●●●●●●

SEL 800 SERIES GENERAL PURPOSE DIGITAL COMPUTERS

- ALL SILICON MONOLITHIC INTEGRATED DIGITAL CIRCUITS
- HIGHEST THROUGHPUT RATE OF ANY MACHINES IN THEIR SIZE OR PRICE CLASS
- 1.75 μ SECOND — FULL CYCLE TIME — FULLY PARALLEL OPERATION
- HARDWARE MULTIPLY, DIVIDE AND FLOATING POINT CAPABILITY



BASIC CHARACTERISTICS

SEL 810 COMPUTER	SEL 840 COMPUTER
WORD SIZE ..... 16 bits	WORD SIZE ..... 24 bits
STORAGE ..... 4096 words	STORAGE ..... 4096 words
Hardware multiply Included	Hardware multiply and divide included

Two independent I/O channels
Typewriter, tape reader and punch
Hardware index register and program counter
Complete software package for real-time applications
FORTRAN package for off-line scientific computation

810 AND 840 OPTIONS

To 32,768 word core in main frame—all directly addressable
External drum or disc storage
Up to 8 I/O channels
Up to 6 direct memory access channels
Any standard peripherals

- REAL TIME DATA READOUT IN ENGINEERING UNITS
- CLOSED LOOP DIRECT DIGITAL CONTROL
- INDUSTRIAL PROCESS PRESET CONTROL
- OFF-LINE GENERAL PURPOSE COMPUTATION

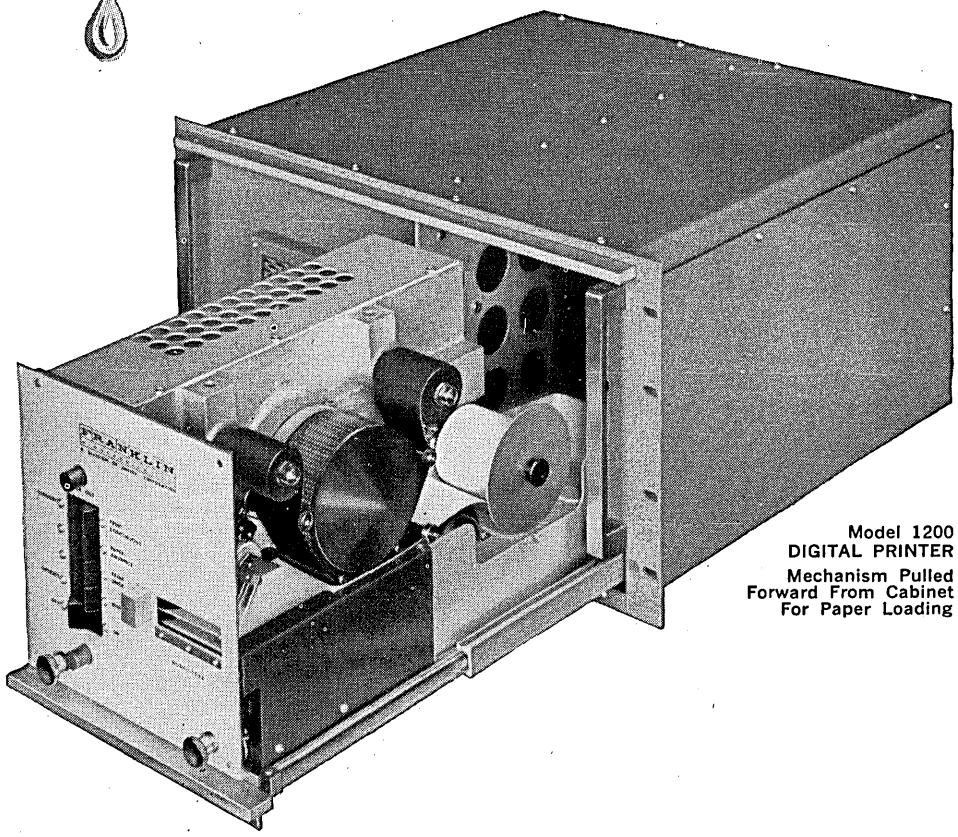
SEL®

SYSTEMS ENGINEERING LABORATORIES, INCORPORATED

P. O. BOX 9148 / FORT LAUDERDALE, FLA. 33310 / AREA CODE 305 / 587-2900

CIRCLE 64 ON READER CARD

SEE IT AT
IFIP
Booth 56



Model 1200
DIGITAL PRINTER
Mechanism Pulled
Forward From Cabinet
For Paper Loading

50,000,000 lines of print on two drops of oil . . . and only $1600*

That's a lot of mileage on anybody's digital printer —end to end, it's a row of printed characters stretching almost halfway across the U.S. Yet, several drops of oil to the drive-motor shaft-ends is the only special maintenance requirement after 50,000,000 lines of print or one year.

There are lots of reasons for the stunning performance of a FRANKLIN Model 1200. Part of the answer is in the printer mechanism. It's so simple, there are only two "moving" parts per column. (Actually they hardly move at all.) There are no cams, ratchets, brakes, hooks, or eyes.

For all the facts, write for Bulletin 2050. It contains schematics, specifications, illustrations, etc. It even lists many of the users.

BRIEF SPECIFICATIONS

PRINTING RATE: 20 lines per second. (Other models to 40 lines per second.)

NUMBER OF COLUMNS: Optional choice of 1 to 12.

INPUT LOGIC: Binary 8421, 4221, or 2421.

COMMAND SIGNAL PROVISIONS: A wide range of input control and output command signals are provided for.

CONSTRUCTION: All solid state, modular, plug-in.

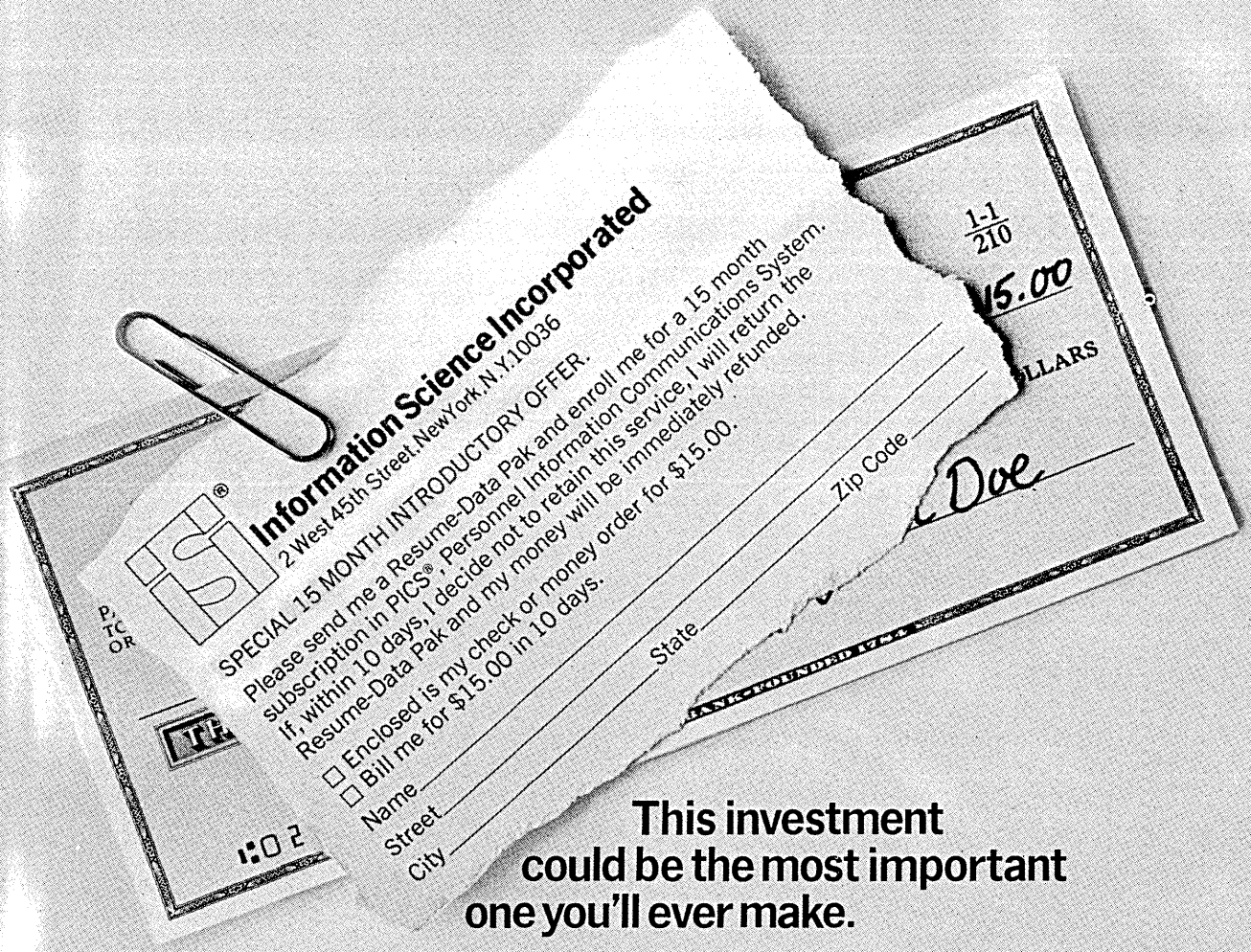
DIMENSIONS: 19" W rack panel x 10½" H x 19⅝" D.

FRANKLIN
electronics, inc.

East Fourth Street • Bridgeport, Pa. • 19405
A Division of the Anelex Corporation

* $1250 to $2000 depending on quantity and columns.

CIRCLE 65 ON READER CARD



This investment could be the most important one you'll ever make.

It could make for a brighter and more challenging future. Now a better way has been found to bring your experience and abilities into contact with the vast national market and give you the chance to consider and select opportunities for career advancement. A better way has been developed to answer your need for accurate, comprehensive and confidential career information.

This service, called PICS®, Personnel Information Communications System, is a powerful computer-based information retrieval system with the memory, the speed and the precision to select your qualifications from thousands of others and accurately match them to industry requirements that represent professional advancement for you. You have the option of authorizing PICS to send your resume in strict confidence to inquiring companies when suitable matches occur. If you choose to have your resume forwarded, PICS will send you the corresponding job descriptions. This selection process will operate for you continuously on a national scale for the duration of your subscription.

PICS supplies only the information—it is not an employment service. You are free to respond as you see fit, without obligation, to any action taken by or information received from an inquiring company as a result of a PICS communication.

PICS doesn't stop there. As a unique feature of this information service PICS will send you four comprehensive reports during the subscription year analyzing in detail the salaries being paid in your profession. You can compare your compensation and rate of increase against those of others with similar qualifications and experience by examining the high, low and average salaries paid according to education, experience, type of industry, company size and geographical area.

There is no other service available today that can give you this complete and exclusive professional information. That is why so many programmers, systems analysts, engineers, mathematicians, technicians, and scientists in the physical and life sciences are making this small investment in their future.

Keep informed about this changing and expanding technological market. Act now; and return the coupon for your PICS Resume—Data Pak. It may be the most important investment you'll ever make.
Information Science Incorporated
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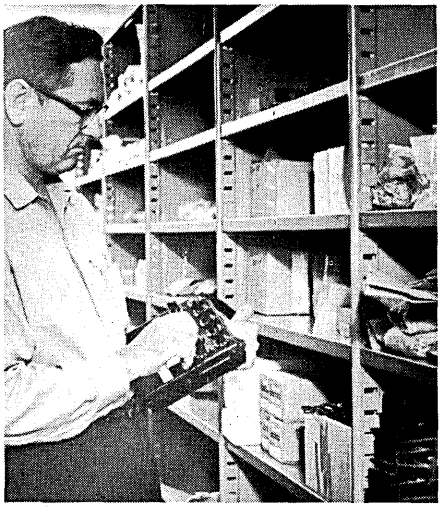
CIRCLE 66 ON READER CARD

Information Science Incorporated

Record it...

(on magnetic tape)

...in accounting department



...at the parts bin

...on the job site

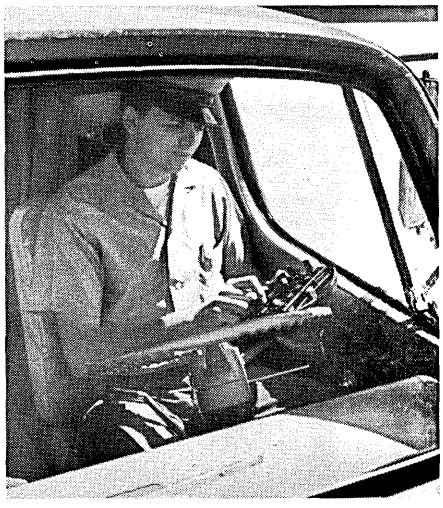
...at the meter

...in the warehouse

...at the cash register

...at the tank farm

...in the payroll department



...in the delivery truck

Report it!

(quickly, correctly)

SODA System closes the gap between data sources and computer

Now—a data acquisition system which enables you to capture data where *you* specify . . . to virtually eliminate key punching and verifying . . . and to remove the possibility of error in transcription. SODA—Source Oriented Data Acquisition offers these capabilities along with many more cost and time-saving advantages.

SODA is a simple two-step system: First, the worker at or near the source of data records entries on magnetic tape with a digital magnetic recorder. Next, the resultant tapes bypass intermediate conversion and go directly through a tape reader into the computer. Record it, report it!

Flexibility

SODA System gives you the flexibility to tailor the hardware to the application. Magnetic recording devices are available in both portable and desk top models. You can capture data when and where your requirements dictate. All hardware is easy to use; only minimum operator training is required.

Reliability

Four key factors combine to assure high level reliability with SODA—First, all recording is made on low density magnetic tape to insure data capture; second, data are usually entered on simple devices by the worker who is most familiar with the meaning of the data itself; third, once the data are recorded on tape there is no further transcription; fourth, computer speed is utilized by programmed routines to accomplish the desired parity function, validity tests and control totals. Accuracy is inherent in the system.

Dollar Savings

In addition to enhancing overall EDP payout, SODA offers dramatic dollar saving advantage. Cost savings in just key punch time and cards add up to overwhelming economic justification in many applications.

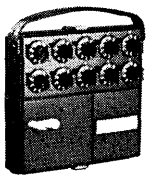
Capability

The SODA concept and hardware blanket a broad range of applications and data acquisition requirements. It answers the need for acquisition of data collected at scattered locations . . . for faster computer input of inventory and forecasting data . . . and most important, reliable and high speed acquisition of decision-generating data for operating and management reports. SODA allows you to RECORD IT . . . REPORT IT quickly, economically, accurately! For full information, write: UGC Instruments, Inc., 5610 Parkersburg Dr., Houston, Texas.

SODA
Data Capture Hardware

SODA permits data capture from virtually any source, including other business machines. All devices produce a reusable ¼ inch tape in a BCD 4 level code, enumerating from 450 to 13,000 words per reel, 10 characters per word.

SODA Metercorder®

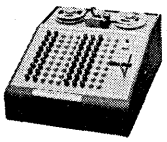


Portable Digital Tape Recorder weighing only two and a half lbs.

SODA Amcorder®

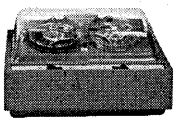
Adding Machine / Digital Tape Recorder. Available in single position and shuttle carriage models.

SODA Countercorder®



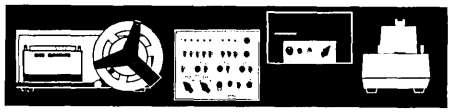
Portable Battery - Powered Tape Recorder.

SODA Adaptocorder®



Digital Tape Recorder Interfaces with many adding machines, cash registers, calculators.

UGC Instruments, Inc.
A Subsidiary of United Gas Corporation
CIRCLE 67 ON READER CARD



Complete tape reproducing equipment with reader, reproducer and punch.

tape reproducer

for fast off-line tape handling

Use it for:

duplicating punched tapes ,

editing and correcting faulty punched programme tapes ,

merging data from several short tapes into a single tape for faster read-in to a data system ,

removing irregularities and defects in punched tapes for more reliable read-in ,

extracting, assembling or reorganizing punched data ,

changing tape material, tape width or hole type ,

transcoding punched tapes (with a transcoder) ,

transmitting punched data over short distances ,

CIRCLE 68 ON READER CARD

Manufacturer Facit, Fack, Stockholm 7, Sweden

General agents

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Belgium	Thomson-Belge, Brussels
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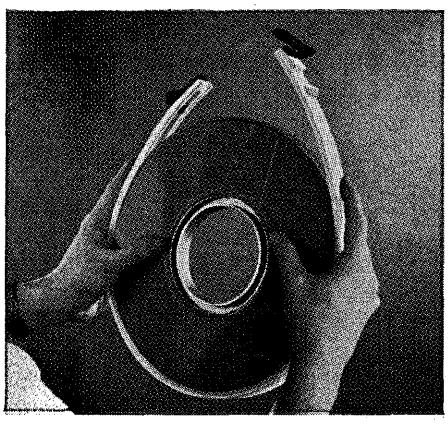
Introducing...

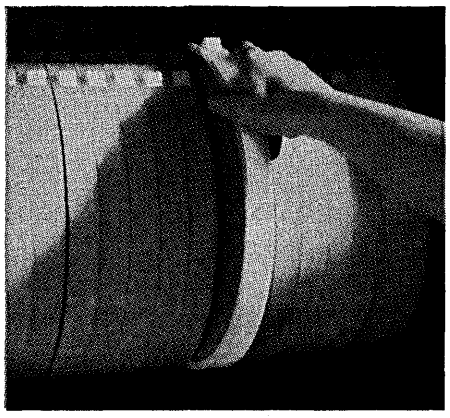
Increases present storage capacity as much as 100%, minimizes tape damage and dust problems with solid flange protection

Heart of the exciting, new Wright Line Computer Tape Storage System is the remarkable Tape-Seal Belt shown above. It does many things. It reduces storage space required for each tape now stored in bulky containers. An integral hook-latch device permits the tapes to be suspended, rather than seated between conventional wire supports. It wraps tightly around the reel flange edges, which fit precisely into grooves in the Tape-Seal Belt. These grooves not only seal out dust, but act as a spacer to prevent the tape from being pinched. Tape-Seal Cabinets hold more tapes (200 on only 5 levels) and expose more tapes (100) with one door open than any other tape storage cabinet. Cost? No more than other tape storage systems, yet gives you so much more for your money. Write now for complete information and a free demonstration.

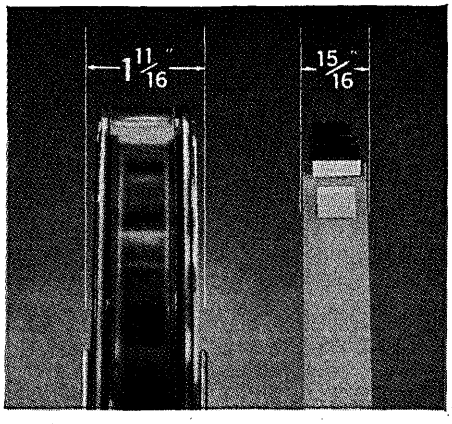


Tape-Seal Belt*, made of flexible polyethylene, is wrapped tightly around reel edges to give solid flange protection.

*Patent Pending



Unique hook-latch device permits tapes to be suspended, eliminates wire supports, permits intermixing of 8" and 10½" reels, easy removal.



The Tape-Seal Belt is 45% narrower than conventional container, 90% lighter, unbreakable, and may be labelled more easily.

Wright LINE DATA PROCESSING ACCESSORIES

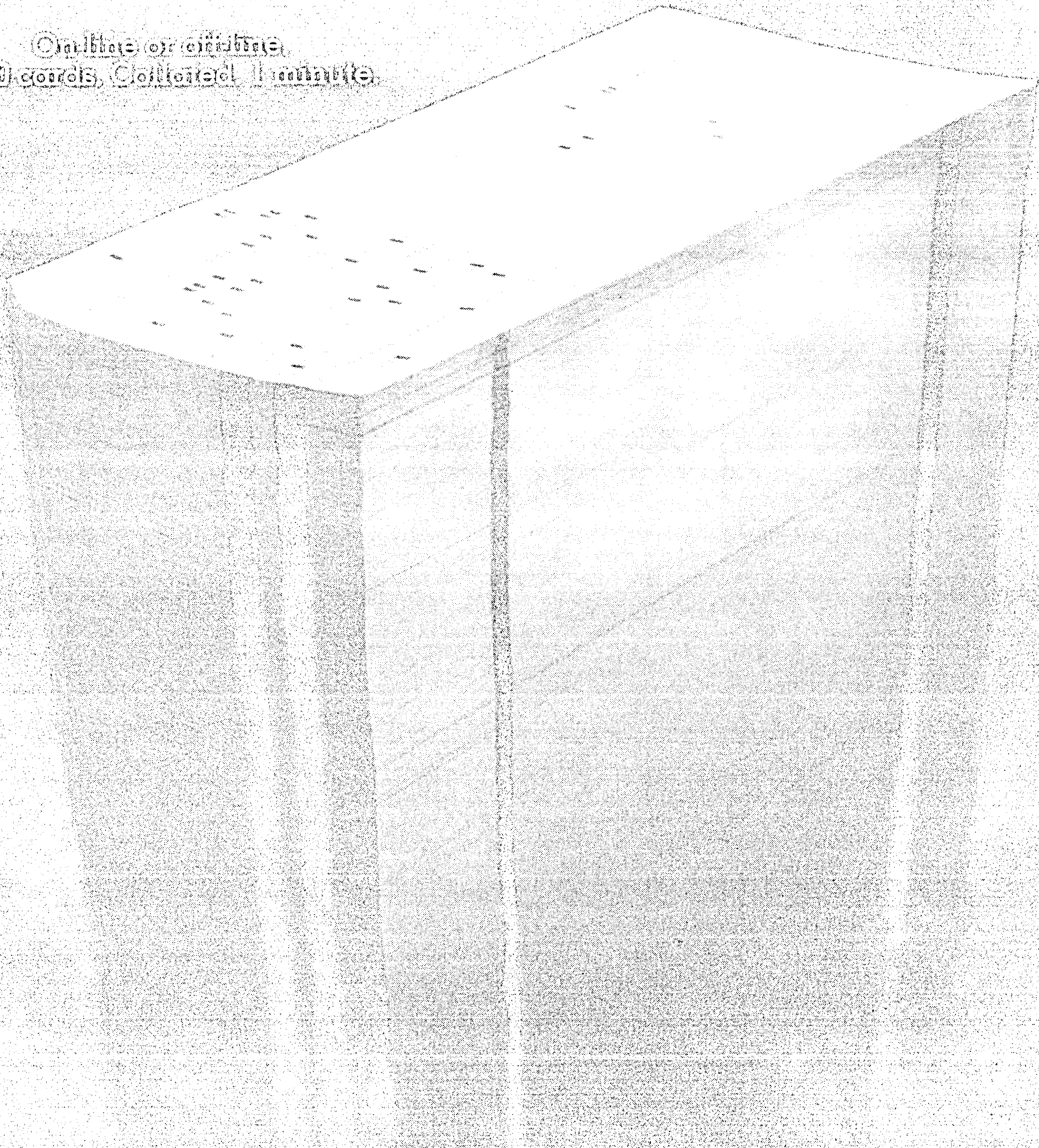
170 GOLD STAR BOULEVARD, WORCESTER, MASS 01606

A division of Barry Wright Corporation

IN CANADA: Wright Line of Canada, Ltd., 600 Eglinton Ave., East Toronto 12, Ontario

CIRCLE 69 ON READER CARD

Online or offline, 2000 cards. Collated. 1 minute.



If you use the new UNIVAC® 1001 Card Controller for nothing but collating, you can still easily justify your investment.

It's an alphanumeric collator that's at least 50% faster than any collator you can buy or rent.

18 common collating functions are pre-wired on a Multi-Program Panel. A flick of the appropriate switch and you're ready to roll.

And selection of control fields is a simple matter of [illegible] on the [illegible] attached to the panel.

Two card feeds operate at 1000 cpm each. And it can compare [illegible] alphanumeric characters and symbols, and compare and [illegible] sequence-check [illegible] columns.

But if the 1001 was nothing more than an extremely fast collator, we wouldn't have called it a Card Controller.

It's a multi-purpose machine that's perfect for card-editing and proving, columnar sorting, merge sorting, group sorting and even statistical sorting and counting. (In 80 or 90 column models.)

It can compare, add, subtract and do programmed multiplication.

It can do combined operations such as editing/accumulating while merging. (Functions previously done by different machines or in separate runs.)

Offline, the 1001 is the workhorse of any EDP or tab installation.

Online with a UNIVAC® 1004 Card Processor, the two machines become a multifile system with dual processing capabilities. An exclusive Advance File Search feature permits you to look ahead in the master file while processing, punching and printing are going on. Or, both machines can operate independently. The 1001's two separate card feeds provide input at [illegible] 2000 cpm. Input files can be [illegible] selected during processing. The 1004 provides still a 3rd input [illegible]

Naturally, the cost and [illegible] value of the 1001 is inherent [illegible] bilities. The more applications [illegible] it for, the more you save.

For details on the 1001 [illegible] with your local Univac re[illegible]

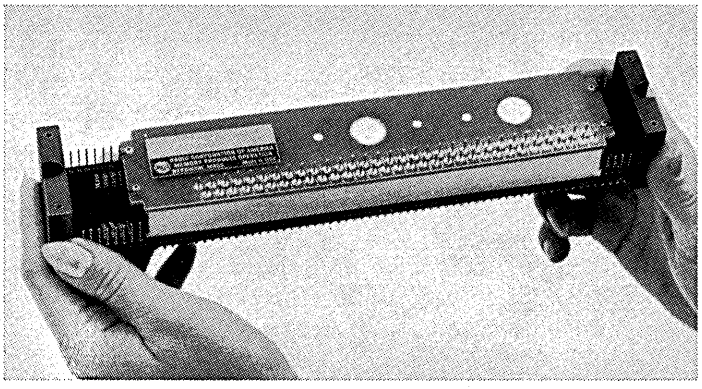
THE UNIVAC 1001 CARD CONT[illegible]

UNIVAC®
A DIVISION OF SPERRY RAND CORPORATION

ASSIGNMENT: BUILD A 16,384-BIT MEMORY STACK FIT FOR OUTER SPACE, TO WITHSTAND:-

50 G SHOCK
10 G VIBRATION
ΔT of -55° to +105°C

Result: This RCA ferrite memory stack, designed to withstand the rigors of space flight, meets the toughest kind of environmental specs:



Vibration—10 g (0 to peak) 5 to 2000 to 5 cps at 1 minute/octave logarithmic sweeps, once along each of 3 mutually perpendicular axes.

Mechanical Shock—50 g, 11 ± 1 msec, half-sine wave, 2 shocks in both directions in each of 3 mutually perpendicular axes, a total of 12 shocks.

ΔT— 5 cycles per MIL-STD-202, Method 102A, within limits of —55° C to +105° C. Unit to operate at specs at 0° C, 25° C and 70° C (without use of heaters or other means of internal temperature control).

See the newest in RCA High-Reliability Ferrite Memories at INTERDATA 65— Booths 136 and 137.

CIRCLE 70 ON READER CARD

How did RCA meet these demanding requirements?

- **By double-testing** each RCA wide-temperature-range ferrite memory core for 100% quality assurance.
- **Precision stringing** an array of 16 planes, each 32 x 32 cores, with continuous wiring through all 16,384 cores; no splices or internal solder joints are permitted. Then 100% testing the entire array.
- **Folding** the 16 planes over to form a continuously wired memory stack—and 100% testing it again.
- **Encapsulating** the stack in silicone rubber and securing it to its support case—and 100% testing it again.
- **Shaking, shocking and temperature cycling** the stack and 100% testing it at three different temperature levels.
- **AND DELIVERING ON SCHEDULE!**

Here's one more example of what RCA can do to build memory-system components to meet *your* requirements, regardless of how difficult they may be. Whatever you need in ferrite memory components, call your local RCA Field Office or write, wire or phone: RCA Electronic Components & Devices, Memory Products Operation, Section FD5, 64 "A" Street, Needham Heights 94, Mass. Phone: (617) HI 4-7200.

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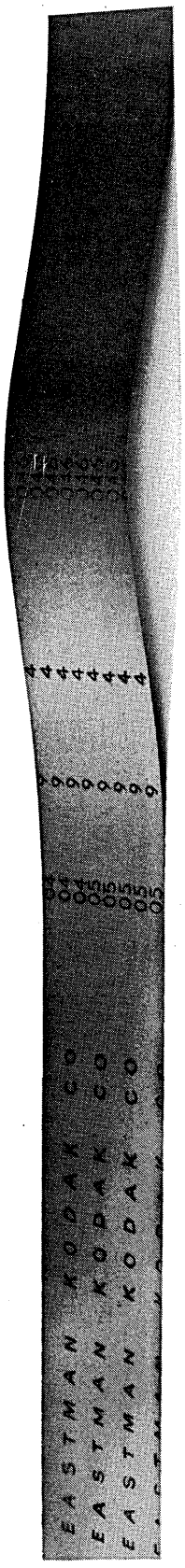
Soon all data tape recording will be "done by the numbers"



CEC Magnetic Tape, created and produced by Eastman Kodak, has virtually eliminated every tape problem in data recording.

The secret begins with traceability

All CEC tape is *numbered*—color-coded on the box, can, 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.

This provides several obvious advantages to the user. A specific run of tape may be immediately located and identified. No longer need a mixup in reels become a problem or delaying factor. So efficient is this coding method, it is possible —through the numbers on the tape, reel, can or box—to trace any roll of tape all the way back to the master web from which it came.

However, digital coding is only one of the significant reasons why CEC Magnetic Tape is rapidly changing the state-of-the-art.

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.

In addition...

⊡ Only CEC tapes provide a standard nomenclature for simplified identification and ordering: S-1 standard, 100 kc; SX-1 standard extended, 300 kc; M-1 medium band, 600 kc; W-1 wide band, 1.5 mc.

⊡ 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.

However, with all these advantages, CEC Instrumentation Tape costs *no more* than the tape you are now 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-X14.

CEC

Technical Supplies Department

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A LITTLE
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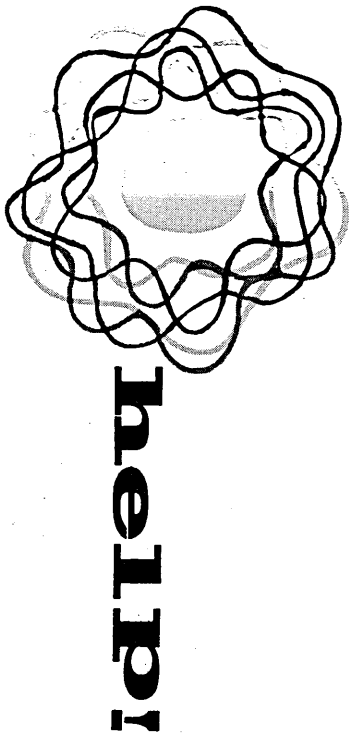
HELP US OUT ?



CHANGE
OF ADDRESS
FORM

DATAMATION MARKET STUDY

1. With regard to data processing equipment how would you classify yourself?
   ☐ User ☐ Manufacturer ☐ Both
2. Is your affiliation with data processing primarily for
   ☐ Business use ☐ Scientific use ☐ Both
3. Which of the following items or classifications of equipment would you recommend, specify, or approve when purchases are planned?
   ☐ Computers ☐ Expendables *(Tape, Forms, etc.)* ☐ Software
   ☐ Peripheral Equip. ☐ Accessory Equip. *(Files, Calculators, etc.)*
   ☐ Data Comm. Equip. ☐ Tab. Room Equip. *(Sorters, Key Punch, etc.)*
4. *Besides DATAMATION* what other Trade Publication do you read regularly?_____
5. What one category would best describe your job function?
   ☐ General Management ☐ Engineering or Operations?

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☐ **Operational Mgmt.** Head, Chief, EDP Programmer, Chief EDP, etc.	☐ **Operational Mgmt.** Head, Chief, EDP Programmer, Chief EDP, etc.
☐ **Operational** Chief Programmer Supervisor, EAM, Analysis, Math., etc.	☐ **Operational** Chief Programmer Supervisor, EAM, Analysis, Math., etc.
☐ **Education**	☐ **Education**
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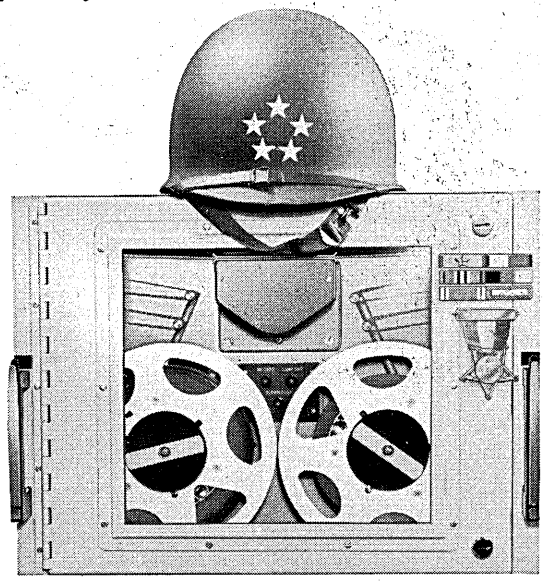

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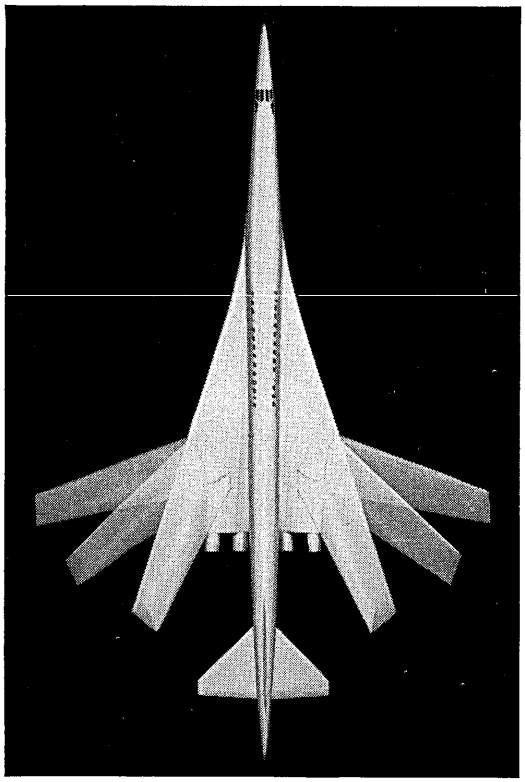

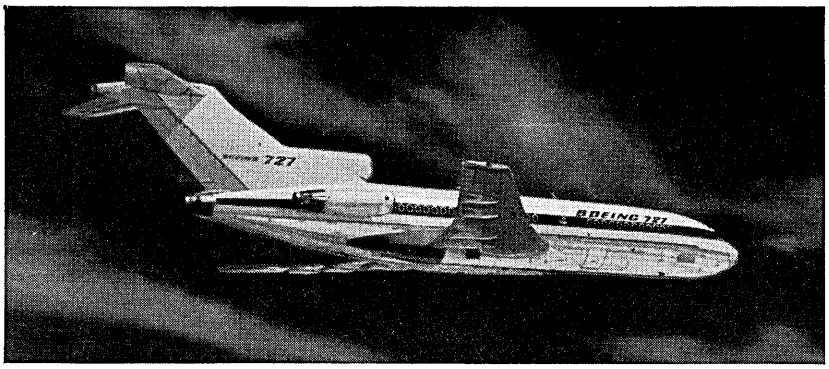

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The classified section is open for the following advertising categories: Used equipment; positions wanted; help wanted, educational institutions; maintenance services; professional cards; hobby products; business opportunities and educational courses. Rates are based on total number of insertions used within each contract year.
Minimum for all advertising—1 column inch. Exception—for Situations Wanted we will accept ½ inch column. See rates below. Maximum vertical space—4 column inches*. Maximum horizontal 2 column wide by 2 column inches deep. Larger units are billed at display rates.
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For further information please contact: DATAMATION Magazine, Classified Advertising Dept., 141 East 44th Street, New York, N. Y. 10017—212-MU 7-5180.

HOW I USED 2^{100} MEMORY LOCATIONS... AND OVERFLOWED

by BORIS BEIZER

"From Hungary comes news of a stranger-than-fiction machine called Maclogal, developed at the Computation Techniques Centre of Hungary's Academy of Sciences. A news agency report gives its storage capacity as 1,260 x 10^{27} alphanumerics. The data is held in ferrite core modules. Each module contains 100 cores having an outer diameter of 1 mm. Its uses are said to be in guidance of satellites and automatic control in industry. (It is also called a universal logical apparatus)."

—*News story, DATAMATION*

In Budapest did commissars
A meta project MAC decree:
To count the atoms in the stars
The fallen hairs of bald Magyars,
  And fishes in the sea.
A million proletariat toiled,
And tons of iron ore were hauled
To furnaces bright red with heat,
Where melt was fashioned into cores
Demanded by this grand conceit
Of their demented tormentors.

But oh! The countless billion wires which threaded
Through every cubic mile of Mother Earth!
A noble task! As savagely ambitious
As e'er conceived by men impervious
To failure from the moment of their birth.

  We have dispatched a satellite with cameras grinding.
  A mariner, to win the mysteries our moon is hiding.
  If made of cheese, or flimsy stuff,
  Or smallish pieces of volcanic fluff.
  But hear me out; for in my heart I know I'm right—
  A monstrous store of reject cores illuminates our night.

And in this technologic globe they loaded
The mightiest bootstrap e'er encoded.
Five miles meandering tape in motion;
Through wood and dale the program ran.
Then reached that memory measureless to man,
To start the grandest compilation.

  And 'mid the decades of the debug task
  Inquiring voices, the prices asked.
The polar caps with printer paper
In triplicate were overlaid;
And problems of the highest abstract nature
Solved by this processor brigade.
It was a miracle of rare device,
A roomy program space which might suffice.

A console hung with gossamer
In a vision once I saw:
It was a not uncommon type,
And on its output scope that night
I saw a random number.
Just to revive that sequence
Of random digits long,
Or for some other nonsense,
Or passion equal strong,
I would build that stack of stacks,
Executive, and a' that:
And all whose need would bring them there,
Would cringe and cry beware! Beware!
His flashing eyes! His floating hair!
Leave a circle 'round him wide,
And close your eyes with holy dread.
For he on memory hath fed,
And programmed paradise.

at Honeywell, programmers are

Qualified candidates sh
forward their resumes tc
Mr. Frederick S. Bartlett
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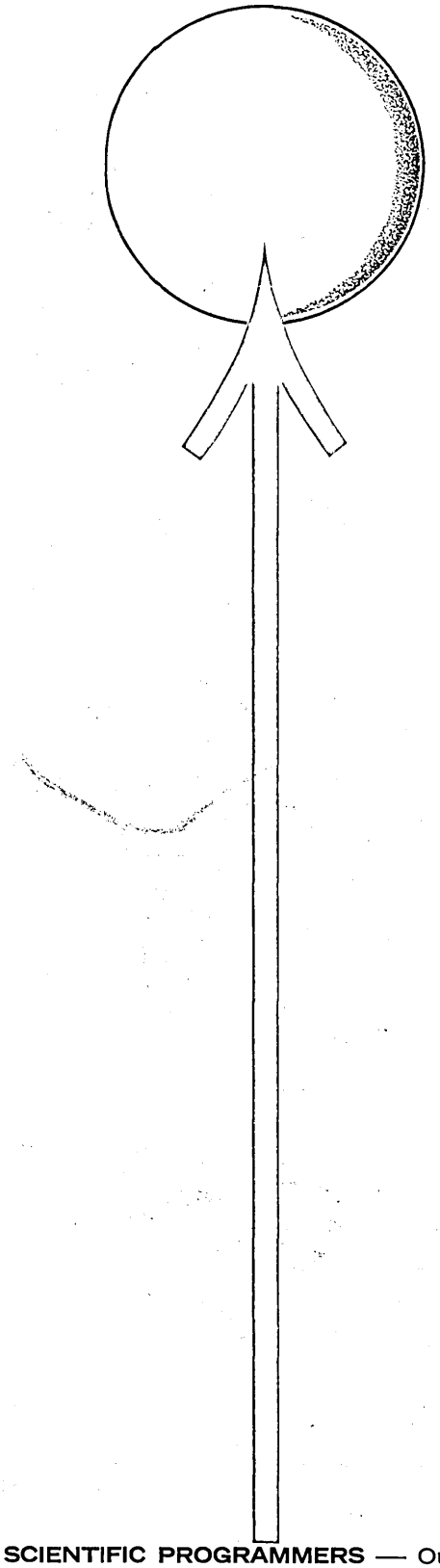

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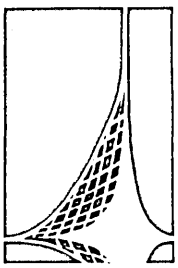

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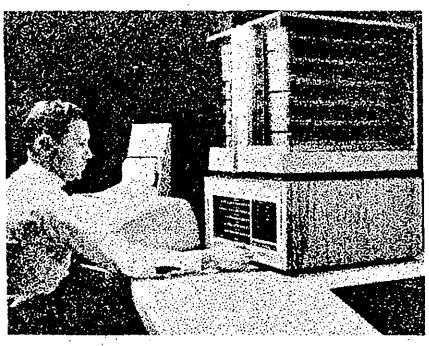

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- Module Sales Engineers
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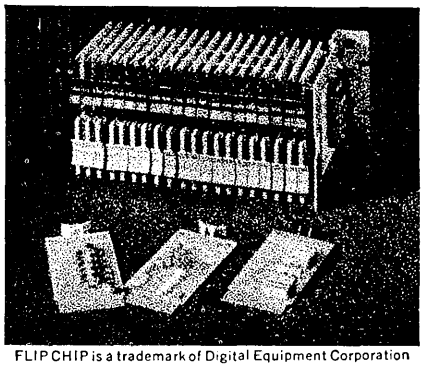

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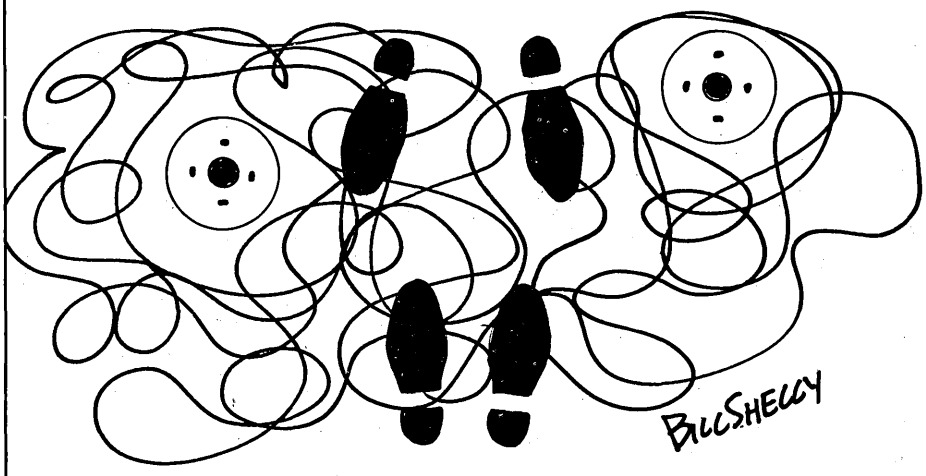

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OPPORTUNITIES IN LOS ANGELES AND HOUSTON WITH TRW SPACE TECHNOLOGY LABORATORIES FOR MATHEMATICIANS, ENGINEERS AND PHYSICISTS IN SCIENTIFIC AND BUSINESS PROGRAMMING

TRW Space Technology Laboratories has openings for Scientific and Business Programmers at its Computation and Data Reduction Centers (CDRC) at TRW Space Technology Center in Redondo Beach, California, and in its new Manned Spaceflight Department in Houston, Texas.

In Redondo Beach near Los Angeles International Airport, you will be working with over 200 programmers and scientists who are applying their background in mathematics, engineering and the physical sciences to resolve problems of the aerospace environment, and to further advance the capability of computers and the computer sciences. Here, their responsibilities include space mission analysis, statistical' analysis, data analysis, spacecraft environmental simulation, interpretive computer simulation, automated plotting, business data processing, real-time operations, list processing, and computer system applications.

In Houston in new facilities adjacent to NASA's Manned Space Flight Center, you will be a vital part of the Apollo Program. TRW Space Technology Laboratories has responsibility to NASA for Apollo mission planning, mission analysis and real-time program development. STL's task, in broad terms, consists of "building a computer highway to the moon." STL Programmers will chart the path the Apollo craft must follow and the functions and maneuvers which will be required to remain on that path for manned landing on the lunar surface in 1969.

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MISSION ANALYSIS: *Strong analytical ability and technical originality with broad background in flight mechanics, astronautics, missile guidance and mission performance.*

TRAJECTORY ANALYSIS: *Familiarity with the use of digital computation, analytically inclined, with background in space mechanics.*

ASTRODYNAMICS: *Theoretical background in celestial mechanics, orbit determination and/or related fields of math, physics or astronomy.*

GUIDANCE ANALYSIS: *Familiarity with techniques for missile guidance and experience in orbital mechanics, random processes and statistics.*

SCIENTIFIC PROGRAMMING: *Background in high speed digital computers. Will assist in the solution of problems arising in missile and space vehicle engineering, with responsibility for direction, programming, debugging and analysis of computer solutions.*

ACT NOW! *Forward your resume immediately to R. J. Brown, TRW Professional Placement, One Space Park, Department D-5 Redondo Beach, California. TRW is an equal opportunity employer.*

TRW SPACE TECHNOLOGY LABORATORIES

THOMPSON RAMO WOOLDRIDGE INC.

CIRCLE 103 ON READER CARD

OF LAWYERS & COMPUTERS

How can an accountant audit the finances of a company when all of the information is stored on magnetic tape and original documents are not preserved? Can a company be held negligent for delegating certain tasks to a computer? What legal problems and risks are involved in providing or using data processing services?

These and many other novel questions were discussed at a course entitled "Law and Computers in the Mid-Sixties" held in New York City on March 25th through 27th. The course, the first of its kind, was designed to educate and sensitize lawyers to the legal problems and possibilities created by the computer age. After the lawyers were introduced to the inner workings of computers and the type of personnel who work with them, experts explained the new forms that business records can take and the problems involved in auditing these records. Especially interesting were stories about how a computer for a department store tried to add a customer's social security number as an expense to his charge account and other instances where more sophisticated internal controls were necessary for computer bookkeeping.

The highlight of the course was a mock trial, prepared and directed by Roy Freed, the course director, on the problems of proof involving the actions and records of a computer. Opposing lawyers in an antitrust action brought by Resources Unlimited against Interplanetary Explorations locked horns about whether computer printouts of information stored in data processing form were admissible and how counsel can obtain access to its opponent's business records which are stored on magnetic tape. Next, the play showed how circumstantial evidence might be used to prove the actions of a computer (it had been secretly programmed to control an antitrust conspiracy) and how a computer-compiled statistical study may be introduced as evidence in a courtroom.

The lawyers then learned how computers can give rise to civil liability and how such suits might fare in the courtroom. In a jury trial, it was pointed out, jurors may be swayed by myths of technological infallibility or by a resentment towards computing machines which take their jobs and treat them "like numbers on an IBM card." Lawyers were advised as to the problems involved when a corporation considers using data processing services and the point to consider when deciding whether to buy or rent the equipment.

There was general agreement that the government's new computer installation would be effective in helping the Internal Revenue Service collect its due. Apparently even the threat of the machine has already brought in large amounts of previously uncollected revenue. Speakers also indicated how data processing would become increasingly important for other administrative agencies and how it was useful in assisting lawyers to do legal research.

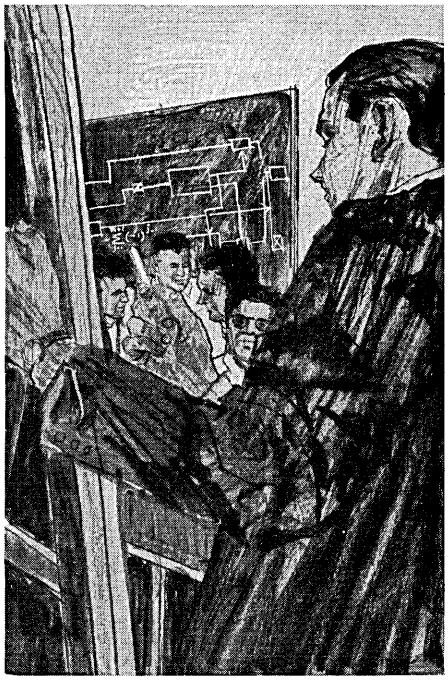
A particularly interesting presentation was a discussion of the part computers can play in redistricting states in accordance with the Supreme Court's recent "one man, one vote" decision. The speakers showed computer-generated plans which they had previously presented in court as alternatives to the plans prepared by state legislatures. This was followed by seminars on the impact computers are having in the areas of banking, insurance, and labor law, and the various forms of legal protection for hardware, software, and systems. One of the speakers concluded that programs probably cannot be protected by patents, although they may be used to protect hardware. Of particular importance to the data processing community was a discussion of a bill now before Congress which would restrict the use of copyrighted material in electronic data storage and retrieval systems.

The course, sponsored jointly by the American Law Institute and the American Bar Assn., seemed to generate more questions than it actually answered but this, in fact, was probably its purpose. It is more important for lawyers and their clients to be aware of possible legal pitfalls in time to avoid them than for them to be able to predict future court decisions in this very new and difficult area. The general concensus was that computers and their problems will be fitted into the general law, rather than a new set of legal principles being created to cover computers.

The most amusing part of the course was the introductory lecture in which members of the audience were called upon to act as flip-flops and gates to illustrate the internal workings of the machines. This human "computer" then added six and seven, and the result found in the answer register was 11. This, said the speaker, is an illustration of the dangers of using elements of untested reliability.

—JOHN F. BANZHAF III

CAREERS WITH CONTROL DATA



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ENGINEERING SOFTWARE: Diagnostic and Acceptance Test Programming—Develop software capable of detecting logic faults and marginal operation in equipment. Mechanized or Automated Design—Develop software to aid the design process and to produce the necessary manufacturing documentation. Hardware/Software Analysis—Develop software to evaluate systems performance. Familiarity with benchmark problems, instruction mixes, compilers and monitors. MINNEAPOLIS location.

COMPUTER SALES ENGINEERS: Sell general purpose computers, peripheral equipment and related industrial product lines. Successful COMPUTER or CAPITAL EQUIPMENT sales experience is required.

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IFIP Conference: If you will be in New York during the IFIP Conference, plan to discuss these and other career opportunities with Control Data employment representative.

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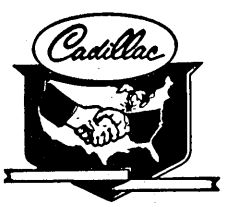

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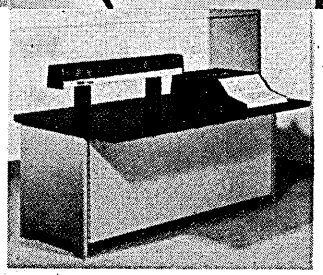

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DESIGN AUTOMATION PROGRAMMERS / Requires previous experience in programming for design automation, good understanding of engineering and hardware problems, BS degree in math, engineering or related field.

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ELECTRONIC PRODUCT ENGINEERS / These positions require a BSEE degree with experience in designing digital computer equipment and in maintaining liaison with manufacturing.

PACKAGING / These positions entail layout and design of packaging for computer systems. Applicants must have previous experience with electronic computers or electromechanical devices. Background in miniaturization utilizing thin films and integrated circuits is desirable. BSEE required.

VALUE ANALYSIS / These positions entail organizing and conducting value-analysis projects on company products. Work also involves assisting in locating new products and services, and participation in design and producibility review. Requires BS in engineering and three years' experience with electronic computers or electromechanical devices.

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MEMORY DEVELOPMENT / Positions will entail analysis and design of advanced thin-film memory systems, both linear select and coincident current. Also advanced random-access development on magnetic-card and disk-file systems. Requires BSEE, with advanced degree desired.

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With a cycle speed of 800 billionths of a second, the NCR 315 RMC Rod Memory Computer solidly underscores the "front line" position that the NCR Electronics Division enjoys in digital systems technology. The 315 RMC—the world's first commercially available computer with an all-thin-film memory—is versatile enough to work in a department store or in an engineering laboratory. It can perform random, sequential, real-time or remote-inquiry processing. It is destined to speed processing time and multiply throughput in NCR commercial markets throughout the world. And it's *hardware*—not hope. NCR is moving forward and moving fast. If *you're* ready to move ahead, look into NCR *now*.

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For a confidential interview at IFIP Congress 65, please send a resume immediately, including training, experience and salary history, to Bill Holloway, Personnel Dept. If time does not permit sending a resume, call the NCR interviewers at the Americana Hotel in New York between May 24 and 29, phone 582-9070.

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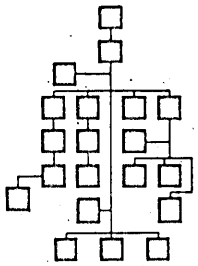

people IN DATAMATION

■ Dave Nickerson, formerly with TWA (Kansas City) is the new assistant to the director of the Carnegie Tech computer center. He replaces Einar Stefferud, who has joined System Development Corp.

■ Daniel D. McCarthy has been appointed president of Monroe International, Orange, N.J. He succeeds William E. McKenna.

■ W. J. Gruen will direct the newly formed Information Technology Lab., Bunker-Ramo Corp., Canoga Park, Calif., and will be assisted by E. E. Bolles. The Information Systems Lab. will be headed by H. L. Shoemaker.

■ Dr. Robert W. Rector has been elected vp plans and programs, Informatics Inc., Sherman Oaks, Calif. F. V. Wagner, who formerly held the position, has been promoted to vp western operations.

■ Joseph F. Gustaferro has been appointed gm of Computer Command and Control Co., Philadelphia, Pa. He will divide his time between the Philadelphia and Washington offices.

■ Roland P. Lacey has been named manager of computer and data services, Honeywell EDP Div., Wellesley Hills, Mass. He succeeds W. C. Thomson, who has been named to assistant to the director of administrative services.

■ Richard A. Mailander has been appointed to head the compiler department, Mesa Scientific Corp., Inglewood, Calif.

■ Mrs. Henriette D. Avram has been appointed Supervisory Information Systems Analyst in the Office of the Information Systems Specialist at the Library of Congress.

■ Dr. Norman Friedman has been named manager, Defense Systems Div., System Development Corp., Lexington, Mass.

SYSTEMS ANALYSTS
SCIENTIFIC PROGRAMMERS

Excellent opportunities now available for men qualified in the following areas:

Systems Analysts

Must have skills applicable to real time simulation systems utilizing digital computers. Experienced in systems analysis, mathematical modeling, numerical analysis, flow charting, programming, problem sizing and computer selection. Experienced in hybrid interface equipment design is highly desirable. BS in Physics or Electrical Engineering with graduate studies in Mathematics and/or Control Theory. Advanced degree preferred with three to eight years of related experience.

Scientific Programmers

Must have experience in developing and debugging programs for real time simulation on digital computers. Requires experience in analysis, flow charting and coding of real time or scientific applications. Will program equations of motion, mathematical and logical models of various systems, executive routines, diagnostics and other utility programs. Will participate in the software debugging and integration of this software with the simulated systems external to the computer. Must have two to eight years related experience with BS in Physics, Engineering or Mathematics. Graduate studies in Math and/or Control theory desirable.

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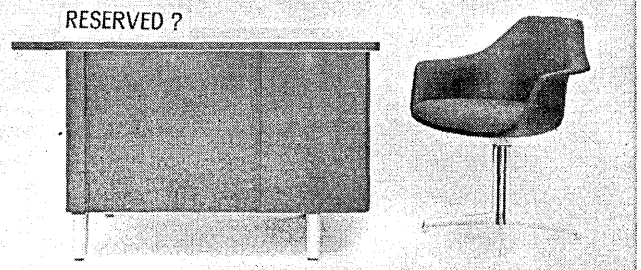

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2897	Bow		12.50	10.00	*8.13*
2901	Pivot		2.22	1.77	*1.45*
2925	Frame		18.22	14.58	*11.85*
2931	Seal		.37	.30	*.24*
2932	Seal	10	.32	.25	*.20*
2939	Plate		.19	.15	*.12*
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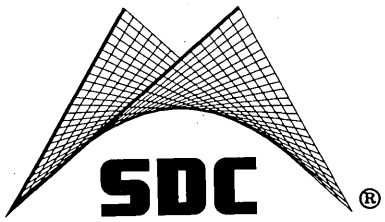

SYSTEM DEVELOPMENT CORPORATION

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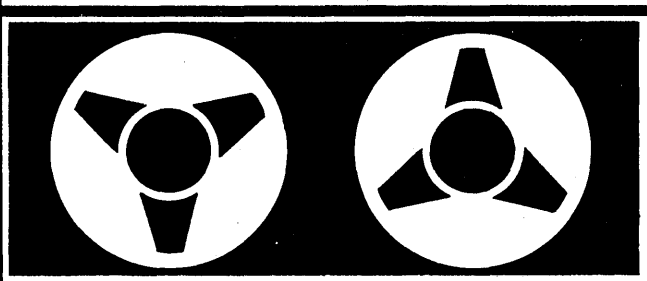
PROGRAMMERS • SYSTEMS ANALYSTS



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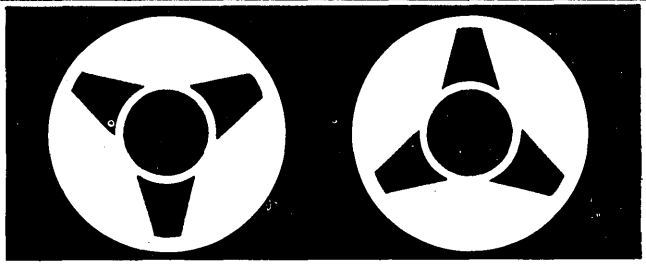

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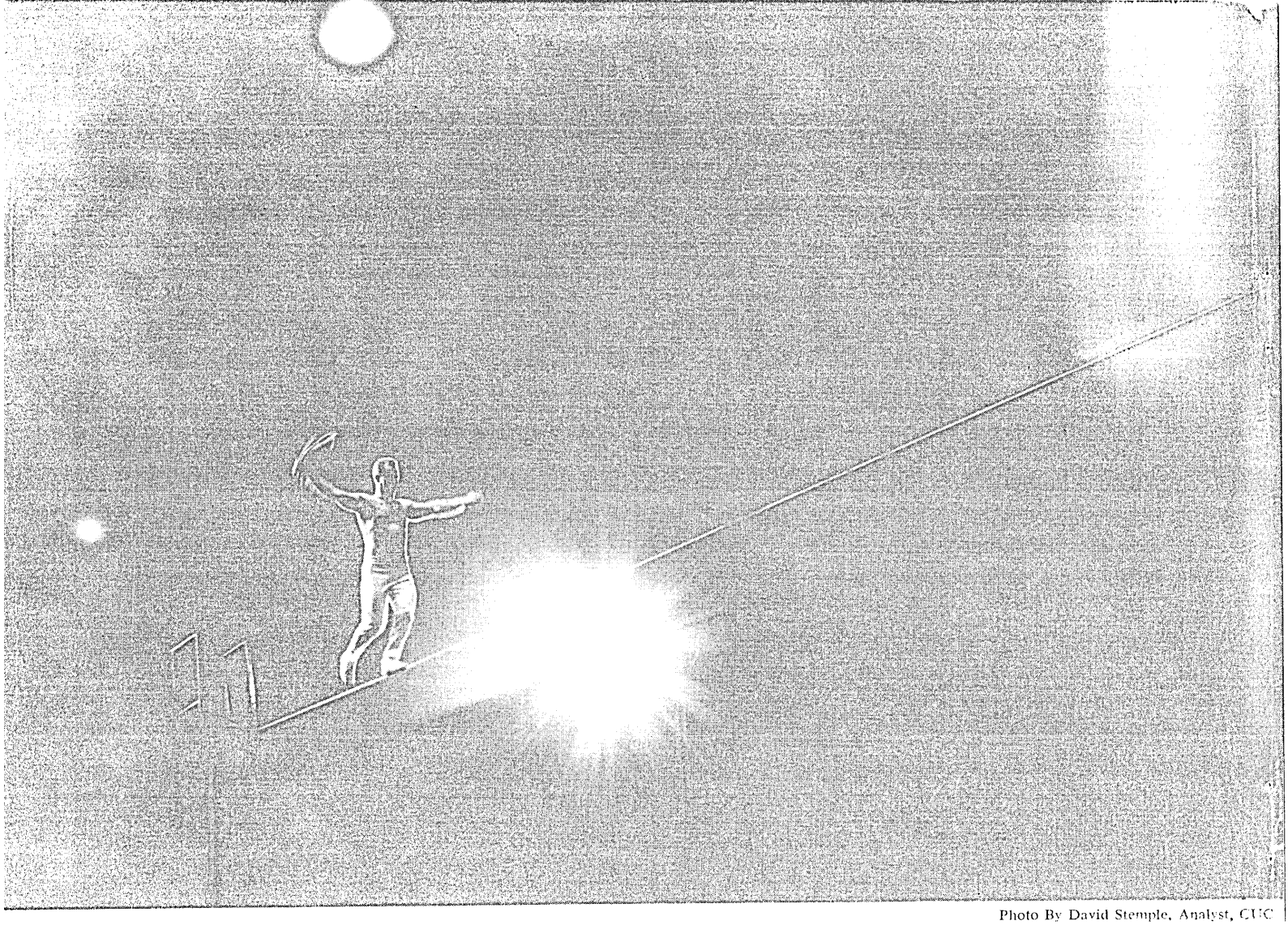

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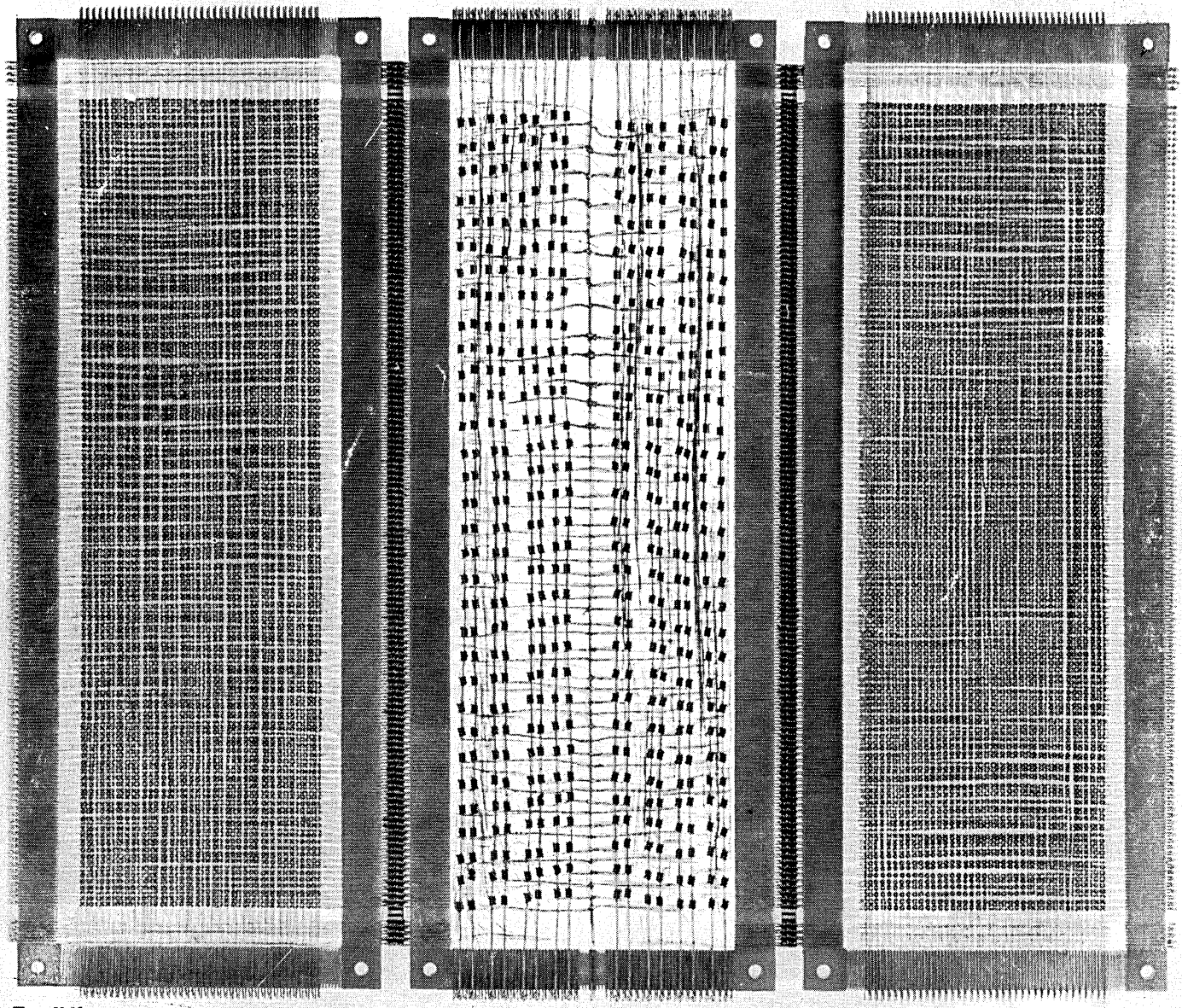

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